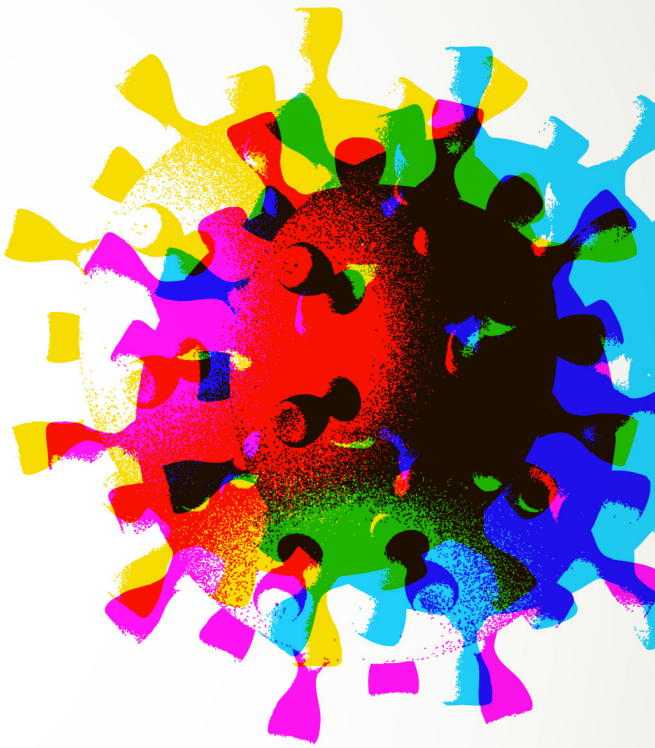
Masks • COVID-19 Testing • PAPR

microscope

Fall 2020

CHIhealth.com

The Innovation Issue



"Armor" invention protects test providers

3D printing boosts PPE supplies

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About CHI Health

CHI Health is a regional health network headquartered in Omaha, Nebraska. The combined organization consists of 14 hospitals, two stand-alone behavioral health facilities, more than 150 employed physician practice locations and more than 12,000 employees in Nebraska and southwestern Iowa.

In fiscal 2019, CHI Health invested more than $185 million back into our communities. The majority of those dollars went to caring for the poor and underserved.

CHI Health is part of CommonSpirit Health, a nonprofit, Catholic health system dedicated to advancing health for all people. It was created in February 2019 through the alignment of Catholic Health Initiatives and Dignity Health. CommonSpirit Health is committed to creating healthier communities, delivering exceptional patient care, and ensuring every person has access to quality health care. With its national office in Chicago and a team of approximately 150,000 employees and 25,000 physicians and advanced practice clinicians, CommonSpirit Health operates 142 hospitals and more than 700 care sites across 21 states. In FY 2019, Catholic Health Initiatives and Dignity Health had combined revenues of nearly $29 billion and provided $4.45 billion in charity care, community benefit, and unreimbursed government programs. For more information, please visit **CHIhealth.com**.

Under the Microscope

Dear Friend,

The COVID-19 crisis has created the highest level of uncertainty that the U.S. has faced in 35 years. While most were nervous, and many were home, CHI Health stepped out onto the edge of the Coronavirus pandemic to do what we do – care, heal and innovate.

Inspired by our mission, we linked arms with Creighton University in a truly great display of partnership and public service. We assembled a brain trust united in a single goal – to care for our communities and protect them against a villain we knew little about. In those early days, clinicians and researchers were on Zoom talking about mask sterilization and how to preserve PPE. The work ahead of us was not a 9 to 5 job, it was a 24/7 job with enormous hurdles and considerable suffering.

As you will read in this magazine, the CHI Health / Creighton University partnership jumped in early knowing that any discoveries were huge leaps forward both for those struggling to breathe and those desperately trying to care for them. Brilliant minds were solving real-time problems using their expertise and innovation. They discovered 3D printers would create face shields that were in short supply; they developed processes to preserve personal protective equipment; and made PAPR parts that were backordered but needed on patient floors.

The results of their hard work saved lives and eased the anxiety of caregivers whose focus could stay on serving patients and one another. Partnership, at its best, is where people and purpose intersect, and it is that place where CHI Health and Creighton University do their most remarkable work.

Thank you for everything you are doing to ensure our communities are safe and well cared for.

Sincerely,

Cliff Robertson, MD
Chief Executive Officer
CHI Health

Dear Colleague,

The academic health system partnership between Creighton University and CHI Health was put to an unprecedented test by COVID-19, beginning in early 2020 and continuing through today, and I am pleased that not only have we passed the test, but we have found new ways to collaborate and bring about important health care innovations.

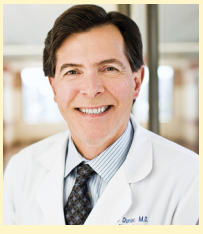
The steadfast and adept cooperation between the clinicians and researchers from the Creighton University School of Medicine and the health care professionals in the area's largest health system resulted in more patients being treated for COVID-19 than by any other system in the region – and without the shortages and struggles experienced elsewhere in the country.

As the academic health care partner, our School of Medicine continually assessed the latest coronavirus developments to modify our education, research, clinical care and advocacy. I am exceptionally proud of how our dedicated faculty supported our students, as together they responded to the evolving situation and the needs of patients.

The articles found on these pages tell the stories of science happening in real time, benefiting families throughout Nebraska and southwest Iowa as they face an invisible and deadly foe.

The battle is not over. But the pandemic forced us to prove that our common mission to serve the region's communities – caring for all in need while advancing knowledge and training tomorrow's providers – is on the right track and moving in the right direction.

Robert Dunlay, MD
Dean, Creighton University School of Medicine



Greg Schardt
System Director - Pharmacy Mail Order, CHI Health

Making Masks for the Masses

Visitors in hospitals, shoppers in stores, inmates in jail. You might see them all wearing free masks handed out by CHI Health.

"As a system, we had adequate supply of masks, but need was growing and we felt we should be proactive about protecting our communities," said CEO Cliff Robertson, MD.

"We know wearing a mask reduces and prevents COVID-19, so this is the best tool we have and we need to help the public," said Renuga Vivekanandan, MD, CHI Health Infectious Disease Specialist.

The team working on the reusable mask project had an early breakthrough: finding medical-grade material already in the supply chain. "This was a material we already use for surgical wrap for surgical sets, so it's a multi-purpose material and it also had very good filtering," said Greg Schardt, System Director – pharmacy mail order.

The team worked with industry partner AMI Environmental, an environmental health and safety consultant, to test the effects of washing the fabric on filtration.

Air was drawn through the washed masks at eight liters a minute, an average amount established by a CHI Health pulmonologist. Micron-sized particles were counted with a handheld laser particle counter.

"We did that to see if there's a change in the filtration efficacy of the material," said Daniel Taylor, President of AMI Environmental. "Measurements indicated that there wasn't a remarkable reduction in efficacy."

The team was ready to move the material into production. To find a local vendor, Schardt partnered with Bergman Incentives and reached out to the Latino Center of the Midlands. That connection led to Little Miss Fashion in South Omaha. Soon 11 local

seamstresses were making thousands of CHI Health masks weekly.

CHI Health hands these masks out to visitors. "We knew we could use 10,000 a week for all of our facilities across the state," he said.

A ready supply makes it possible to respond to community requests, such as when Hall County Corrections needed masks for inmates and staff.

"Our first 600 masks went there," Schardt said. "These are quality, two-ply fabric masks. We know they can be washed many times and the quality of air filtration has been established."

The masks have been handed out at several drive-up community events. Each mask comes with an instruction card explaining how to care for it.

Petticoats to Protective Equipment:

Dress Designer to Mask Maker

When the pandemic put parties on hold, work at Little Miss Fashion, a south Omaha dressmaker, screeched to a halt. About the same time, CHI Health was looking for a business to produce masks.

The project became a lifeline for business owner Yolanda Diaz. "We need to work for our families, so I said, 'Yes, we can do it.'" She and her staff learned how to make two mask styles – three-pleat and cone-shaped. The sheer quantity meant Diaz needed to hire more seamstresses. "We had just three employees, now we are 11," she said.

The shop turned out 10,000 masks each week for a total of around 200,000 masks.

"It feels great to help a local small business support their employees, and for our health system to support our employees, patients, and the communities we serve by providing these masks to those in need," said Greg Schardt, System Director – pharmacy mail order.

John Cote, MD
Obstetrician/Gynecologist, CHI Health; Assistant Professor, Creighton University

3D Printers to the Rescue: Keeping PAPRs in Use

Two 3D printers regularly get fired up in the basement of John Cote, MD. The CHI Health Obstetrician/Gynecologist has a knack for research and creating.

"I have experience with acquiring imaging technology and converting that to a 3D print," Dr. Cote said.

That experience came in handy when brainstorming ways to preserve personal protective equipment (PPE) for CHI Health frontline workers caring for COVID-19 patients. Dr. Cote helped come up with a way to source a small connector device vital to keeping Powered Air Purifying Respirators (PAPR) in use.

Throughout the COVID-19 outbreak, PAPRs have been one of the most essential pieces of PPE. They pass contaminated air through a filter and bring clean air through a face piece. A vacuum hose runs from the hood to a battery pack. On each end of that hose, plastic connector pieces keep the hose fastened in place.

"When staff was using the PAPRs so much, the hoses would break and the plastic connectors wouldn't last as long," said Dr. Cote. "Ultimately, they could find a hose that would go from the hood to the positive pressure generator, but they needed a connector that would work with that."

The connectors were nearly impossible to purchase and if they were available, they'd be on backorder for months. Staff needed them now. So, Dr. Cote took the connectors and CT scanned them, turning the scan into a file the 3D printer could recognize. This allowed him to create a prototype of the PAPR connectors.

"I took the prototypes Dr. Cote printed to Creighton University Medical Center-Bergan Mercy, where staff would then actually apply the connectors in the field and figure out what tweaks we wanted to make," said Greg Schardt, System Director - pharmacy mail order.

Next, Schardt took the prototypes to a community 3D printing group, PPE for NE. The group has an abundance of 3D printers and a greater ability to refine the original prototype Dr. Cote made. The project also included collaboration with Creighton University.

"3D printing is layers, layers and layers of very thin plastic material," Schardt said. "The community group took the rougher picture and made smoother edging, made it look like it was almost commercially made."

Fine-tuning is still underway, which Schardt said is the beauty of the 3D printing process – changes can always be made to make the product better. Jeff Thompson, an engineer on the CHI Health facilities team, took the 3D printed connectors, attached them to PAPRs in the field and worked with frontline staff to find out what's great about the product and what could be better. Dozens of the connectors were also sent to CHI Health St. Francis and CHI Health Good Samaritan.

"We're still editing the connectors today," Schardt said. "We found that the ends are slipping off out in the field. The team suggested adding threading to improve the product and make it more durable."

Dr. Cote is submitting a pre-application to patent the process used to make the PAPR connectors – the brain child of CHI Health and Creighton University staff collaborating to overcome COVID-19's curveballs.

"We like to chase ideas, and we have a lot of creativity," Schardt said. "We're willing to try, fail and try again. It's a common theme with a lot of us. We're interested in creating solutions to our problems."

Researchers Help Stretch Mask Supplies

It started with a text. Infectious Disease Specialist Renuga Vivekanandan, MD, asked colleagues: Can a surgical mask be sterilized for reuse? Supplies were tight in some areas.

That query unleashed a flurry of activity. A diverse group of researchers, clinicians and businesspeople – most who'd never met – spent the next few weeks connecting virtually to work on the problem.

"Everyone wanted to help out and do what they could," said Laura Hansen, PhD, Associate Dean for Research at Creighton University.

"We wanted to come up with an approach that was practical, that could scale up easily," said Jason Bartz, PhD, Vice Chair of medical microbiology and immunology at Creighton University.

Aspects included determining what bacteria to test, what sterilization techniques worked best and how sterilization affected the mask.

Laura Hansen, PhD
Associate Dean for Research, Creighton University

Jason Bartz, PhD
Vice Chair of Medical Microbiology & Immunology, Creighton University

Evidence showed the autoclave, a medical sterilizer, was effective without compromising mask integrity.

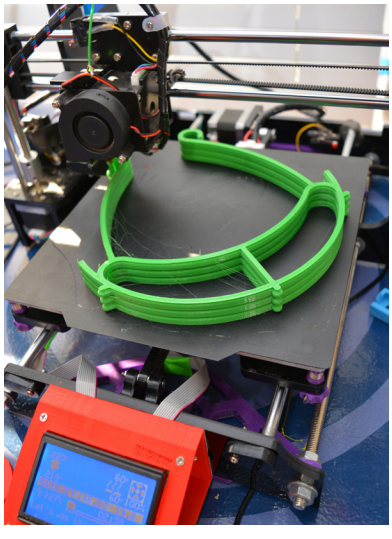
The carefully researched conclusion allows Dr. Vivekanandan to make a precise recommendation. "We are fortunate to have these experts in our system at Creighton University to be able to collaborate," she said.

Dr. Hansen expects the research efforts to continue, including a meta-analysis by Creighton University students and grad students.

Start-up Helps Shield Nebraska from COVID-19

At left: From left to right - Jim Clements, owner of Made New Makerspace, and PPE for NE founders Jordan Points, Matt Spaustat and Matthew Van Zante hold printed face shields used to protect frontline caregivers and first responders from across the state.

Below: The headband which holds the face shield is created with 3D printers.



Omaha friends Matt Spaustat, Matthew Van Zante and Jordan Points are 3D printer enthusiasts, not health care workers. That didn't stop them from taking on COVID-19.

The trio quickly gathered a small band of volunteers to manufacture, disinfect and deliver face shields to Nebraskans in need, free of charge. Their initiative, PPE for NE, went live on Facebook March 27.

The face shield's simple design – a printed plastic headband, transparent face shield and elastic bands – provides a barrier against coughs and other fluids. They also help to extend the life of personal protective equipment by keeping them from getting soiled.

PPE for NE's grassroots effort quickly drew the attention of CHI Health's innovation team.

"As COVID-19 swept across the nation, we realized the critical role personal protective equipment would play. When a local resource emerged, I knew instantly we had to help any way we could. Not only for our staff, but health care providers and first responders across our state," said Greg Schardt, System Director - pharmacy mail order.

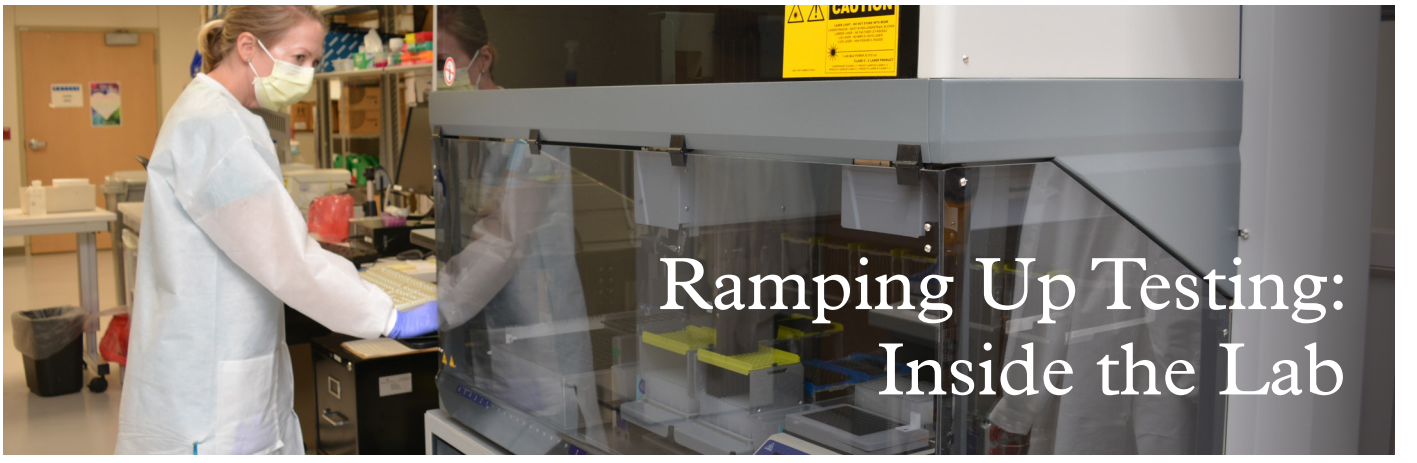
To help the start-up get going, CHI Heath, the largest health care provider in the state, supplied 12,000 PVC sheets for shields and 50 kg of filament to print headbands. CHI Health continues supporting PPE for NE by providing an additional 69 kg of filament and several liters of resin fluid.

"Having a partner like CHI Health come through so sizably on supplies was absolutely critical and enabled us to make a far greater impact," said Spaustat.

CHI Health's pulmonary and critical care team, caring for many of the state's hospitalized COVID-19 patients, also tested and provided feedback to help improve design, fit and comfort in the initiative's early stages.

A total of 5,706 shields have been delivered with more being made – at least 529 protecting CHI Health frontline staff at hospitals and clinics across Nebraska and southwest Iowa.

"It was so amazing to see how many people stepped up from our 3D printing community and all of those who pledged their money, time and connections to make sure we could get face shields in the hands of health care providers. It was truly a humbling display of generosity," said Spausat.



Ramping Up Testing: Inside the Lab

Stephen Cavalieri, PhD
Technical Director of the Microbiology Lab, CHI Health; Assistant Dean, Creighton University

Joseph Knezetic, PhD
Technical Director of the Molecular Lab, CHI Health; Director, Research Compliance Office, Creighton University

"Where can I get a test?" That was the question as COVID-19 moved into our area.

In the pandemic's earliest days, the Nebraska Department of Health and Human Services and Nebraska Medicine had labs doing testing.

"But demand was much greater than their capacity. We decided we needed to bring this in house," said Stephen Cavalieri, PhD, D(ABMM), Technical Director of the microbiology lab.

The challenge was to validate and implement a molecular COVID-19 test – and do it quickly. "It's not an easy thing to just set up a test," said Joseph Knezetic, PhD, Technical Director of the molecular lab and Director of the research compliance office at Creighton University.

The effort brought together laboratorians and leaders from two areas of expertise – molecular pathology and microbiology.

"He knows the bugs, I know the technology," Dr. Knezetic said.

"We complement each other," Dr. Cavalieri said.

Starting from Scratch

The team caught an early break. They did not have to buy new instruments because a molecular test using a nasopharyngeal swab became available for a machine called the Abbott 2000.

"The Abbott 2000 platform was already being used here for HIV and hepatitis C quantitative assays," said Dr. Knezetic. "That was lucky because the cost of instruments is massive."

The next step was validation.

"You have to be able to take samples we know the results of and make sure the results are the same," said Dr. Knezetic. "You have to be able to replicate it."

To do that, you need COVID-19 samples which have already been tested.

The lab was able to get some samples from the Nebraska Department of Health and Human Services and proceeded with validation.

Up and Running

By March 27, CHI Health's lab was able to process COVID-19 tests. "We've been ramping up testing capacity since then," said Dr. Cavalieri.

Just weeks into testing, the labs were required to move to a new location – a move that had been in the plans for months. "That required re-validating all the clinical assays that we perform while not delaying patient results significantly," Dr. Knezetic said.

Laboratorians worked around the clock. "Those are the folks who need the accolades; they have done an incredible job," said Dr. Knezetic.

The lab initially followed federal guidelines of limiting testing to hospitalized patients and those who had been exposed to COVID-19 – including health care workers, first responders and nursing home residents and staff.

"As we expanded, we've been able to open up testing to those having elective surgeries," said Dr. Cavalieri.

By mid-June, the CHI Health lab had performed 20,000 tests resulting in 2,400 positive results, and doubled its testing capacity in August.

"We don't want to turn anyone away," said Dr. Knezetic. "That's why we're continually trying to expand the capabilities we have so we can handle what might occur."

Renuga Vivekanandan, MD
Infectious Disease Specialist,
CHI Health;
Associate Professor,
Creighton University

"Armor" Invention Protects Test Providers

Testing people for COVID-19 puts providers at risk of catching the virus, so they cover themselves head-to-toe in personal protective equipment (PPE).

Plexiglass booths also protect providers but have drawbacks.

"The plexiglass booths serve the purpose of conserving PPE, but they are expensive and difficult to move around," said CHI Health Infectious Disease Specialist Renuga Vivekanandan, MD.

As members of the innovation team looked at images of the large rectangle boxes, Brian Smith, who at that time served as Facilities Compliance Coordinator for CHI Health, also saw problems: "How will we transport them, and where will they be stored?"

Dr. Vivekanandan and Smith immediately went to work. Their vision was to create a collapsible booth – similar to isolation booths that are often stood up in emergency situations.

Initial ideas were sketched in AutoCAD and the final product quickly evolved. The team took the idea to Heartland Awning & Design for production, and a great partnership was formed.

The end result – an inexpensive booth that can be set up in less than 60 seconds and fits in a duffle bag. The health care provider stands inside, protected by thick, clear non-permeable fabric. Their arms fit into arm-length rubber gloves, allowing them to test for COVID-19 without all the PPE.

"This booth allows us to save valuable PPE while providing great patient care because staff know they are completely safe," said Dr. Vivekanandan. "Additionally, if the booth is used outside, it cuts down on cleaning in between patients. When testing in a clinic room, the entire room must be disinfected in between patients."

The booth is also equipped with a positive pressure environment with filtered air, so it can be used in even more hazardous environments.

"This will give people the ability to respond faster and safer – especially internationally in remote locations where they have limited resources," Smith said. "And, it is reusable."

The testing booth will be piloted at CHI Health Clinics, but could be used globally. "We wanted to create something community hospitals could use – something deployable, affordable and easily transported," said Dr. Vivekanandan.

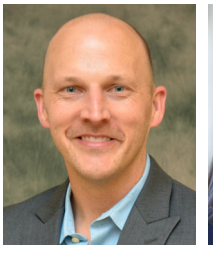
Reflecting on what the team created, Smith said, "It's like building a piece of armor."

Great Minds Don't Think Alike
They Work Together

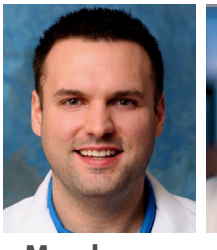
While the pandemic forced distance into everyday lives, it had the opposite effect for academic health center partners CHI Health and Creighton University. A diverse team from each institution came together to solve urgent problems. Each brought unique expertise to Innovation Team projects – often from a distance via Zoom. Their collaborative efforts resulted in real-time solutions as well as patent applications and grant proposals which will improve how we care for our communities through COVID-19 and beyond.

Special Thanks

More people than we can list contributed their expertise and sweat equity to innovation projects. They include staff from CHI Health and Creighton University as well as business leaders and community members throughout Nebraska and southwest Iowa. We thank you for stepping forward when the community needed you most.



Innovation Team Leaders
Greg Schardt, Dr. Renuga Vivekanandan



Innovation Team Members
Top, L-R: Dr. Jason Bartz (research), David Buffington (library/3D), Dr. John Cote (OB/3D), Dr. Robin Farias-Eisner (OB). Bottom, L-R: Dr. Laura Hansen (research), Dr. Adam Highley (pulmonary), Dr. Theresa Townley (internal medicine).

We Value Your Feedback!

Please share your thoughts about this issue of *microscope* and your ideas for future stories at **CHIhealth.com/MicroIdeas**

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We're interested in **CREATING SOLUTIONS** to our problems.

We felt we should be proactive about protecting our communities.

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It's like building a piece of armor.

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PEOPLE STEPPED UP FROM OUR 3D PRINTING COMMUNITY.

THE SHOP TURNED OUT 10,000 MASKS EACH WEEK.

We like to chase ideas and we have a lot of creativity.

CHI Health Hospital Locations

NEBRASKA

Grand Island
CHI Health St. Francis

Kearney
CHI Health Good Samaritan

Lincoln
CHI Health St. Elizabeth
CHI Health Nebraska Heart

Nebraska City
CHI Health St. Mary's

Omaha
CHI Health Creighton University Medical Center - Bergan Mercy
CHI Health Immanuel
CHI Health Lakeside
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