

FALL 2020 | WINTER 2021

# Carilion Medicine

In partnership with the Virginia Tech Carilion School of Medicine and Fralin Biomedical Research Institute at VTC

## SURGE PROTECTORS

Before the first patient with coronavirus  
had even arrived, Carilion Clinic was ready







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CARILION MEDICINE FALL 2020/WINTER 2021

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## Features





THERE HAVE BEEN INDELIBLE MOMENTS in my life: The Space Shuttle *Challenger* explosion. The Oklahoma City bombing. The collapse of the World Trade Center's South Tower, followed by that of the North Tower.

I remember the unusual eeriness that followed the September 11 terrorist attacks. For days, it felt like the world had stopped. Yet we found comfort with family, friends, and other loved ones. We became closer, literally and figuratively. Shaken yet undeterred, we resolutely continued our daily lives.

The COVID-19 crisis feels different. The world as we knew it stopped, but so did many of our usual sources of comfort.

We were told: Don't get together. Don't leave your home unless you must. Don't gather with others to share your faith. You can't have dinner with your closest friends. You can't attend plays, movies, or concerts.

Unlike with 9/11, we must endure this historic event often isolated and alone, exacerbating physical and mental health challenges on many levels.

The idea that a virus, so tiny and invisible, could cause such large-scale disruption—shutting down schools, businesses, sports, entertainment, and even health care around the world—seemed implausible a year ago.

Now we're living it. Sometimes I experience a disquietude. It seems like we're living in a containment. At other times, I've wanted to jump out of my skin or hop on a plane until I realized there was nowhere to go! The virus is inescapable.

The coronavirus is not confined to a specific population either; we're all at risk. In our region, as of this writing COVID-19 cases and hospitalizations, rather than abating, are climbing steadily, and our positivity rate now is among the highest in Virginia.

Rather than going about our lives, we're finding that COVID-19 continues to dominate our culture. As the weeks and months wear on, I continue to be impressed with the way our teams selflessly put patients first. I've witnessed nurses working long shifts in our COVID-19 unit as well as throughout our hospitals and then volunteering in their free time. I've seen care providers pitching in to cover for colleagues with even more pressing needs or those who may have been exposed or infected.

I'm grateful, too, for the families of our providers, for whom this work also represents a sacrifice.

The outpouring of support from our community means so much. While we didn't go into health care for the accolades, the clear appreciation we've received reminds us that what we do every day really is special. Despite our social distancing, in many profound ways the pandemic has brought us closer.

**Patrice M. Weiss, M.D.**

Chief Medical Officer and Executive Vice President  
Carilion Clinic

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Carilion Clinic is a nationally ranked integrated health system headquartered in Roanoke, Virginia. Its flagship, Carilion Roanoke Memorial Hospital, is the clinical affiliate of the Virginia Tech Carilion School of Medicine and Radford University Carilion.

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## On the pulse of the Carilion Clinic community

### Pictures of Health

The American Hospital Association has honored Carilion Clinic as one of only five recipients of the 2020 AHA Dick Davidson NOVA Award.

This prestigious national award recognizes hospitals and health systems for their collaborative efforts toward improving community health status. Carilion was recognized for its work with Healthy Roanoke Valley, a partnership with the United Way of Roanoke Valley and other local organizations to address health disparities in Roanoke.

Healthy Roanoke Valley projects include Fresh Foods Rx, a 12-week program that provides patients with weekly health education, peer and physician support, and vouchers for fresh, locally grown produce; Pathways Community Hub, a care coordination system in which community health workers use a home visiting model; and the Morningside Community Garden, which provides residents in a food desert with fresh fruits and vegetables.



**CROSSING THE DESERT:** The Morningside Community Garden is a Healthy Roanoke Valley initiative that offers residents who live in a food desert access to fresh produce in addition to wellness education and community resources.

# in brief



### A SHOT IN THE ARM

In mid-December, Carilion Clinic received its first shipment of Pfizer's COVID-19 vaccine. "The light at the end of the COVID-19 tunnel is getting a little brighter," said Chad Alvarez, Pharm.D., senior director of pharmacy and the leader of Carilion's COVID-19 Vaccine Task Force.

"This is an exciting step forward in the fight against this pandemic."

Paul R. Skolnik, M.D., chair of the Department of Medicine, agreed, adding a reminder to double down on precautions: "Those actions and the COVID-19 vaccines will be what beat this pandemic."

#### research tool

### Strength in Numbers



Carilion Clinic has launched Storage and Programs Accelerating Research Collaborations (SPARC), a new, secure tool that enables research teams to store, share, and analyze data within the same cloud-based research environment, all while being HIPAA compliant.

"The future of research is about the ability to manage, share, and use big data," said Paul R. Skolnik, M.D., chair of the Department of Medicine. "We can now securely share data beyond the researchers who collected them, enabling scientists to translate massive amounts of data more quickly into findings with clinically relevant outcomes."



## prevention



## Telemedicine Expands

The U.S. Department of Agriculture awarded Carilion Clinic a grant of nearly \$1 million to expand and optimize its telemedicine program.

“We are honored to receive this grant and excited to get to work,” said Stephen Morgan, M.D., senior vice president and chief medical information officer for Carilion. “This will allow us to build on our existing network, offering rural patients throughout western Virginia increased access to high-quality primary and specialty care services.”

The Telemedicine Expansion and Optimization Project will feature several new ways for patients to connect and receive care from Carilion, including virtual care centers, expanded inpatient and outpatient teleneurology services in community hospitals, and portable telehealth video devices available for patient use in primary care practices, in assisted living centers, and during home health visits.

“This grant, paired with Carilion’s telemedicine expansion in response to the COVID-19 pandemic,” Dr. Morgan said, “will allow for continued improvements in telemedicine access throughout western Virginia, ensuring patients in rural communities can receive quality care close to home.”



**DISTANCE VISION:** In their first telemedicine appointment, Bella and her mother, Kerri, consult with Dr. Andre Muelenaer, chief of pediatric pulmonology at Carilion Clinic, about Bella’s asthma.

## ADVANCE GUARD

Certified medical assistants in Virginia are now allowed to apply fluoride varnish to young children at well-child doctor’s visits, thanks to a collaboration among physicians, dentists, nurses, and an advocacy group.

In 2018, the Delta Dental of Virginia Foundation awarded the Virginia Tech Carilion School of Medicine \$100,000 to start a new pilot program to promote integrated oral health care exams and fluoride varnishing for young children in local doctors’ offices.

“Many people don’t realize that early childhood caries is the number one chronic disease in kids,” said Tarin Schmidt-Dalton, M.D., associate dean for clinical science

years 1–2 at the Virginia Tech Carilion School of Medicine and a family medicine physician at Carilion Clinic.

Guidelines recommend that children receive regular fluoride applications starting at the onset of their first tooth eruption. Yet children at that age are more likely to see a physician than a dentist. So the interdisciplinary team successfully advocated for legislation enabling certified medical assistants to be able to apply the varnish. At the same time, Dr. Schmidt-Dalton said, the team built a model for collaboration.

“I believe we are leading the way with this,” she said, “having developed a model that other communities can use and adapt.”

## community

## Taking a Knee for Justice

The week after George Floyd’s brutal death, several dozen members of the Carilion Clinic community gathered near the Roanoke River to kneel in solidarity with White Coats for Black Lives, a national campaign by health care workers against racism.



Their silent vigil lasted 10 minutes, just slightly longer than the amount of time police officer Derek Chauvin pressed his knee into Floyd’s neck.



**END RACISM NOW:** Artist and social worker La’Shay Foreman paints a crown in “W” the final letter in a street mural in downtown Roanoke. The Urban Art Project of Roanoke hosted the project, in which local artists painted letters that together spelled out “End Racism Now.” Carilion Clinic and the Virginia Tech Carilion School of Medicine both helped fund the project in support of social justice.

## appointment

## School of Nursing Dean Named



Johnnie Sue Wijewardane, Ph.D., has been named the inaugural dean of the Radford University School of Nursing, based in both Radford and Roanoke, Virginia.

Dr. Wijewardane had most recently served as a professor in the School of Nursing at the University of Mississippi Medical Center, where she also served as associate dean for academic affairs. Before entering academia, she spent more than a decade as a nurse in a variety of clinical and hospital settings. She has been honored as a fellow of the American Association of Nurse Practitioners.

Dr. Wijewardane earned a bachelor’s degree in nursing, a master’s degree in nursing with an emphasis in emergency and trauma management, and a doctorate in nursing—with additional focus in psychometrics and evaluation, family and child obesity, and self-efficacy—from the University of Mississippi Medical Center.

“This is an exciting and pivotal time in the School of Nursing’s history as it recently became the largest academic school at Radford University with the establishment of Radford University Carilion located in Roanoke,” said Brian O. Hemphill, Ph.D., president of Radford. “I am confident that, under the leadership of Dr. Wijewardane, the Radford University School of Nursing is poised for continued success and expanded impact in the region, the commonwealth, and beyond.”

## briefings



## Practice Makes Perfect

Carilion Clinic surgeons recently performed their 1,000th transcatheter aortic valve replacement (TAVR), a minimally invasive procedure that uses a catheter to implant an artificial heart valve in patients with severe aortic stenosis. Carilion was one of the first health systems in the country to perform this lifesaving treatment.

## Best Practices



In 2020, *U.S. News & World Report* recognized Carilion Roanoke Memorial Hospital as one of Virginia’s top five hospitals for the sixth year in a row. The hospital was also recognized among the elite 13 percent of hospitals nationwide that won “Best” honors; Carilion performed highly in nine areas.

## Close to the Heart



Carilion Clinic’s Heart Failure team has achieved VAD (Ventricular Assist Device) Accreditation from DNV GL – Healthcare, making the center one of only 10 in Virginia. The American College of Cardiology has also accredited Carilion Roanoke Memorial Hospital with “Chest Pain Center with Primary PCI.”



# 1918

## Snapshot of a Past Pandemic

Just over a century ago, a worldwide influenza pandemic killed more than 50 million people, including hundreds in the Roanoke Valley.



It began quietly, with a teenage boy at the Baptist Orphanage in Salem, Virginia, complaining of chills and fever. Soon nurse Mary Dunton was tending to two dozen orphans, then twice that many.

At Hollins College, in nearby Roanoke, student Louise Mapp fell ill. By week's end, 80 other students had joined her in the infirmary. Just weeks later, 30 Norfolk & Western Railway laborers were hospitalized with "the gripe."

Wiley W. Eastwood didn't even manage to see a doctor; he left work early one day and died at home the next morning, after receiving a stream of visitors. On September 25 of that year, Eastwood became the first Roanoke Valley resident to succumb to the 1918 flu pandemic.

Within a month, nearly 90 of the 4,000 Roanokers already infected with the virus had died, including Dunton and Mapp.

At the time, many local physicians were stationed away, having received U.S. military commissions. So, with the encouragement of Alice Terry Jamison, the local Red Cross chapter president and a major player in the founding of what is now Carilion Roanoke Memorial Hospital, Red Cross student nurses joined high school teachers and other volunteers in helping to fill the caregiving gap.

With the urging of Dr. Brownley Foster, the city health director, on October 8, the Roanoke City Council declared all schools,

churches, dance halls, movie theaters, and bowling alleys closed. Streetcars operated with windows wide open, police began enforcing the anti-spitting statute, and gauze masks started appearing on faces across the region.

Residents were advised to restrict telephone use to emergencies, as so many operators had fallen sick. Police too saw their numbers diminish, with one-third of the force becoming infected.

Druggists soon ran out of supplies. In the meantime, newspaper ads offered relief from flu symptoms through such remedies as Cascara Quinine cold tablets, Dreco stomach tonic, Dr. Pierce's Pleasant Pellets, and "Oil of Hyomei," a concoction of alcohol, liquid paraffin, and eucalyptus oil that, once inhaled, promised to "absolutely destroy the germs of influenza."

Fortunately, by the time the Great War armistice was declared on November 11 of that year, the Roanoke area was experiencing minor victories in its own war against the influenza virus.

At the end of 1918, the health department reported 162 deaths from more than 6,500 influenza cases in the region. Although cases—and deaths—would continue to occur over the next two years, their numbers fell significantly. Even so, Dr. Foster concluded 1920 with a warning to guard against complacency during the cold winter months.



**FACING PAGE:** In Roanoke, Red Cross volunteers, shown here selling Liberty Bonds to support the World War I effort, cared for people stricken with the flu during the 1918 pandemic. **THIS PAGE:** Masked workers across the country included New York City conductorettes (above, middle); Red Cross nurses in Washington, D.C. (above, right); barbers in Cincinnati (center); office clerks in New York City (below, left); and nurses and doctors in a makeshift emergency hospital in Brookline, Massachusetts (middle, left). Local newspaper ads extolled the virtues of "pure milk" and bicycling to work to avoid crowds, while state and national posters advised hygienic practices.





# grand rounds

Education at Carilion Clinic and its affiliates

mentoring

## Recognition for a Trailblazer



**MASTER MIND:** Dr. Paul Dallas explains an anatomical principle to a medical student during a portable ultrasound machine demonstration.

The American College of Physicians has bestowed a Master-ship on Apostolos “Paul” Dallas, M.D., director of Continuing Medical Education at Carilion Clinic. The honor is reserved for clinicians who have reached distinction in the excellence and significance of their contributions to the science and art of medicine.

“Dr. Dallas is eminently qualified for this prestigious honor,” said Nancy Howell Agee, president and chief executive officer of Carilion. “For nearly three decades, he has served as an outstanding internist. He is also a superb teacher and an innovative leader nationally.”

Dr. Dallas has been a trailblazer locally and nationally in ultrasound training. When he established a portable ultrasound program at the Virginia Tech Carilion School of Medicine a decade ago, the institution was one of only three medical schools in the nation to provide such instruction.

His curricular innovations continued. In 2018, the school, where he serves as an assistant professor, became the first in the country to use portable ultrasound machines equipped with 12-lead EKG technology, which allows students to view images of the heart while also measuring its electrical activity through electrodes attached to the body.

“Dr. Dallas’ enduring contributions are perhaps marked best by his students,” said Agee. “He watches with pride as many top physicians who were once mentees reach the pinnacle of their profession by following in his footsteps—as beloved clinicians and leaders of residency and fellowship programs. His legacy has been remarkable.”

## EXPANDED CLASS OF 2024



In July, the Virginia Tech Carilion School of Medicine welcomed its 11th class, its largest to date. The Class of 2024 has 49 members, reflecting the first expansion in the school’s history.

“We are excited to welcome this outstanding new class, and to offer seven more seats to students who are so well-qualified for careers in medicine,” said Lee A. Learman, M.D., Ph.D., dean of the Virginia Tech Carilion School of Medicine. “Members of the Class of 2024 bring rich backgrounds. As with our smaller class size of 42, having 49 students supports the formation of a close-knit community, with rich relationships among students, their faculty, and our community.”

Nearly 4,300 people applied for a slot. Ten members of the Class of 2024 hold a master’s degree and one has a doctorate. The average member has completed more than 2,390 hours of research and accumulated more than 4,100 hours of clinical experience.

“The increase in our class size allows us to cultivate seven additional scientist physicians whom we hope will work collaboratively, effectively, and sensitively toward a better health future for our communities,” said Melanie Prusakowski, M.D., associate dean for admissions. “The candidates are outstanding, and the admissions team expects big things from this class.”

The school welcomed its first class in 2010. Since then, seven classes have graduated, each with a 100 percent match rate to residency.



**SAFETY FIRST:** The Virginia Tech Carilion School of Medicine traditionally takes a photo of its incoming class clustered together on the front steps of the school’s building; this year, the pandemic inspired a new approach.



**RITE OF PASSAGE:** First-year medical student Vemmy Metsutnan flashes a peace sign while Dr. Lee A. Learman, dean of the Virginia Tech Carilion School of Medicine, helps her don her new white coat (above left). Dr. Learman also helps Brandon Ganjineh into his white coat (above right). Students express emotion while watching a video with clips of family members and friends who were unable to attend the ceremony in person (bottom right).

## WHITE COAT CEREMONY



When members of the Class of 2024 began their studies at the Virginia Tech Carilion School of Medicine during the COVID-19 pandemic, they knew their medical school experience would differ from those of the classes before them. The same was true for their White Coat Ceremony.

White coat ceremonies tend to draw a large crowd of family and friends, but this year, with the need to ensure social distance, guests were limited to only a loved one who lives with the student. Other friends, family, faculty, and community members were asked to attend virtually through a livestream. Students were widely spaced out in the auditorium where the event was held.

Still, the ceremony managed to have a celebratory feel, recognizing each student’s hard work to get into medical school and complete their first block of study. “The purpose of the ceremony is to clarify for our students that a physician’s responsibility is both to take care of patients and to care for patients,” said Aubrey Knight, M.D., senior dean for student affairs.

The evening’s keynote speaker, Lisa Uherick, M.D., an associate professor of emergency medicine and medical director of the pediatric emergency department at Carilion Roanoke Memorial Hospital, gave each student a stone to remind them that bumps and friction along their journeys will help shape them into polished physicians.



## Focus on Design



Three Virginia Tech Carilion School of Medicine students have created a medical design club that merges medicine and innovation.

Second-year students Luma Abunimer, Katie Hardin, and Tommy To said their goal is to support the engineering and design ideas of medical students and physicians so they can innovate and improve medical technology, systems, and procedures.

“We felt that if we could provide medical students with the platform and skills to creatively address the many needs in the field of medicine, especially now during the pandemic, we would all be even more dynamic physician thought leaders,” Abunimer said.

Abunimer and Hardin have backgrounds in biomedical engineering; To’s undergraduate degree is in biology.

“We thought this was an amazing opportunity to work alongside classmates and have ideas together and learn how to solve problems by designing real-world solutions,” To said.

The group’s first project was a website that serves as a virtual repository for sharing computer-aided design files that can be used for 3D printing of materials for use with personal protective equipment. The site accepts designs from medical students, physicians, engineers, researchers, and anyone with a bright idea. Early designs include face shields and accessories to reduce the strain on ears from face shield straps.

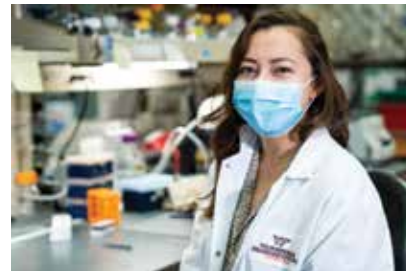
“The Medical Design Club has a lot of energy and expertise,” said Stephen LaConte, Ph.D., an associate professor at the Fralin Biomedical Research Institute at VTC who serves as the club’s faculty advisor. “It will be a wonderful experience for medical students to be thinking about medical design and technology issues from the very beginning of their basic science and clinical training.”

The club plans to use human-centered design principles to foster innovation. “We’re hoping to make this an incubator for new ideas,” Hardin said. “We will help walk people through the process of designing a technology.”



**DESIGNERS FOR GOOD:** A trio of medical students—from left, Luma Abunimer, Tommy To, and Katie Hardin—started a club to serve as an incubator for biomedical design ideas.

## UNDER THE MICROSCOPE



Gabriela Carrillo didn’t always aspire to be a neuroscientist. It wasn’t until she was providing in-home behavioral analysis therapy for children with autism that she was drawn to the laboratory.

“Science gave the families I worked with a lot of hope,” said Carrillo, a graduate student in Virginia Tech’s Translational Biology, Medicine, and Health program. “Parents appreciated the therapy and saw progress, but they were also encouraged by the idea that one day, in our lifetime, a scientific breakthrough in our understanding of autism might help their child.”

Now, just six years after her academic switch from studying architecture and psychology to pursuing neuroscience, Carrillo earned a competitive six-year, \$445,000 National Institutes of Health grant that will fund her remaining doctoral and postdoctoral training.

Under the mentorship of Michael Fox, Ph.D., a professor at the Fralin Biomedical Research Institute at VTC, Carrillo studies how infections alter brain circuits. Her long-term goal is to study how infections alter those circuits in babies. After completing her doctoral studies, Carrillo hopes to join a world-leading neuroimmunology lab for post-doctoral training, paving the way to one day lead her own research lab focused on perinatal neuroimmunology.

“When I think about the impact that my research could one day have on children and their families,” Carrillo said, “that’s what really motivates me.”

PHOTOS: RYAN ANDERSON (LEFT); CLAYTON METZ (ABOVE)



**BEST IN CLASS:** Alexandria Pilot, a doctoral student at Radford University Carilion, wants to translate her health studies background into a role in higher education.

## PULLING RANK



*U.S. News & World Report* ranked Radford University Carilion among the top health schools for 2021. The programs listed included the doctor of physical therapy, the doctor of nursing practice, the master of occupational therapy, and the master of communication sciences and disorders with a concentration in speech-language pathology.

The doctor of physical therapy program engages students in honing decision-making skills, critical thinking, psychomotor skill development, and social skills integration. The School of Nursing prepares registered nurses with a bachelor of science in nursing. The program is distance-based to promote maximum flexibility, while preparing graduates to work in a variety of settings and provide leadership in health care.

After passing the National Board for Certification in Occupational Therapy, graduates in occupational therapy are licensed to practice in settings ranging from hospitals and nursing homes to schools, community centers, and private practice. Those with a master’s degree concentration in speech-language pathology are prepared to earn the Certificate of Clinical Competence in Speech-Language Pathology.

“Radford University has long been known and respected for its delivery of high-quality academic programs in a student-centered environment,” said Brian O. Hemphill, Ph.D., president of Radford University. “I am so proud of the great work occurring on the main campus and at the recently established Radford University Carilion.”

## fellowship

### Medical Student Awarded Grant to Study Pediatric Brain Cancer



Yazdi Doshi, a third-year student at the Virginia Tech Carilion School of Medicine, spent his summer pursuing a research fellowship at the St. Baldrick’s Foundation. There he continued his Fralin Biomedical Research Institute at VTC explorations into developing effective ways of treating pediatric glioblastoma, a brain cancer that is one of the most aggressive and difficult to treat cancers in children.

PHOTOS: RYAN ANDERSON (ABOVE); MARK LAMBERT (TOP)

## grand roundup

### A Room of Her Own



Research has shown that a lack of appropriate facilities can impede physicians who become mothers while completing their training from being able to follow the recommended guidelines for breastfeeding their infants. To help fulfill its commitment to physician well-being and to encourage physicians to follow the same advice they give patients, Carilion Clinic has expanded its lactation facilities for residents and fellows.

Dedicated lactation spaces—private rooms with a computer, phone, sink or full bathroom, and hospital-grade stationary breast pump—are now located throughout Carilion Roanoke Memorial Hospital. Each dedicated space has a nearby refrigerator.

### Fellowship News



The Wilderness Medical Society confirmed its certification of Carilion’s

Wilderness Medicine Fellowship, one of only eight programs nationally to be so honored.

The Accreditation Council for Graduate Medical Education has granted Carilion initial accreditation for a two-year rheumatology fellowship based in the Department of Internal Medicine.

OMeGA, the Medical Grants Association, awarded a grant to the Orthopaedic Hand Fellowship to offset the salary of one fellow.



# UP TO SPEED



## Modern hospitals are built for crisis.

Their intricate and diverse departments and specialties share a common goal of saving, prolonging, and improving the quality of human lives.

But what happens when a health crisis threatens to engulf the hospital itself? Carilion Clinic and thousands of hospitals and health systems across the United States have been put to that test in 2020 and will continue to be in 2021. As the novel coronavirus and its associated disease, COVID-19, spread inexorably, health care facilities faced monumental questions: Were they prepared to isolate pandemic victims from other patients? How would they keep their workers safe and communicate clearly—without spurring panic? Where would they find essential supplies that the whole world needed at the same time?

At Carilion, the ability to overcome these and other challenges in real time resulted from longstanding traditions of teamwork and interdisciplinary leadership.

Weeks before the first COVID-19 case struck southwestern Virginia, Carilion's Incident Command system kicked into gear. Medical and administrative leaders from across the enterprise formed plans to create isolation units, convert office space to beds if needed, and retrain and reassign workers to areas of critical need.

Years of close collaboration between Carilion and Virginia Tech enabled physicians and researchers to work seamlessly together on everything from finding new ways to decontaminate and reuse precious personal protective equipment to developing a new respirator whose usefulness may well outlast the current crisis.

And a long tradition of warm relations between Carilion and the communities it serves has paved the way for steady communication of key public health information. The community responded in kind, with an outpouring of donated meals, masks, and equipment for Carilion workers that brought Tom Hill, a senior vice president at Carilion, nearly to tears. Hill, who oversees procurement for Carilion, says, "We were overwhelmed with the generosity, the kindness."

While the final chapters on COVID-19 have yet to be written, the events of 2020 set the backdrop for an object lesson in how a great health system, in a great community, can meet a crisis head on with speed, efficacy, and grace.

CARILION CLINIC RESPONDED SWIFTLY TO THE UNPRECEDENTED CHALLENGES OF COVID-19. *by Charles Slack*





# SURGE PROTECTORS

EARLY IN THE PANDEMIC, CARILION CLINIC MOBILIZED QUICKLY  
TO TURN PLANS INTO ACTION. *by Charles Slack*



On March 19, 2020, Paul R. Skolnik, M.D., an infectious diseases specialist and chair of Carilion Clinic's Department of Medicine, announced in a video the news that everyone, at some level, had been bracing for—southwestern Virginia had its first case of COVID-19.

A woman in her late 80s had presented at Carilion Roanoke Memorial Hospital three days earlier with symptoms consistent with the disease. She was admitted to an isolation unit, and a laboratory test confirmed the diagnosis. Already in serious condition when she arrived and at high risk because of her age, she died 10 days later.

Steve Arner, Carilion's chief operating officer, recalls that, for all the nervous anticipation of the inevitable arrival of COVID-19, a sense of calm prevailed. "We knew we were ready for whatever might occur," he said, "because of the intense planning we had already done."



## Laying the Groundwork



That confidence lay rooted in weeks of preparation. As the deadly virus made its push into Seattle, New York City, and elsewhere, Roanoke’s location—more than 150 miles from the nearest major metropolitan area and girdled by the Blue Ridge Mountains—offered a gift of time that Carilion leaders were determined not to waste.

Starting in December, nearly three months before the World Health Organization’s March 11 declaration that COVID-19 was a pandemic, Carilion was already forming a response plan. On February 27, the health system gathered leaders from areas ranging from infectious diseases to nursing to procurement to communications for the formal launch of Incident Command, Carilion’s official structure for responding to emergency situations.

“What we really didn’t want was panic,” Arner says. “We knew there would be a great deal of concern, so the question became, how do we make sure everyone knows we have a system in place to make decisions and roll solutions out quickly?” Arner, who also now serves as chair of the Virginia Hospital & Healthcare Association, began meeting weekly with medical and civic leaders around the region and the commonwealth to ensure a coordinated response.

During a pandemic in which misinformation and rumor have sometimes spread faster than the virus itself, one key role of Incident Command is to convey accurate information to Carilion staff and the community at large. Nearly 50 marketing and communications professionals from around the Carilion system coalesced into a crisis communications team responsible for managing both breaking news and longer-term educational content about the disease, including a town-hall style Coronavirus Community Conversation simulcast on all local radio and television stations.

“The key for much of our planning was anticipating a surge of patients, and preparing to address it when it came,” says Chris Turnbull, director of corporate communications and operational continuity at Carilion. “We knew we’d have to be on top of our game, every person, every day.”

## Protecting Patients and Staff



Carilion carefully observed how other areas were dealing with the crisis, their successes and setbacks. When New York experienced a surge in COVID-19 deaths in nursing homes and senior care centers, Arner says, “We made a decision very quickly to let our medical directors and others find ways to help those facilities in our

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UPWARD OF 40 PERCENT OF INFECTED PEOPLE ARE ASYMPTOMATIC. THAT’S VERY DIFFERENT FROM, SAY, EBOLA, WHERE PEOPLE ARE HEMORRHAGING. EBOLA IS NOT A SECRET.”

Paul R. Skolnik, M.D., Infectious Diseases Specialist and Chair of Carilion Clinic’s Department of Medicine

community. We had to make sure we were protecting those most vulnerable to the virus.”

Another key issue facing Carilion—like all health systems—was the sudden need for equipment. And, unlike with a natural disaster or regional outbreak of illness, coronavirus has been so encompassing that virtually every locality in the world was scrambling for the same suddenly precious supplies. Modern supply chains—marvels of complex logistics—suddenly came to resemble a Wild West free-for-all.

With stories emerging about patients in other hard-hit cities lying in hospital corridors in need of ventilators, wearied hospital staff donning bandanas for masks, and humble hand sanitizer suddenly a rare and precious commodity, Carilion procurement teams kicked into high gear, making thousands of phone calls in search of equipment to keep patients and staff safe. And Carilion clinicians teamed with Virginia Tech researchers to fashion new equipment and explore novel ways to clean precious N95 masks for reuse.

At the same time came the all-important decisions about how to best manage space and how to treat COVID-19 patients without risking spread of the virus to other patients or providers.

## Creating Barriers to Disease



The Incident Command structure, used at hospitals throughout the country, is designed to help Carilion respond to crises of all kinds, from floods to fires to major accidents. In many instances, the chair of medicine is a key member of that team. In the midst of a historic pandemic, Carilion had a stroke of luck: Its chief of medicine is also a noted infectious diseases specialist. In previous roles, Dr. Skolnik had joined the fight against diseases ranging from HIV/AIDS to the West Nile virus, and he helped lead the response against Ebola in Connecticut.

Among alarming characteristics of the virus, two stood out from the start, Dr. Skolnik says. First was the speed of transmission. Graphs and maps tracking the global spread of the coronavirus and the West Nile virus during the early 2000s resemble each other, but with a crucial difference.

“The West Nile spread took four to five years to develop,” Dr. Skolnik says. “The coronavirus took four or five months. That’s alarming.”

The second characteristic was the stealth of the coronavirus. “Upward of 40 percent of infected people are contagious yet asymptomatic, which makes viral transmission harder to prevent,” Dr. Skolnik says. “That’s very different from, say, Ebola, where people are hemorrhaging. Ebola is not a secret.”



Guarding against this unpredictable threat required what Craig Bryant, director of emergency management and safety, refers to as a “hardening” of all facilities. Working with an area contractor at Carilion Roanoke Memorial Hospital, he says, “We basically turned a whole floor into a negative pressure unit.”

Patients with COVID-19 and those under investigation for the disease were placed in rooms with HEPA (high-energy particulate air) filters designed to capture and remove microscopic contaminants. A special air handling system maintains air pressure at lower levels than in surrounding corridors and rooms—thus making it harder for air to escape to the rest of the hospital. Doors to the rooms remain tightly shut, with entry through an anteroom, and displays give workers a running read on the air pressure.

Hardening also meant limiting access to buildings—no easy task at a community institution with a long and proud tradition of openness.

“Carilion was, and still is, very community-oriented, so visitors came and went easily prior to the pandemic,” Bryant says. “At Roanoke Memorial we had something like 14 ways that people could enter the hospital. We narrowed that down to five. That’s the only way we can ensure that everyone’s wearing a mask, and that all visitors get screened to make sure they’re not exhibiting symptoms.”

## Managing People



Yet the most complex challenge was not the buildings or the equipment but the people—managing Carilion’s more than 13,000 employees across seven hospitals and more than 100 clinics in 20 counties. For hospitals

everywhere, the pandemic has been a study in contradictions. With elective surgery and other services shut down to control spread of the virus, hospitals experienced a drop in revenue and demand that forced reductions in staff and hours.

In April, Carilion made the difficult decision to furlough some employees. Ultimately, this move affected fewer than 10 percent systemwide, and all staff retained health benefits. Carilion leaders, physicians, and senior managers also took temporary pay cuts of 5 to 20 percent. Yet while some departments languished, the virus placed unique and ongoing stress on Carilion’s ability to find sufficient staff to treat coronavirus patients and help keep communities safe.

For Carilion, nowhere has that fine balance been more obvious than among its 3,000-strong staff of nurses and physician assistants.

“Our biggest issue has been staffing,” says Meg Scheaffel, B.S.N., R.N., vice president and chief nursing officer. “When COVID-19 first hit, our patient census declined about 40 to 50 percent.”

**LUCKY BREAK:** In confronting the COVID-19 pandemic, Carilion Clinic found itself fortunate in that its chair of medicine, Dr. Paul R. Skolnik, is a noted expert in infectious diseases.



With some staff furloughed, she and the nursing team found themselves facing a whole new set of challenges and vacant positions.

“We reassigned 20,000 hours of employee time right out of the gate,” she says. Whereas under normal circumstances each Carilion hospital operates more or less autonomously in terms of staffing, in this case a more comprehensive, cohesive approach was needed. To date more than 75,000 hours of employee time have been reassigned to meet the needs and demands of the pandemic.

To manage the challenge, Carilion developed an enterprise-wide staffing command center. At Carilion Roanoke Memorial Hospital, an entire floor spanning three towers was dedicated to COVID-19 patients.

“We had to train staff quickly,” Scheaffel says. Protective safety officers—positions newly created in response to the pandemic—were assigned to make sure that everyone, whether patient, visitor, or staff, wore appropriate personal protective equipment inside Carilion buildings and practiced proper hand hygiene. Contact tracers, another new role, track the recent histories of anyone who is ill and may have been exposed to or recently diagnosed with the virus.

Another immediate challenge was to fill a potential void of intensive care nurses. “It takes about a year to develop and fully orient a nurse to intensive care, and they need to have a certain experience level to be successful even within that year,” Scheaffel says. “But we didn’t have a year. We had two months—or even just two days.”

Scheaffel and her team developed a “mini critical care course” and turned to nurses with past experience in such settings as an intensive care unit or catheterization lab. While these nurses can’t fully replace ICU-dedicated nurses, Scheaffel says, “They can still give medications, conduct basic assessments, and help with suctioning or ventilator care. Their presence has helped take some of the pressure off the ICU staff.”

## From Raw Data to Lifesaving Action



Sharing accurate information is even more crucial among Carilion staff. Like most health systems, Carilion generates vast amounts of data, as many as 12 terabytes (one terabyte is equal to 1,000 gigabytes) a year on admissions, medical histories, and even patients’ vital signs.

In 2019, Stephen Morgan, M.D., senior vice president and chief medical information officer, had begun a two-year project aimed at organizing all those data to help clinicians and administrators anticipate patient needs, manage resources, and improve care.

“Our data strategy and data analytics are among Carilion’s high-priority areas,” he says. “Our leaders

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OUR LEADERS HAVE LONG RECOGNIZED THE VALUE OF DATA. THE CORONA-VIRUS PUT A NEW URGENCY ON THE NEED TO CONVERT DATA INTO ACTION-ABLE INFORMATION.”

Stephen Morgan, M.D., Senior Vice President and Chief Medical Information Officer, Carilion Clinic

have long recognized the value of data. The coronavirus put a new urgency on the need to convert data into actionable information. Fortunately, having some of that infrastructure already in place allowed us to mobilize quickly.”


Since the pandemic began, Dr. Morgan and a team of nearly 80 information specialists have created dashboards with data updated in real time to track cases, predict surges, and better align the supply of personal protective equipment with needs. At a glance, internal users can see the number of confirmed COVID-19 cases within the Carilion system, as well as the number of people tested and the number of deaths. Cases are also broken down by race, gender, age, and geographic location. Users can compare the number of recent cases to longer timeframes and the number of beds devoted to COVID-19 patients to those with other conditions. They can also track cases at each Carilion facility and the health effects on staff.

In May, when a statewide ban on elective surgery and other procedures lifted, the dashboards helped Carilion ensure that reopening wasn’t driving a spike in new infections. They have also tracked volumes of non-COVID-19 patients in the wake of reopenings, comparing patients in 2020 with those in prior years. In that sense, the intense need for information related to the virus is in turn spurring new systems that will help Carilion better manage patient care even when the pandemic eventually becomes a memory.

By mid-September, with non-COVID-19 patients returning and most Carilion services functioning as before, furloughed employees returned to full hours. In the early months of the pandemic, at least, even amid the real suffering of many patients and their families, southwestern Virginia appeared to have escaped the worst.

With a surge of cases and hospitalizations in late 2020, though, Carilion has drawn on portions of its original provisional plans to handle this influx of additional patients with COVID-19. As effective vaccines started rolling out in December, along with additional treatments—and with infection rates rising alarmingly in the United States and elsewhere—there’s no room for complacency.

Indeed, just as experience from past crises has helped Carilion manage the coronavirus, the pandemic is already teaching lessons that will inform responses to future challenges.

“When a health crisis hits, people are fearful and need clear, accurate, and easy-to-understand information,” Dr. Skolnik says. “It’s our job to deliver that information. Getting our team all on the same page and working to the same goal is absolutely key. We can never let our guard down.” 

# MEDICINE GOES VIRTUAL

NOW, MORE THAN EVER, PATIENTS ARE CHOOSING TO USE TECHNOLOGY TO CONSULT THEIR HEALTH CARE PROVIDERS.



Like many experts in the growing field of digital medicine, Stephen Morgan, M.D., senior vice president and chief medical information officer of Carilion Clinic, had long envisioned a time when virtual doctor visits might help clinicians provide quality care remotely. But he never predicted the sort of trial by fire wrought by the coronavirus pandemic.

Before COVID-19, Carilion clinicians were averaging just over three virtual visits a day, often involving psychotherapy, as that field was an early adopter of virtual options. By mid-March, when the virus curtailed in-person visits to Carilion’s network of hospitals and clinics, that number jumped to more than 600 a day, eventually reaching 700 by mid-March—an increase of more than 23,000 percent over pre-COVID-19 levels, covering a wide spectrum of specialties.

While some 60 percent of virtual visits were by telephone, 30 percent were conducted virtually using video conferencing technology. The remaining 10 percent

## DIGITAL MEDICINE BY THE NUMBERS

700

Number of patients each day using telehealth services by mid-March 2020

23,000

Percentage increase from pre-COVID-19 days, when daily visits had averaged only three

60

Percentage of virtual visits by phone

30

Percentage of virtual visits by online video

10

Percentage of virtual visits through MyChart

were conducted asynchronously via Carilion’s secure patient portal, MyChart. Patients can use MyChart to ask their doctors questions, check lab results, refill prescriptions, pay bills, and perform other functions.

For Carilion and other health systems nationwide, the rapid transition to virtual medicine during the pandemic was made possible by waivers from the Centers for Medicare and Medicaid Services that enabled reimbursements for telemedicine.

In a recent column in *Modern Healthcare*, Nancy Howell Agee, president and chief executive officer of Carilion, wrote, “With regulatory barriers removed, the health care field has made significant progress. At Carilion, for example, what we thought would take us two years, we were able to accomplish in a matter of days.”

While patients have expressed high satisfaction with virtual visits, a key challenge will be to continue improving the experience for physicians, Dr. Morgan says, to convince them they can provide the same level of care as with in-person visits. And in rural areas, insufficient broadband technology prevents many patients from seeing their doctors online.

By late summer 2020, with many Carilion departments reopened, virtual visits dropped to about 20 percent of all visits. Yet for Dr. Morgan and others, the future seems clear.

“What we’ve experienced since the spring,” Dr. Morgan says, “has been a fundamental shift in the way we treat patients and the way we will continue to treat them going forward.”



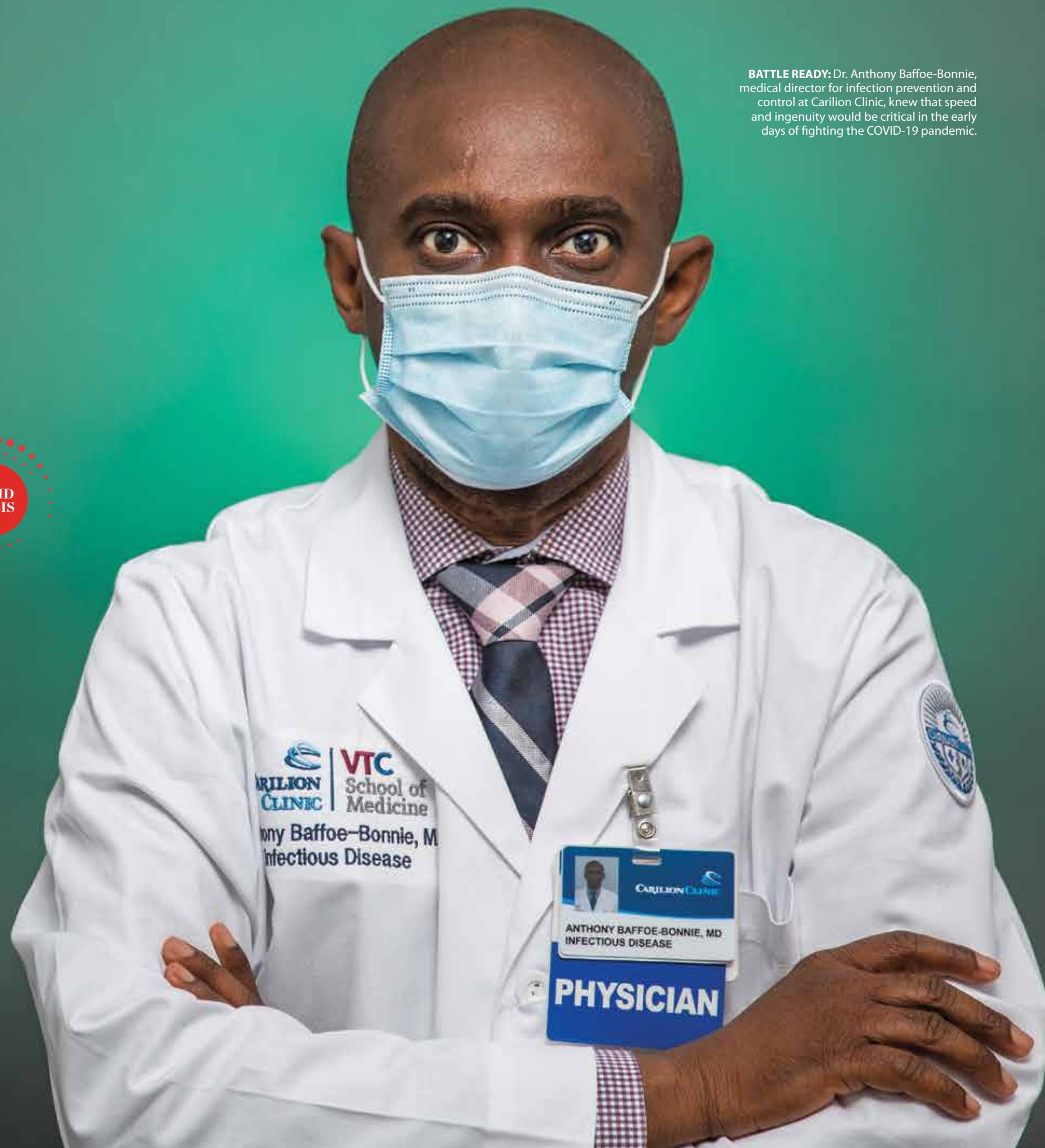


**BATTLE READY:** Dr. Anthony Baffoe-Bonnie, medical director for infection prevention and control at Carilion Clinic, knew that speed and ingenuity would be critical in the early days of fighting the COVID-19 pandemic.

COVID  
CRISIS

# DESIGN *for* LIFE

AS THE CORONAVIRUS SPREAD AND  
THREATENED LIVES, CARILION CLINIC  
AND ITS COLLABORATORS BECAME  
INVENTIVE. *by Marcia Lerner*





**SUPPLY AND DEMAND:**  
“We’ve never had to fight for products before,” says Tom Hill, Carilion’s senior vice president of materials management (below). “We could get anything we wanted as long as we were willing to spend the money. With the advent of the coronavirus, though, we were no longer in that environment.”



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atient beds. Masks. IV bags, tubes, and splitters.

The list goes on. From automatic pill dispensers to X-ray machines to pharmaceuticals and office supplies, every piece of equipment a hospital uses comes through the often-unsung heroes of health care facilities: the procurement team. • As senior vice president of materials management at Carilion Clinic, Tom Hill oversees the vast supply chain, warehouses, and distribution system that ensure Carilion’s 13,000-plus employees—physicians, nurses, administrators, emergency workers, and others—have the tools they need to do their jobs.



PHOTO: JARED LADIA



**IN THE AIR:** As an avid outdoor athlete, Dr. Linsey Marr (above left) has long understood the importance of air quality. Top right: Carilion Clinic workers decontaminate equipment. Bottom right: Virginia Tech graduate student Lindsey Bezek works with 3D-printed masks to be tested by Dr. Marr.

But even for a team used to performing daily miracles, the disrupted supply chains and acute shortages that occurred in the early days of the coronavirus pandemic posed staggering difficulties.

“We’ve never had to fight for products before,” Hill says. “We could get anything we wanted as long as we were willing to spend the money. With the advent of the coronavirus, though, we were no longer in that environment.”

As Hill and his team went into overdrive, making thousands of phone calls to source suddenly scarce products, Carilion practitioners and their Virginia Tech colleagues responded with innovation: improving mask sanitization, designing better face shields, transforming BiPAP machines into ventilators, and modifying respirator hoods. The results of their vision are helping protect Carilion patients and staff, offering options to the wider health care community, and invigorating the relationship between Carilion and one of its principal partners, Virginia Tech.

## The Mask Challenge

Early in the pandemic, it became clear that the United States was facing a shortage of N95 masks, which, as they block 95 percent of airborne particles, are an essential part of personal protective equipment for workers treating COVID-19 patients. Together with his infection prevention team, Anthony Baffoe-Bonnie, M.D., medical director for infection prevention and control at Carilion, realized that extending the life of the masks already in stock would be crucial.

Dr. Baffoe-Bonnie learned that Duke University’s biological warfare center had science supporting the potential for hydrogen peroxide to decontaminate masks. Experimenting with different concentrations and methods, he found that hydrogen peroxide gas could indeed remove any active trace of the virus as well as other contaminants.

“Then came the next question,” Dr. Baffoe-Bonnie says. “Did the decontamination method itself negatively affect the mask’s efficacy?” He connected with Linsey Marr, Ph.D.,

PHOTO: PETER MEANS FOR VIRGINIA TECH (ABOVE LEFT AND BOTTOM RIGHT)





## Transforming Machines

Masks weren't the only area in which shortages and future needs loomed. As cases increased, news and medical reports highlighted a desperate need for ventilators, with *The New England Journal of Medicine* alerting health care organizations in March of potential shortages.

Concerned for both his patients and his staff, Edmundo Rubio, M.D.—Carilion's chief of pulmonary, critical care, environmental, and sleep medicine—wanted to be proactive. Knowing that beds might fill and ventilators run out, he sat in his office, considering his options.

In that office, Dr. Rubio had a bilevel positive airway pressure (BiPAP) machine, commonly used to treat sleep apnea. "I said to myself, this is, in essence, a tiny ventilator," he says. "But a BiPAP machine doesn't have many of the additional functions of a ventilator."

So Dr. Rubio started with a BiPAP-ST, which uses a spontaneous timed feature to support a patient's breathing if not enough breaths are taken in a set time. Seeing that the spontaneous timed feature could support breathing as a ventilator would, Dr. Rubio faced the next challenge: "We needed to make sure that when people breathe out, the air they're breathing out gets filtered," he says. "Otherwise the virus would become aerosolized."

Dr. Rubio then designed a T-tube with a side port that could be connected to a HEPA filter, sealing the system. That problem solved, he contacted Virginia Tech colleagues for help addressing other concerns. The first was finding a way to measure air volumes to avoid overinflating the lungs—and to add alarms to hone and improve the machine. They worked together, coming up with solutions, until they had an inexpensive ventilator alternative.

Happily, Carilion was able to handle the initial waves of the pandemic with sufficient ventilators. But Dr. Rubio and his collaborators continued fine-tuning their creation, and the project has now passed on to Virginia Tech doctoral students who are working to refine it.

Even if the new device is never needed to meet COVID-19 demands, Dr. Rubio imagines multiple future uses for the ventilator, including helping patients with sleep apnea or chronic obstructive pulmonary disorder. And as the Virginia Tech students continue their work, the collaborators know they can transform more BiPAP machines should the need arise with any additional spikes in COVID-19 cases.

## A New Face Shield

With aerosolized viruses, face shields offer critical protection. But the shields in use before the pandemic were designed for short procedures—two hours at most, rather than throughout the long days the pandemic necessitated.

Cue Sarah Henrickson Parker, Ph.D., senior director of Carilion's Center for Simulation, Research and Patient Safety and an associate professor at the Fralin Biomedical Research Institute at VTC, who worked with her team to explore better options.

Part of the impetus was absolute need, explains Damon Kuehl, M.D., who serves as vice chair of Carilion's Department of Emergency Medicine and is part of the face shield team.

"Carilion had done a great job of sourcing different items," Dr. Kuehl says. "Yet we found that some face shields weren't usable, and the

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WE NEEDED TO MAKE SURE THAT WHEN PEOPLE BREATHE OUT, THE AIR THEY'RE BREATHING OUT GETS FILTERED. OTHERWISE THE VIRUS WOULD BECOME AEROSOLIZED.”

Edmundo Rubio, M.D., Chief of Pulmonary, Critical Care, Environmental, and Sleep Medicine, Carilion Clinic



**TOP:** Genevieve Gural, a master's student in mechanical engineering at Virginia Tech, works on different types of face masks. **BOTTOM:** The laboratory of Dr. Joseph Meadows, a Virginia Tech professor, has led the design of flow meters to measure oxygen flow from BiPAP machines to patients in real time.

THE  
CHALLENGE  
Few  
Ventilators

**BREATHING MORE EASILY:** Edmundo Rubio, M.D., Carilion's chief of pulmonary, critical care, environmental, and sleep medicine, teamed up with Virginia Tech colleagues to adapt a BiPAP-ST machine so it could be used as a ventilator.

Charles P. Lunsford Professor of Civil and Environmental Engineering at Virginia Tech, in an effort to find an answer.

Dr. Marr's lab focuses on airborne viruses—one of the few engineering labs in the country to do so. She was more than ready when Dr. Baffoe-Bonnie called. As early as February, Dr. Marr suspected that SARS-CoV-2—the virus that causes COVID-19—was transmitted through the air. She knew masks would be crucial weapons, and she had already transitioned her lab to mask testing.

"We were blessed to have Linsey Marr," Dr. Baffoe-Bonnie says. He quickly sent over masks decontaminated with hydrogen peroxide.

Dr. Marr's lab devised methods to test transmission of both small and large particles, the size that might carry the virus. For large particles the researchers used an airbrush spray, and for smaller ones they used a medical nebulizer. They then placed two mannequins in a chamber, about a foot apart.

"We sent the mist through one mannequin's mouth," Dr. Marr says, "and then we sampled the air at the opposite mannequin's mouth with specialized equipment that measures the number and size of the droplets or aerosols."

The scientists alternated masks on the mannequins to test for source control—protecting others—as well as for exposure reduction, or protecting the mask wearer. In doing so, they were able to determine that the hydrogen peroxide gas method did not

adversely affect the masks' efficacy for up to 10 decontamination cycles, a huge win for mask longevity.

Dr. Marr was also able to help when Dr. Baffoe-Bonnie received a shipment from the Strategic National Stockpile of P100s—elastomeric respirators that, like gas masks, have twin side filters. Dr. Baffoe-Bonnie was thrilled to have an alternative to N95s, until he realized that the P100 filters had expired in 2014. Worldwide equipment shortages meant no replacement filters were available. Again, Dr. Baffoe-Bonnie reached out to Dr. Marr.

"She rigged up a whole new system to test them and found they were functioning just as an N95 would function, or maybe even at a slightly higher level," Dr. Baffoe-Bonnie says. "It really did save us significantly; it saves us to this day."

Dr. Baffoe-Bonnie had even more ideas for extending mask life. He partnered with an oncology physicist to work with a model he learned about at another university.

"University of Nebraska researchers had done some things previously for Ebola as well as for COVID-19, and they posted their techniques on their website, so we adapted them," he says. Using ultraviolet light sources normally applied to the bacterium *Clostridium difficile*, the Carilion team converted resident classrooms into decontamination sites, creating yet another way to preserve their N95 stocks.



ones that were usable in the short-term were too uncomfortable to wear all day.”

A face shield is designed to protect facial orifices—eyes, nose, and mouth—and so offers an additional barrier when worn in conjunction with a surgical mask. But each practitioner has different responsibilities, to which the face shield offers different obstacles.

Understanding these varied challenges fell to Dr. Parker’s human factors team, the Carilion group that studies how workers function and looks for ways to support them. The team sent out a survey, and more than 1,700 frontline staff members responded. What’s more, close to 900 of those respondents took the time to write in additional information to help define what the problems were.

“We gleaned more than 20 design criteria from those comments,” says Matthew Jesso, human factors lead at Carilion. “And the new design is 100 percent from those comments.”

The team learned of a range of challenges. NICU nurses feeding babies with bottles found the shield hit their shoulder when they turned their head, for example, while doctors trying to put in central lines couldn’t see because of glare. Fogging of the shield was also a major issue.

So the team designed a glare-free, fog-free shield that was comfortable enough to wear for 8 to 12 hours without spurring headaches. With each iteration, the team worked with Virginia Tech to create a prototype, then tested it out in Carilion’s simulation laboratory, where they made adjustments. The most recent prototype is now being tested.

“While our initial intent is to get folks at Carilion the absolute best shield,” Dr. Parker says, “we’re also interested in sharing that information as widely as we can, because everyone needs this right now.”

To ensure broad accessibility, Troy Keyser, director of Carilion’s innovation program, will publish the face shield information in an open-source manner, making the advancement available to all—something the team finds gratifying.

“I have family members and friends who work in hospitals in other states,” Jesso says. “It’s nice to know my work may benefit them.”

## Intubation Hoods

While face shields and masks can protect personnel from the risk of aerosolized droplets during most procedures, endotracheal in-

tubation—in which doctors introduce a tube into the windpipe—is an aerosol-generating procedure, creating a particularly high risk of exposure to the coronavirus. The droplets can land on personal protective equipment, hospital equipment, the floor—anywhere in the vicinity, creating risk for anyone who uses or cleans the equipment.

Existing hood options were heavy, difficult to set up, and cumbersome. Members of the innovation team joined with Emergency Department experts to create an alternative. They focused on users’ needs, aiming for an option that was disposable, allowed for free hand movement, and offered access to two or three practitioners at a time. Designers went through multiple iterations, tweaking the parts each time in response to user feedback, making the gloves easier to accommodate fine motor skills, and increasing visibility.

The prototype was swiftly approved by clinical workers. For further needed protection, negative pressure has since been added and successfully tested. The innovation team is vetting manufacturers to make an industry-grade intubation hood to protect providers and patients alike.

## A Shared Goal

While medical and health care communities have long dreaded a global pandemic, actually experiencing one provides its own learning curve, offering lessons for the future.

“I resolved to never let my organization get caught in this kind of dilemma again,” Hill says, underlining the need for a more diversified, and local, supply chain. “With the staff we have and the work we’ve done—and the knowledge we’ve gained over these past months—we’re better equipped today than we’ve ever been to provide excellent patient care and protect our staff.”

That care and protection are the focus of Carilion employees as well as their Virginia Tech colleagues. Their partnership and the ingenuity born of an international crisis have been essential and much valued as they continue to confront the pandemic—and will likely be key to their eventual success.

“Carilion epitomizes the American spirit, the can-do spirit,” Dr. Baffoe-Bonnie says. “Our efforts represent just a microcosm of what goes on across the United States and world. We can beat this—together.” **CM**



### THE CHALLENGE Better Face Shields

**THE BEST DEFENSE:** Clockwise from top left: Rod LaFoy uses a 3D printer to create headbands for face shields at Virginia Tech. Dr. Damon Kuehl is vice chair of Carilion’s Department of Emergency Medicine. Liam Chapin, a member of Virginia Tech’s Field and Space Experimental Robotics (FASER) Laboratory, works on laser-cut face shields. Dr. Sarah Henrickson Parker heads Carilion’s Center for Simulation, Research and Patient Safety. The 3D-printed and laser-cut face shields required multiple rounds of design. Matthew Jesso serves as Carilion’s human factors lead. (Individual portraits were taken before the COVID-19 pandemic.)





# LOVE & GRIEF

## In the Time of Coronavirus

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AT THE SAME TIME SHE WAS STRUGGLING FOR HER OWN LIFE, MARCIA DUPREE NEEDED TO MOURN HER HUSBAND'S COVID-19 DEATH.

by *Anita Slomski*

Dupree. "He felt that COVID-19 was an automatic death sentence, especially after the medical ordeal he'd just been through. Nurses whisked him to an isolation ward so fast that all I could do was shout 'I love you' as the elevator doors closed."

Two days later, Dupree's husband of nearly 53 years was dead. In less than a week, Dupree would also test positive for COVID-19.

"My mom wasn't eating or drinking and she slept a lot, but she was also mourning the death of her husband," recalls DJ, Dupree's son, with whom she now lives near Smith Mountain Lake, Virginia. But when she became too weak to stand, DJ called an ambulance to take Dupree to Carilion Roanoke Memorial Hospital. In the Emergency Department, Dupree, whose oxygen saturation level was normal, received a COVID-19 test, was treated for dehydration and exhaustion, and was released.

**Marcia Dupree never imagined the two greatest crises of her life would occur simultaneously.**

For two months starting in late February 2020, her husband, David, was at a local hospital being treated for multiple complications arising from gastrointestinal bleeding from diverticulitis. Every other day, Dupree, 75, would drive an hour to the hospital to help fill an external infusion pump with treprostnil, better known as Remodulin, to increase blood flow through her husband's lungs, which were damaged from the pulmonary arterial hypertension he'd developed six years before. "Administering his medication was very complex," says Dupree of the multistep procedure.

But just when her husband was ready to be discharged, he tested positive for COVID-19. The nurses put Dupree in personal protective equipment before allowing her to see her husband and tell him the bad news.

"As soon as he heard, David said, 'This is it,'" recalls



**LIFE AFTER COVID-19:** Marcia Dupree suffered a tragic loss when her husband, David, died of complications from the coronavirus. She is still recovering from her own bout with the virus.



The next day Dupree learned she'd tested positive for COVID-19 and on May 4, five days later, she was admitted to a COVID-19 unit at Roanoke Memorial with a high fever, profound weakness, and difficulty breathing. Thus began Dupree's three-week hospitalization for COVID-19, including 14 days in the intensive care unit.

"I was totally numb; I thought, I can't lose her, too," recalls DJ when his mother was admitted to the hospital. DJ also worried that his own symptoms of exhaustion and feeling winded were harbingers of COVID-19, but his test results were negative. And with international flights severely restricted, Dupree's daughter, Diane, who lives in Ireland, had to remain thousands of miles away from her critically ill mother.

When infectious diseases specialist Ekta Bansal, M.D., saw Dupree on May 7, she privately worried that Dupree, who had severe respiratory failure and pneumonia in both lungs, might not survive.

"She looked so sick and she required a considerable amount of high-flow oxygen—up to 80 percent—in order to breathe," says Dr. Bansal. Dupree's age, coupled with her diabetes and hypertension, made her particularly vulnerable to severe illness.

"In early May, we didn't have any specific therapies for COVID-19," says Dr. Bansal. "We were still learning about the virus and could primarily offer only supportive care to treat symptoms."

A day later, Dupree was transferred to the ICU. "Patients on high-flow oxygen can deteriorate quickly and require mechanical ventilation," says Dr. Bansal. "Marcia was nearly at the threshold for intubation."

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Dr. Ekta Bansal,  
Infectious  
Diseases Specialist,  
Carilion Clinic

Dupree was too weak to talk with her son over FaceTime, but physicians called DJ daily with updates about his mother. "I was pretty oblivious to what was going on around me initially," says Dupree, "because I was so sick."

Dupree received a transfusion of convalescent plasma. At the time, Roanoke Memorial was participating in the National Expanded Access Program for Convalescent Plasma, which was sponsored by the U.S. Food and Drug Administration and led by Mayo Clinic. Across the country, more than 35,000 hospitalized patients critically ill with COVID-19 were given plasma rich with antibodies from people who had already recovered from the virus.

Convalescent plasma has been used to treat infectious diseases for more than a century; many hoped that a treatment of antibodies from recovered patients might prevent progression of COVID-19 in those struggling to fight the virus on their own.

In May, Dupree became Roanoke Memorial's first patient to receive the then investigational therapy for COVID-19. She felt results within 24 hours of receiving the infusion.

"My breathing became easier and I felt much better," she says. "On day two I felt better still. That's when I thought I would survive this."

DJ also heard the difference in his mother's voice. "She sounded stronger and had more pep during our conversation," he says. "I was happy her physicians were trying experimental treatments like convalescent plasma."

Dupree received one unit of convalescent plasma per the study's protocol. Although the Mayo study was not a randomized, placebo-controlled trial, Dr. Bansal thought it was worth a try based on early, preliminary data.

"She required less oxygen after the infusion and her inflammatory markers showed improvement," Dr. Bansal says. "While more recent trials have shown that convalescent plasma doesn't benefit all patients, and other treatments such as monoclonal antibodies have since become available, we were very pleased with the progress she made after the infusion and other treatments we used."

Dupree also received systemic corticosteroids for three days based on early observational studies that suggested improvement from short courses of steroids, as they temper the host immune response and decrease lung inflammation.

In addition, Dupree received therapeutic anticoagulation therapy, since she had elevated levels of D-dimer, a marker for blood clots, which are a risk for people with COVID-19. Elevated D-dimer levels have been found to correlate with severe disease and worse outcomes. Dupree also prac-



**PHOTOGRAPHIC MEMORY:** Marcia Dupree holds a portrait of her late husband, David, as she stands with her son, DJ, at their home in Smith Mountain Lake, Virginia.

ticed self-proning—a method of lying on one side alternating with lying face down—in an effort to improve her oxygenation.

It wasn't until Dupree left the ICU on May 19 and was back on a COVID-19 floor that she realized how sick she'd been.

"My vision was blurry," she says. "I couldn't write or feed myself well because my hand would shake, and I was so weak I couldn't stand or get out of bed."

But Dupree, a Michigan native, has retained her Midwestern grit and fortitude in the face of adversity. "There's no sense in being miserable," says Dupree, who spent 34 years as an elementary school art teacher in Michigan and Delaware, instructing as many as 1,100 students each week. "There are so many things in life to be happy about, or at least you can be content."

Despite grieving her husband's death and coping with the challenging effects of COVID-19, Dupree found comfort in a cardinal that repeatedly flew to her hospital window.

"I've long heard stories that cardinals are messengers sent from above to remind you of a loved one who has died," she says. "I've no idea if that's true, but looking for that cardinal every day gave me strength, and I felt my husband's presence when I saw it."

Her doctor won't soon forget Dupree's positive spirit and determination.

"From day one, she was a warrior and never gave up," Dr. Bansal says. "She knew her situation was critical, but she said she would deal with whatever

came her way. She had faith that she would make it, and she did."

After leaving the hospital in late May, Dupree has been recovering at her apartment within DJ's Virginia home. The fatigue she felt when she first returned home is easing, and her strength is slowly returning, though she finds her short-term memory is still impaired.

"I forget the simplest things, and I can't add numbers in my head the way I used to," she says. "My son has to remind me to do things."

Over the summer, mother and son drove from Virginia to Michigan and back multiple times, hauling a trailer filled with three generations of antiques and family heirlooms as Dupree prepared to put her Michigan home of 16 years on the market.

"It's in an isolated wooded area, and I wouldn't be able to enjoy the house without David in it," says Dupree. In time, she says, she will return to painting, sculpting, and designing clothes for herself. Dupree and DJ also plan to adopt two rescue greyhounds.

When Dupree reflects on her ordeal with COVID-19, it's not without humor. She laughs when she relates how a physical therapist and an occupational therapist—both men—improvised a hair band from a surgical glove and worked together to tame her unruly hair before helping her walk.

"Everyone I met at the hospital was not only caring, but also kind," says Dupree. "My doctors were so knowledgeable and I felt like I was treated as a family member."



**GLIMMERS OF HOPE:** Dr. Ekta Bansal suspects convalescent plasma may have helped save Marcia Dupree's life.





# RISING STARS

THE HEROES OF THE PANDEMIC—FROM CARILION CLINIC’S FRONTLINE PROVIDERS TO GIVING COMMUNITY MEMBERS—DESERVE CELEBRATION.

*by Tiffany Holland*



WHEN THE COVID-19 PANDEMIC HIT THE ROANOKE region in March, many businesses paused, and thousands of employees began working from home.

As most people stepped back, health care workers stepped forward.

Carilion Clinic’s frontline staff worked to keep patients safe and to deliver compassionate care even under the most difficult circumstances—and it didn’t go unnoticed by the public.

More than ever before, the people of southwestern Virginia showed their appreciation for Carilion’s health care workers, in gestures large and small.


Roanoke-area churches rang their bells at shift change, and children chalked messages of encouragement on hospital and clinic sidewalks. Individuals and community organizations gave personal protective equipment, sent thank-you cards by the bundle, and donated more than \$120,000 to

the Carilion Clinic Foundation’s COVID-19 Support Fund. Roanoke landmarks—including the iconic Roanoke Star—were illuminated in blue to show support for health care workers and first responders.

**STAR SPANGLED:** Police officers and firefighters flew a giant flag outside Carilion Roanoke Memorial Hospital to show support of health care workers.

And on one day in April, regional police officers and firefighters gathered outside of Carilion Roanoke Memorial Hospital to cheer for staff during shift change. They also draped a giant American flag

from the top of a fire engine ladder and aired sirens to signal the community’s support of hospital staff.

These efforts both enhanced the bond the community shared with its leading health system and provided encouragement to Carilion’s health care workers at a challenging time. 



**A COMMUNITY UNITED**

Top row, from left: Community members made hundreds of donations in support of clinicians; families posted messages of thanks on social media; Roanoke landmarks were bathed in blue light in recognition of frontline workers; restaurants delivered meals for staff. Middle row, from left: Donations arrived from across the region and beyond; community members chalked messages of encouragement on hospital and clinic sidewalks; Spiderman joined other superheroes in entertaining hospital staff and patients from window-washing perches; Carilion staff received extra sanitation supplies; Nancy Howell Agee, Carilion's president and chief executive officer, delivered the region's first public address on COVID-19.



**SUPPORT NETWORK**  
Bottom row, from left: Carilion instituted new precautions, including temperature screenings, amid the pandemic; Dr. Anthony Baffoe-Bonnie, Carilion's medical director for infection prevention and control, led meetings of the Department of Infectious Diseases; community donations arrived by the truckload; community members gathered outside Carilion facilities to wave signs of support and cheer on health care workers.



THE BRACHIAL PLEXUS CLINIC AT CARILION IS BRINGING A MULTIDISCIPLINARY APPROACH AND WORLD-CLASS CARE TO PATIENTS AT RISK OF LOSING ARM MOBILITY TO NERVE DAMAGE.

By Veronica Meade-Kelly

# HELPING HANDS

A WRENCHING, HIGH-SPEED TUMBLE OFF A motorcycle; an unexpected fall; a car crash; the wedging of a shoulder in the birth canal—accidents like these can happen at random, yet can take a terrible, lifelong toll.

Not infrequently, such traumas cause injuries to the network of nerves in the neck that send signals down the arm—a complex known as the brachial plexus. The damage disrupts critical communication between the spinal cord and the affected limb, potentially causing pain, impairment, decreased sensation, or even the loss of use of a shoulder, arm, elbow, or hand.

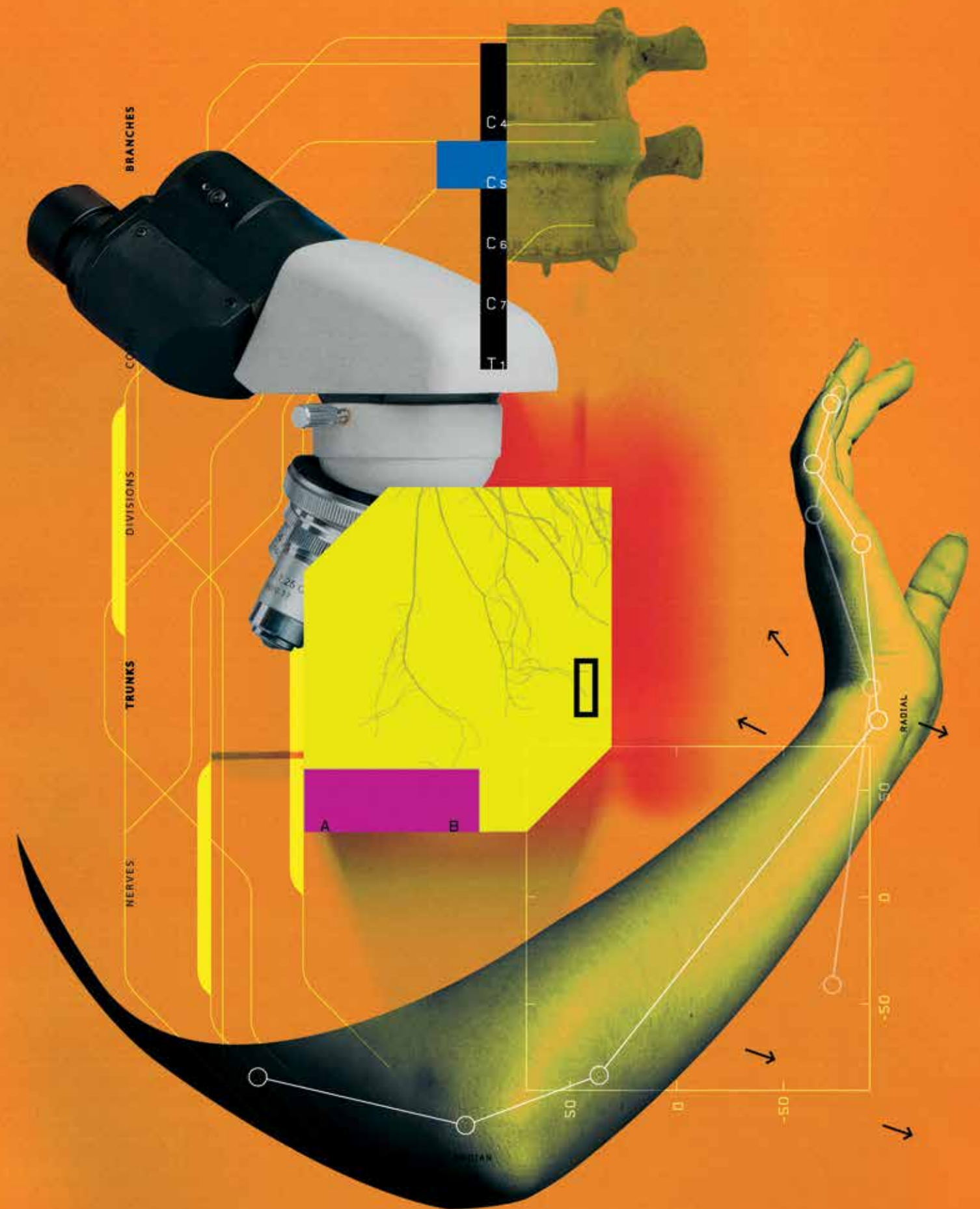
When these injuries happen, time is of the essence. Nerves have a limited ability to regenerate, and muscles will stop working over time if they don't receive signals sparking them to action. That means there's a ticking clock on

efforts to fix the problem—as little as three to six months before the effects of the injury become irrevocable.

While prompt treatment is crucial, the complicated, specialized care that offers the best outcomes for brachial plexus injuries isn't available everywhere. Too often, patients have to go to large and distant cities for state-of-the-art care—a practice untenable for many without the time, money, or transportation to travel.

Fortunately, these obstacles are no longer a problem for patients in southwestern Virginia. In 2017, several factors aligned, including the fortuitous recruitment of the right personnel and the vision of Carilion Clinic leaders, resulting in the foundation of the Brachial Plexus Clinic at Carilion's Institute for Orthopaedics and Neurosciences.

"Our region sees a number of these traumatic injuries," says Peter Apel, M.D.,





Ph.D., an orthopaedic surgeon at the clinic and an assistant professor of orthopaedic surgery at the Virginia Tech Carilion School of Medicine. “We established the Brachial Plexus Clinic to be a home for these patients, where they could get appropriate, timely, and, quite frankly, life-changing care.”

TACKLING A “WHOLE-LIFE PROBLEM”

The brachial plexus is crucial for both sensory and motor function of the arm. Damage to the network, inflicted when the nerves are overstretched, compressed, or torn, can have a range of consequences.

People who sustain such injuries can have trouble lifting a shoulder or bending an elbow, or even using the hand on their injured side. They might not be able to pick things up or bring a fork to their mouth. Putting on a shirt, reaching for a door handle, or scratching an itch can be a challenge.

Patients with brachial plexus injuries might even have what’s known as a flail arm—one that’s weak, senseless, essentially “dead weight.” The effects can severely limit an individual’s ability to work and necessitate support from family or friends. “A brachial plexus injury isn’t just a nerve problem,” Dr. Apel says. “It’s a whole-life problem.”

How patients are affected can depend on the severity and location of the injury itself—which and how many of the brachial plexus nerves are damaged, and where in the neck the injury occurs.

“Every patient is different,” says Cesar Bravo, M.D., an orthopaedic surgeon at the Brachial Plexus Clinic and a faculty member of the Virginia Tech Carilion School of Medicine. “Some injuries are more complex and some might present in a delayed fashion. Those differences change what we are able to do for treatment.”

Making the diagnosis—and developing and executing the right treatment plan—requires the input of specialists in many disciplines. Electromyography and nerve-conduction studies are needed to figure out which nerves and muscles are working or impaired. Physical and occupational therapy sessions are key to improving movement and mobility, as

well as tracking progress in recovery of day-to-day function. In some cases, surgery is required to repair, reconstruct, or transfer nerves or tendons. Amid all this, patients need help with daily life issues such as addressing work situations, acquiring specialized equipment, and coordinating rides.

The entire process requires a dedicated crew and a multidisciplinary approach—a mindset that has been baked into the Brachial Plexus Clinic from the start. Modeled after some of the large centers in which Drs. Apel and Bravo conducted their medical training, treatment at the clinic relies on multispecialty involvement at every step. Patients make a single appointment to see their surgeons and therapists, the nerve specialists who conduct diagnostic tests, a social worker, and the nurse who coordinates their care.

“It’s literally a team approach,” says Dr. Apel. “It’s not like a typical doctor’s visit. The entire medical team meets with the patient and family in a big room. Ideas are discussed. We encourage everyone, whether it’s the therapist, nurse, patient, or family members, to speak up. We talk through the injury, the situation, the plan—everything—because they affect everybody.”

The clinic runs monthly, and visits usually take an hour. “These aren’t rushed doctor’s appointments,” says Dr. Apel. “We’re dealing with life-changing injuries for these patients, and we take all the time needed to understand how patients are being affected and where they are in their recovery.”

The clinic’s dedicated physical and occupational therapists, who have expertise helping patients recover from brachial plexus injuries, are a critical part of the team. Patients work with these therapists exclusively throughout their time with the clinic.

“At each visit, we see how the patient is progressing,” Dr. Bravo says. “We assess how they’re working back into their professional and social life. Together we’re able to see where the patient has recovered—and what functions they’re not going to recover. That’s how we develop the treatment plan.”

If needed, that plan can involve surgery. But even in the operating room, brachial plexus injuries demand an espe-

A brachial plexus injury isn’t just a nerve problem,” Dr. Apel says. “It’s a whole-life problem.”

cially team-minded approach. The operations for these injuries are delicate procedures that take several hours. Two surgeons with the highly specialized training are needed.

Dr. Bravo and Dr. Apel set aside one day a month to make sure they’re available to perform these time-sensitive procedures together.

OPERATING SHOULDER TO SHOULDER

Several hours into such complicated surgeries, fatigue is bound to set in for the surgeons. The procedure can get frustrating. Maneuvering a tiny nerve fiber through a larger web of nerves, under a microscope, can be exhausting. Doing it when you know that the surgery is potentially life-changing—that the use of the patient’s arm hangs in the balance—adds to the stress.

It’s times like these that a surgeon truly appreciates the team approach. It helps to have a second surgeon there—a co-pilot on the journey—not just to help work through technical challenges, but also to provide emotional support.

“He knows my right hand and I know his left hand,” Dr. Bravo says. “Over the years we’ve gotten to know what the other is thinking. These are fairly extensive surgeries, so you need a partner you can trust, who has the right capabilities, so together you can provide patients with the best care.”

It’s also reassuring to know that the clinic’s team of experts have helped identify the exact problem, the nerve or nerves involved, and the proper procedure to ensure the best possible outcome.

Surgical options include nerve repair, reconstruction, and transfer. Repair entails a reconnection of fibers. Reconstruction involves removing injured or scarred tissue in the damaged nerve and replacing it with a graft. And, when a damaged nerve can’t be repaired, nerve transfer allows it to be replaced with a live functioning one nearby.

“In a nerve transfer, we’re basically taking a functioning nerve, rerouting it, and hooking it up to a nerve that’s not functioning. That provides that muscle, and by extension that extremity, with the connection it needs to work,” Dr. Bravo says. “It’s like taking from Peter to pay Paul. We’re redirecting the nerve and rewiring that person’s anatomy.”

The surgeons say finding that donor nerve—one that works yet isn’t essential to existing function—is particularly challenging. Then comes the chore of extracting it from surrounding tissue, an exercise akin to pulling a single thread from a rich fabric without damaging it. Then, finally, comes sitting down at the microscope and sewing the reworked or rewired nerve fibers together with sutures smaller than a human hair.



**MIND MELD:** “Over the years we’ve gotten to know what the other is thinking,” says Dr. Cesar Bravo, left, about Dr. Peter Apel, right.

The operations can run eight hours, but the grind is worth it for the patients and families—and their doctors.

“We may not always get full return of function, but every bit can mean a great deal,” says Dr. Bravo. “It’s amazing to see how life-altering this type of procedure can be.”

THINKING LOCAL

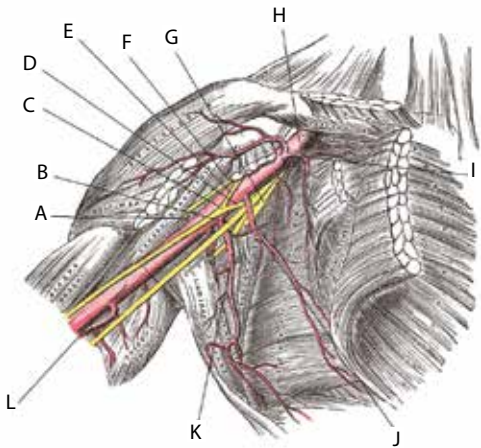
“What sometimes happens to patients in areas where this type of specialized care isn’t available is they get lost in the shuffle,” Dr. Apel says. “They’re seen somewhere where the condition goes unrecognized. They’re sent for tests or follow-up appointments they don’t need. Time slips by and they lose their opportunity for recovery. We created the clinic to have a means for capturing these patients and getting them prompt care so we can maximize their outcomes.”

To that end, the team has educated others in the Carilion system about brachial plexus injuries—to identify them early and refer them to the clinic. A gradual increase in patients year over year suggests their education efforts are working.

“With the help of clinicians throughout Carilion, we’re able to catch patients who weren’t being treated in a timely fashion,” says Dr. Bravo, who credits his early training at Mayo Clinic with helping to inspire the formation and multidisciplinary approach of the Brachial Plexus Clinic.

“My exposure to these techniques early in my training opened my eyes to the need for this type of medical access for patients with these types of injuries,” he says, noting that such specialization has too often been limited only to major health care hubs.

Dr. Apel agrees. “Our team is really proud,” he says, “that we’re providing what is, by all measures, world-class care for our patients here in little old Roanoke.”

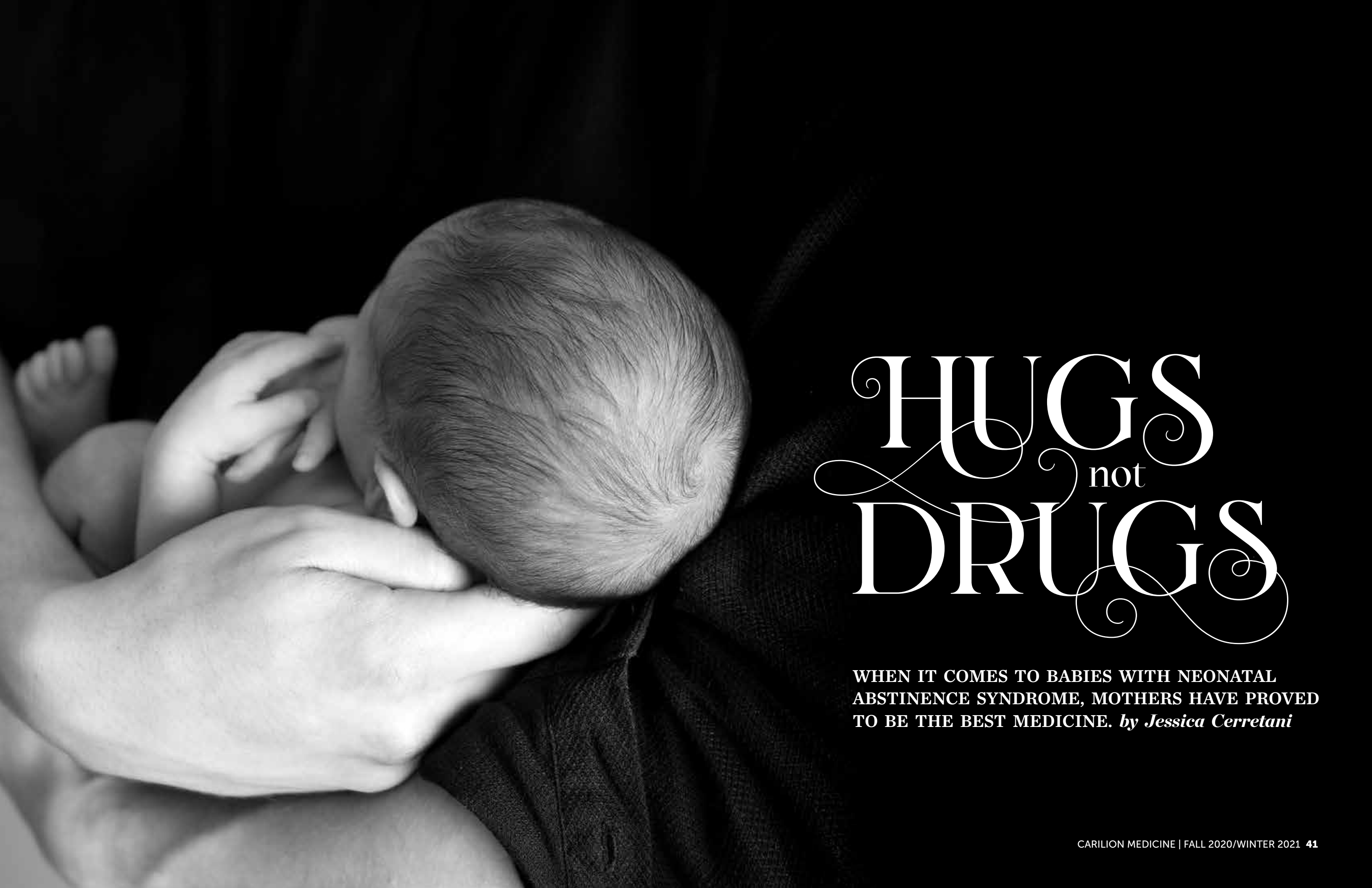


Anatomy of the Brachial Plexus

Injuries to the network of nerves in the neck that send signals down the arm—a complex known as the brachial plexus—can disrupt critical communication between the spinal cord and the affected limb.

- |  |                                  |
|--|----------------------------------|
| <b>A</b> Axillary artery                           | <b>G</b> Posterior cord          |
| <b>B</b> Ulnar nerve                               | <b>H</b> Axillary artery         |
| <b>C</b> Median nerve                              | <b>I</b> Thoracoacromial artery  |
| <b>D</b> Medial cord contribution to median nerve  | <b>J</b> Lateral thoracic artery |
| <b>E</b> Lateral cord contribution to median nerve | <b>K</b> Subscapular artery      |
| <b>F</b> Musculocutaneous nerve                    | <b>L</b> Brachial artery         |





# HUGS not DRUGS

WHEN IT COMES TO BABIES WITH NEONATAL  
ABSTINENCE SYNDROME, MOTHERS HAVE PROVED  
TO BE THE BEST MEDICINE. *by Jessica Cerretani*



THE PATIENT IS IN THE THROES OF WITHDRAWAL—uncomfortable, restless, and irritable. In this case, she’s having symptoms associated with the clearance of opioids from her system after months of exposure. But the patient isn’t an adult. Instead, she’s an infant experiencing neonatal abstinence syndrome, a group of conditions that occur once a fetus is exposed to drugs while in its mother’s womb.

Babies with neonatal abstinence syndrome, or NAS, are not born addicted to such substances, but are instead physically dependent on them. After delivery, exposure abruptly ends and within a few days, withdrawal symptoms—temporary and treatable, yet troubling—begin appearing.

Although NAS also can occur in response to benzodiazepines, nicotine, and other substances, it’s most common in infants exposed to opioids. These include not only drugs like heroin and oxycodone, but also maintenance medications such as buprenorphine and methadone.

These maintenance drugs are typically prescribed as part of medication-assisted therapy used to help people with opioid use disorder—including pregnant women—safely sustain recovery, explains Kimberly Simcox, D.O., a physician in Carilion Clinic’s Department of Obstetrics and Gynecology who is also board certified in addiction medicine.

It’s a necessary approach, despite the risk of NAS. “It’s important to know that addiction treatments are lifesaving for the mother—and babies need their mothers to be as healthy as possible,” says Dr. Simcox. “The goal is not just to keep women in recovery for nine months of pregnancy, but for life.”

## A Paradigm Shift

There’s little doubt that NAS is a mounting concern. According to the most recent data, the rate of NAS in Virginia has risen over time, with more than seven cases for every 1,000 live births in 2017. Indeed, the number of infants born with NAS increased by 11 percent just from 2016 to 2017, the most recent year for which statistics are available.

As the problem has grown, so, too, has the need for effective care. Much like treatment for opioid use disorder, the approach to NAS has evolved. Not long ago, Carilion clinicians followed a treatment program in line with those of many other hospitals—one based on the assumption that, like

many adults, infants require medications such as methadone or morphine to prevent symptoms of opioid withdrawal.

Relying on the traditional Finnegan Neonatal Abstinence Scoring System (FNASS) assessment, clinicians scored babies on a 21-item scale. This commonly used approach grades infants on the severity of symptoms such as tremors, excessive crying, and diarrhea, and is typically administered every two to six hours.

“We used to take babies from their mothers to score their amount of withdrawal, which often made them more agitated,” says Dr. Simcox. Treatment also involved up to 90 days of therapy with morphine or methadone, monitored in an outpatient clinic. Babies with more severe symptoms often ended up being cared for at Carilion’s Neonatal Intensive Care Unit.

Like many clinicians, Hiren Patel, M.D., the NICU’s medical director, says he was working from the long-held belief that medication was necessary for these infants. “I came out of my training with one image of how babies with NAS are,” he says, “and we perpetuated that through treatment.”

The tide began to turn in 2017, as the opioid crisis worsened and Carilion found itself facing a surge in infants with NAS—and in the NICU. “We had about 100 babies getting treatment in our NICU and we were maxing out,” remembers Carilion neonatologist Lisa Andruscavage, D.O. “It became a crisis.”

Around the same time, physicians at Yale New Haven Children’s Hospital released a pioneering study, published in the January 2018 issue of *Hospital Pediatrics*, that compared the FNASS to a novel assessment approach they termed “Eat, Sleep, Console.” Unlike the FNASS, this new approach takes into account just three main factors when assessing babies with NAS: whether infants can feed normally, sleep well, and be consoled within 10 minutes of crying. Using this system, Yale researchers found that just six infants with NAS were treated with morphine, compared to 31 NAS babies assessed with the FNASS.

“When the Yale findings came out, we jumped on them,” says Dr. Andruscavage. “It was such a big change from the way we had been caring for these babies.”

## Learning the “3Cs”

By September 2018, Carilion had unveiled its Help Us Grow Strong (HUGS) Nursery, housed in Carilion’s Mother/Baby Unit. “We like to say ‘HUGS, not drugs,’” says Dr. Andruscavage.

The transitional HUGS Nursery provides infants with NAS a safe, controlled, and soothing setting in which to ride out the temporary symptoms of withdrawal and follows what Dr. Andruscavage and her then-colleague Jacinda Hayes, D.O., termed the “3 Cs”—coordination with feeding, comfort, and calm—Carilion’s take on Eat, Sleep, Console. Staffed by nurses experienced in NAS care, the nursery offers a low-stimulation environment. That means dim lighting and hushed sounds—but also involves dedication and commitment from parents.

In fact, treatment for NAS often begins well before birth, when pregnant women with substance use disorders receive

office-based outpatient treatment through Carilion Women’s Emerald Program. There, Dr. Simcox and her colleagues offer medication, on-site behavioral health services, and care coordination, with the aim of helping women continue their recovery and prepare for motherhood.

A large part of this work involves educating parents and removing the stigma associated with opioid use disorder, says Dr. Simcox, who counsels women about what to expect after delivery—and how they can help ease symptoms in their infants.

“We spend a great deal of time talking to our mothers about NAS and what they can do to help their babies,” she explains. “We discuss in detail what to expect in the delivery room, what NAS symptoms are, how to comfort babies in withdrawal, and how we use the 3Cs. The more education we can provide these women ahead of time, the easier the transition is after delivery.”

Indeed, one of the most effective ways to treat most cases of NAS has turned out not to be pharmacological treatment, but partnership with new parents. Both in the HUGS Nursery and at home, mothers are taught and encouraged to practice comforting measures such as swaddling their babies, offering skin-to-skin contact, gently holding and rocking them, and singing lullabies.

Breastfeeding can also help: “Not only is it safe for moms on maintenance medications like buprenorphine to nurse their babies,” explains Dr. Andruscavage, “but it also appears to ease NAS.” Because small amounts of such medications are released into breast milk, they can provide babies with enough to take the edge off symptoms. “As breastfed babies grow, they experience a slower withdrawal, over the course of months, which seems to really help,” says Dr. Andruscavage.

Along with lactation consultants, Carilion connects mothers and babies with physical, occupational, and speech therapists to

address the high muscle tone and suck-swallow-breathe discoordination that can occur temporarily in NAS infants.

Babies with severe NAS who can’t meet the 3C criteria are monitored after receiving a single small dose of morphine to quell symptoms. In most cases, just one dose is needed—“a far cry from 90 days of treatment,” says Dr. Andruscavage.

## A Ripple Effect


The success of the HUGS Nursery has had a ripple effect throughout the Carilion community. Today, most babies born with NAS spend a week or less in the hospital before going home. Only about 3 percent of infants with NAS are now transferred to the NICU, typically those whose mothers are using heroin or other street drugs or who are taking multiple drugs at a time.

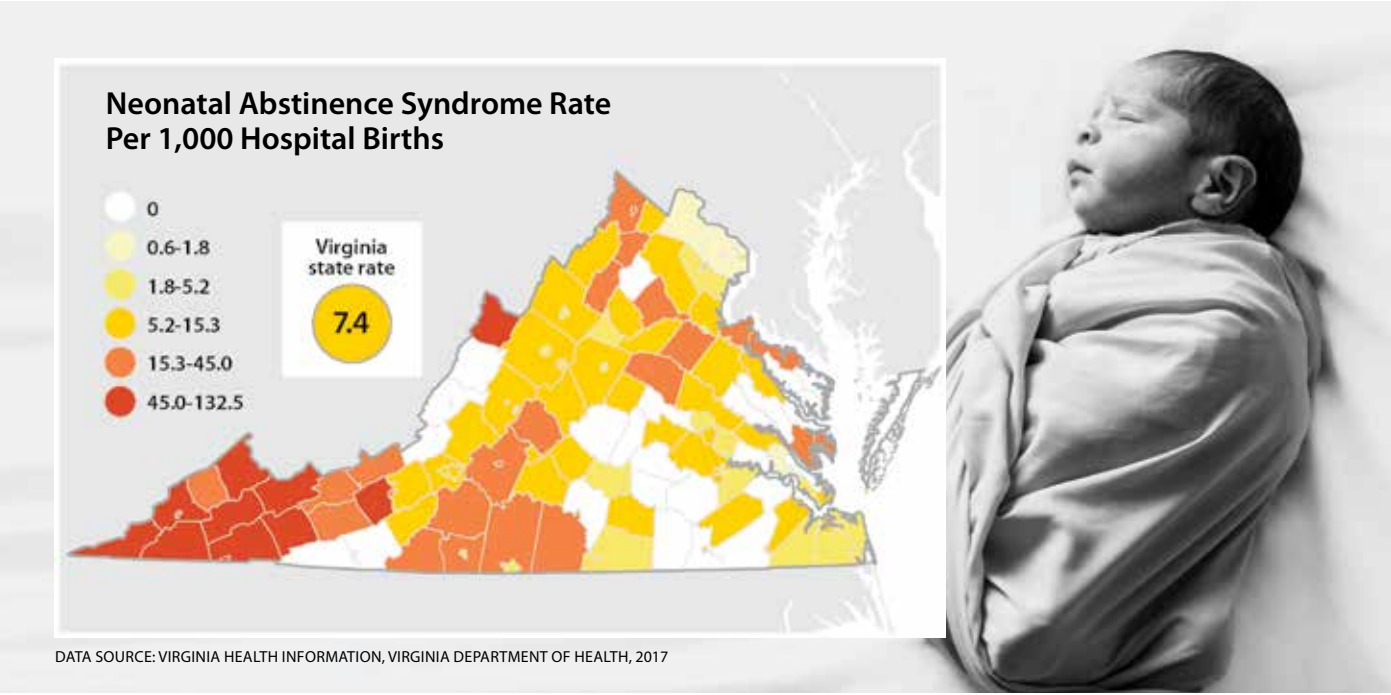
Not only does going home allow parents the opportunity to bond with their babies in a calmer environment, but it also frees up space in the NICU for other infants who need it.

“I’m so grateful for the HUGS Nursery,” says Dr. Patel. “We’ve seen far fewer NAS babies admitted to the NICU.”

Yet the greatest benefit of this new approach has been its effect on families. “These mothers want to overcome their situation,” says Dr. Andruscavage. “They want to feel good, live their lives, and stay in recovery. We want to help them achieve that.”

In fact, the Emerald Program and HUGS Nursery are powerful proof that investing in parents can have a positive, life-changing impact on children. By firmly establishing mothers—and fathers—as partners in their child’s care, Carilion is giving them the tools they need to raise healthy, happy babies.

“These programs are empowering moms to console their babies,” says Dr. Simcox. “We’re showing that when it comes to treating NAS, mothers really are the best medicine.” 





# THE HEALING CEILING

Carilion Clinic’s new ceiling tiles were painted by children to brighten the spirits of kids in the hospital. **BY TIFFANY HOLLAND**

SOMETIMES CONNECTING WITH PATIENTS CAN HAPPEN without treatment—or even words. That’s the aim of the “Healing Ceiling” project, sponsored by Carilion Clinic and its Dr. Robert L.A. Keeley Healing Arts Program in partnership with the Taubman Museum of Art in Roanoke.

Local children hand-painted more than a hundred tiles that will be installed in ceilings throughout Carilion Children’s Hospital to help ease the anxiety of the youngest and most vulnerable patients.

“Studies have shown how important it is for patients to feel connected and supported during the healing process,” says Katie Biddle, Ph.D., consultant to the Healing Arts Program. “This art will play a role in many patients’ care.”

The project began after Martin Misicko, vice president of facilities, had seen similar creative tiles at other children’s hospitals in the country. He realized art would offer a way to involve local students—including his own daughter—in the care of others. It would also offer creative ways to brighten up the sterile hospital environment and add comfort to care delivery. Misicko worked with regional school superintendents to launch the project.

Fourth and fifth graders from Roanoke-area elementary schools and youth groups painted the tiles, with Taubman Museum of Art experts providing artistic guidance, inspiration, and resources.

“We’re honored to partner with Carilion on an initiative that will have such a positive impact for so many in our community,” says Cindy Petersen, executive director of the Taubman. “Besides cheering Carilion Children’s Hospital patients, this project engendered kindness and empathy in the young artists who created the ceiling tiles. Their creativity is truly inspirational.”

The museum plans to partner with Carilion again in 2021 to produce an additional 100 tiles. Misicko hopes the project can become annual and even spread beyond the children’s hospital, uplifting the spirits of many more patients. **CM**

TILES TRANSFORMED INTO ART

**A** Mikayla, fifth grade, “The Courageous Lion.” **B** Danazie, fifth grade, “The Beautiful Sunset.” **C** Deahzae and Donovan W., fourth grade, “Grey Queen Puppy/Wolf Pup.” **D** Eva, fifth grade, “Mountains with Stream.” **E** Landon and Kayden, fourth grade, “Teal Dolphin/Pink Sky.” **F** Ana, Maria, and Mayce, fourth grade, “Swinging Cat.” **G** The Teen Youth Group of Temple Emanuel, “Cacti.” **H** Phoenix and Donavon A., fourth grade, “Yellow Puppy.” **I** Aliza and Mayce, fourth grade, “Purple Castle.”







Emergency Medicine

**SARAH KLEMENCIC, M.D.**, Emergency Medicine, was named volunteer director for the Carilion Clinic IRONMAN 70.3 Virginia’s Blue Ridge.

**STEPHANIE LAREAU, M.D.**, Wilderness Medicine Fellowship director, received the Education Award from the Wilderness Medicine Society at its summer meeting. She was recognized for her work creating elective opportunities in wilderness medicine for both medical students and residents, and providing wilderness medicine education for community members.

Family Medicine

**MEGAN LAWSON, P.A.**, Urgent Care Medicine, and **CHRISTINA GARDNER, D.HSC., P.A.**, director of the ACP Fellowship in

Urgent Care and Rural Health, published a case study in *The Journal of Urgent Care Medicine* titled “Urgent Identification and Management of Postsplenectomy Sepsis.”

Internal Medicine

**ALI HAMA AMIN, M.D.**, Cardiology, published a research paper, “The Feasibility and Safety of Same Day Discharge for All Comers after Elective Percutaneous Coronary Interventions,” in the journal *Cardiovascular Revascularization Medicine*.



**GREGORY DEHMER, M.D.**, medical director of quality and outcomes for Carilion’s Cardiovascular Institute, recently coauthored several articles: “2020 AHA/ACC key data elements and definitions

for coronary revascularization: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Data Standards,” which was simultaneously published in the *Journal of the American College of Cardiology and Circulation: Cardiovascular Quality and Outcomes*; “Closing gaps in essential chest pain care,” which appeared in the *Journal of the American College of Cardiology*; and “Role of randomness in observed outcomes and implications for quality assessment,” which was published in the *Proceedings of Baylor University Medical Center*.

**JEFFREY TODD, M.D.**, Cardiology, and **JAMES DROUGAS, M.D.**, a vascular surgeon with Jefferson Surgical Clinic, published “Whom Should You Screen for Abdominal Aortic Aneurysm?” in the May edition of *The Journal of Family Practice*.

Obstetrics and Gynecology



**SHANNON ARMBRUSTER, M.D.**, Gynecologic Oncology, organized the Survivors Exercise Together campaign through the Foundation for Women’s Cancer and the Society of Gynecologic Oncology to encourage cancer survivors to become active for better physical and mental health during COVID-19.

**FIDEL VALEA, M.D.**, chair of Obstetrics and Gynecology, coauthored “Hysterectomy Route and Numbers Reported by Graduating Residents in Obstetrics and Gynecology Training Programs” in the February edition of *Obstetrics and Gynecology*.

**PATRICE M. WEISS, M.D.**, chief medical officer and executive vice president, was appointed chair of the American Hospital Association’s Committee on Clinical Leadership for 2020. The committee provides clinical input to the association’s advocacy and policy process, serving as a clinical resource on policy issues and guiding the ongoing work of the association’s Physician Alliance.

Orthopaedics

**CARILION** was among *Becker’s Hospital Review’s* list of 100 hospitals and health systems with great orthopaedic programs for 2019. The ranking is reserved for programs that have earned recognition for quality of care and patient satisfaction for orthopaedic and spine surgery.

Pediatrics

**ANDRE MUELENAER, M.D.**, a professor of pediatrics at the Virginia Tech Carilion School of Medicine and a professor of practice in Virginia Tech’s Department of Biomedical Engineering and Mechanics, recently received a \$50,000 grant from the COVID Rapid Response Fund.

**MELANIE PRUSAKOWSKI, M.D.**, has been promoted from assistant to associate dean for admissions at the Virginia Tech Carilion School of Medicine. A pediatric emergency medicine physician at Carilion since 2008, she has led the school’s admissions team since 2016.

Psychiatry

**WILLIAM REA, M.D.**, vice chair of Psychiatry, has been selected to serve on the Lifelong Learning and Self-Assessment Committee of the American College of Academic Addiction Medicine.



**ROBERT TRESTMAN, M.D., PH.D.**, chair of Psychiatry and Behavioral Medicine, and **ANITA KABLINGER, M.D.**, clinical trials research director for Psychiatry and Behavioral Medicine, coauthored a chapter, “Psychopharmacology and Neuromodulation,” for *The American Psychiatric Publishing Textbook of Suicide Risk Assessment and Management*, Third Edition.

Dr. Trestman was selected to receive the 2020 NAMI (National Alliance on Mental

Illness) Exemplary Psychiatrist Award. The award honors exceptional contributions by psychiatrists to improve the lives of people with mental health conditions. He was also named chair-elect for the American Hospital Association’s Behavioral Health Council for 2020 and was appointed to serve as a chairperson of the Council on Healthcare Systems and Financing of the American Psychiatric Association.

**ERIC TRINH, M.D.**, fourth-year resident in Child and Adolescent Psychiatry, joined with **ANDREW LEE, M.D.**, second-year resident in Psychiatry, and **KYE**

**KIM, M.D.**, Geriatric Psychiatry, in publishing “End-of-Life Care of Persons With Alzheimer Disease: An Update for Clinicians” in the *American Journal of Hospice and Palliative Medicine*.

Radiology

**MARIA HIRSCH, C.R.N.A.**, Anesthesiology, was the lead author of “It’s Never Just a Block: An Analysis of Regional Anesthesia Closed Claims,” a study published in the *AANA Journal*. She also presented a one-hour lecture on the research at the American Asso-

ciation of Nurse Anesthetists’ Annual Congress in 2019.

Residency and Fellowship Programs

**LINDSEY BIERLE, D.O.**, second-year resident in Internal Medicine, was one of just 31 recipients nationally of a SCOPY award from the American College of Gastroenterology. The SCOPY—the Service Award for Colorectal Cancer Outreach, Prevention, and Year-Round Excellence—recognizes the most innovative and impactful awareness efforts.

New Chair of Radiology



**DANIEL KAROLYI, M.D., PH.D.**, has been named chair of the Department of Radiology for Carilion Clinic. Dr. Karolyi joined Carilion in 2010 and has served as department co-chair for both the health system and the Virginia Tech Carilion School of Medicine since March 2019. He has also served as vice chair of the Department of Radiology as well as director of the medical school’s radiology clerkship since 2012. His other leadership positions within Carilion include medical director of MRI, quality officer for the Department of Radiology, and co-chair of the Medical Professional Acquisition Advisory Committee.

A national expert in MRI, Dr. Karolyi has been a faculty member for the American College of Radiology (ACR) Education Center for the past decade, teaching attending radiologists from around the world about best practices and innovations in body MRI.

Dr. Karolyi’s other appointments include chairman of the ACR Measurement and Assessment Committee, chairman of the

ACR Education Center Advisory Committee, member of the ACR Commission on Publications and Lifelong Learning, member of the ACR Appropriateness Criteria Committee, and member of the ACR Practice Parameter Committee for MR Enterography. He received Level IV (Leadership Mastery) honors from the ACR’s Radiology Leadership Institute and has been named to the Academy of Radiology Leadership and Management Honor Roll.

As chair of Radiology, Dr. Karolyi will be responsible for growing and developing the clinical services and medical education for general and specialty radiological and imaging services throughout Carilion and the Virginia Tech Carilion School of Medicine.

Dr. Karolyi received a bachelor’s degree in chemistry, a master’s degree in mechanical engineering, and a doctorate in bioengineering, all from the Georgia Institute of Technology. He received his medical degree from the Medical College of Georgia. He completed his postgraduate training—including an internship with the Department of Medicine, a residency in diagnostic radiology, and a fellowship in body MRI—at Emory University.



## THE THIRD PILLAR OF LEARNING

Health systems science gives medical students the holistic framework they need to make a positive impact on medicine. **BY LEE A. LEARMAN, M.D., PH.D.**

**O**NE OF THE FIRST THINGS THAT ATTRACTED me to the Virginia Tech Carilion School of Medicine was its mission to train future physician thought leaders. This purpose is rare among medical schools, and its importance is now more apparent than ever.

Months before COVID-19 transformed our world, we had decided to innovate the school's already cutting-edge curriculum, to better prepare our graduates to solve health care's most complex problems.

The pandemic has highlighted the importance of understanding the complexity of health systems. Addressing COVID-19 successfully requires the expertise of many professions and sciences, from doctors, nurses, and other health care providers to biomedical researchers, public health specialists, epidemiologists, emergency management professionals, and policy makers, just to name a few. Ultimately, our success will require a coordinated response by multiple systems at the local, regional, national, and global levels. Optimizing how these systems function and interact requires an understanding of health systems science.

Health systems science is the study of how health care is delivered, with the goal of improving the quality of health care for patients and populations. It is often called the third pillar of medical education, standing with basic science and clinical science. It includes a dozen interrelated topics, including population health, quality and safety, health systems analysis, health care finance, value-based care, informatics, interprofessional teams, and health disparities. Systems thinking connects these topics as a mental model for addressing health care improvement.


When I joined the Virginia Tech Carilion School of Medicine as dean in July 2019, my colleagues and I started exploring an opportunity for curricular innova-

tion. Our school had already developed a national reputation for our curriculum in interprofessionalism, which predated the newer concept of health systems science. A year ago, we expanded and renamed the domain "health systems science and interprofessional practice."

Our implementation of this curricular focus is motivated by our vision of excellence in medical education: what we teach, how we teach it, and the experience of learning how to become a physician. The additional focus on health systems science will help our students emerge with a better understanding of the challenges of health systems in practice and the skills they need to make a positive impact on the health of patients and populations.

We are incredibly fortunate to have Carilion as our health system partner. Its focus on value-based care, population health, and community service creates unparalleled opportunities for our students to experience health systems science in action. Curricular change is typically challenging, but the enthusiasm of Carilion leaders, our department chairs, and our clerkship directors sets the stage for a rapid implementation of health systems science and interprofessional practice in the clinical setting.

With our most recent class, we implemented the school's first increase in size, from 42 to 49 students. We are delighted that more highly qualified and deserving students will be able to take advantage of our cutting-edge curriculum, made even more innovative by our more expansive focus.

We are proud to create an experience our students will look back upon as being transformative in the years ahead, even as they look back on this historic year. 

*Lee A. Learman, M.D., Ph.D., is dean of the Virginia Tech Carilion School of Medicine.*



# ORTHO LIKE NO OTHER

At Carilion Clinic, Orthopaedics is more than a specialty. It's a commitment to an impeccable level of care. We recently proved that commitment yet again, earning our Advanced Certification by the Joint Commission for hip and knee replacements—the only academic joint replacement program in western Virginia to achieve this designation as a leader in orthopaedic care.

*Make your appointment today to see the difference our difference can make for you.*

[CarilionClinic.org/ortho](https://CarilionClinic.org/ortho)

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and Neurosciences

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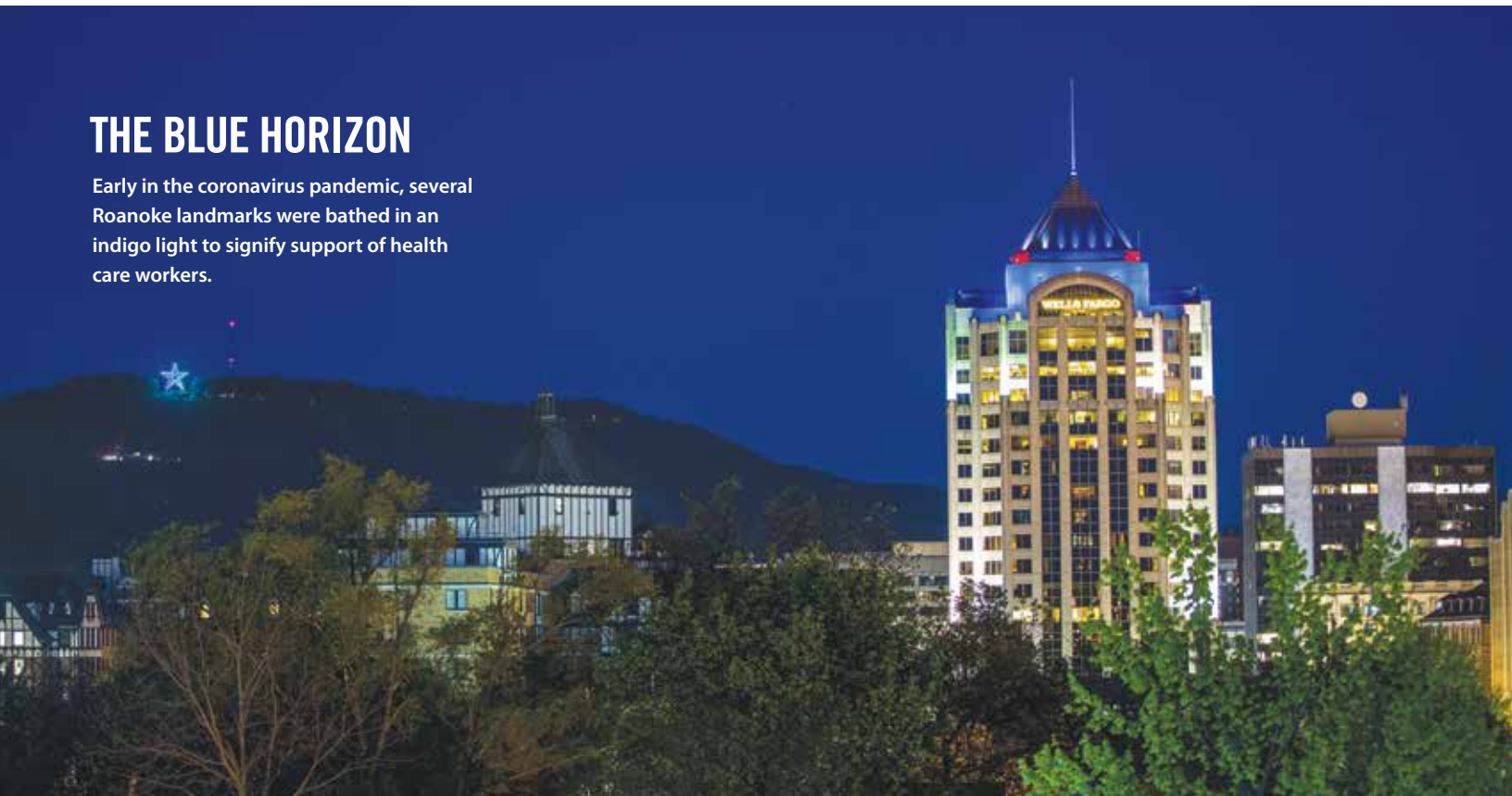
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## THE BLUE HORIZON


Early in the coronavirus pandemic, several Roanoke landmarks were bathed in an indigo light to signify support of health care workers.

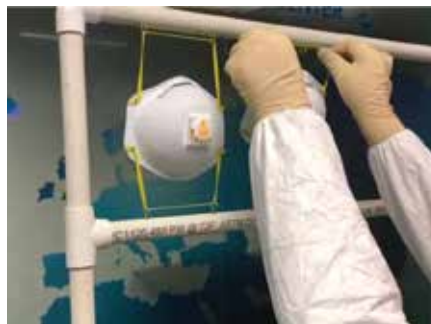


### online exclusives




### Bundle of Nerves

 A team of cutting-edge orthopaedic surgeons offer life-changing treatment for injuries to the network of nerves that send signals down the arm.




### Clean Bill of Health

 At the beginning of the pandemic, when precious N95 masks were scarce, Carilion Clinic and its collaborators discovered valuable decontamination methods.



### Fog Cutters

 Carilion Clinic partnered with Virginia Tech to solve a fogging concern with personal protective equipment during emergency helicopter flights.

Please visit us at [CarilionClinic.org/carilionmedicine](https://CarilionClinic.org/carilionmedicine). If you would like a complimentary subscription to Carilion Medicine, please email us at [CarilionMedicine@carilionclinic.org](mailto:CarilionMedicine@carilionclinic.org).