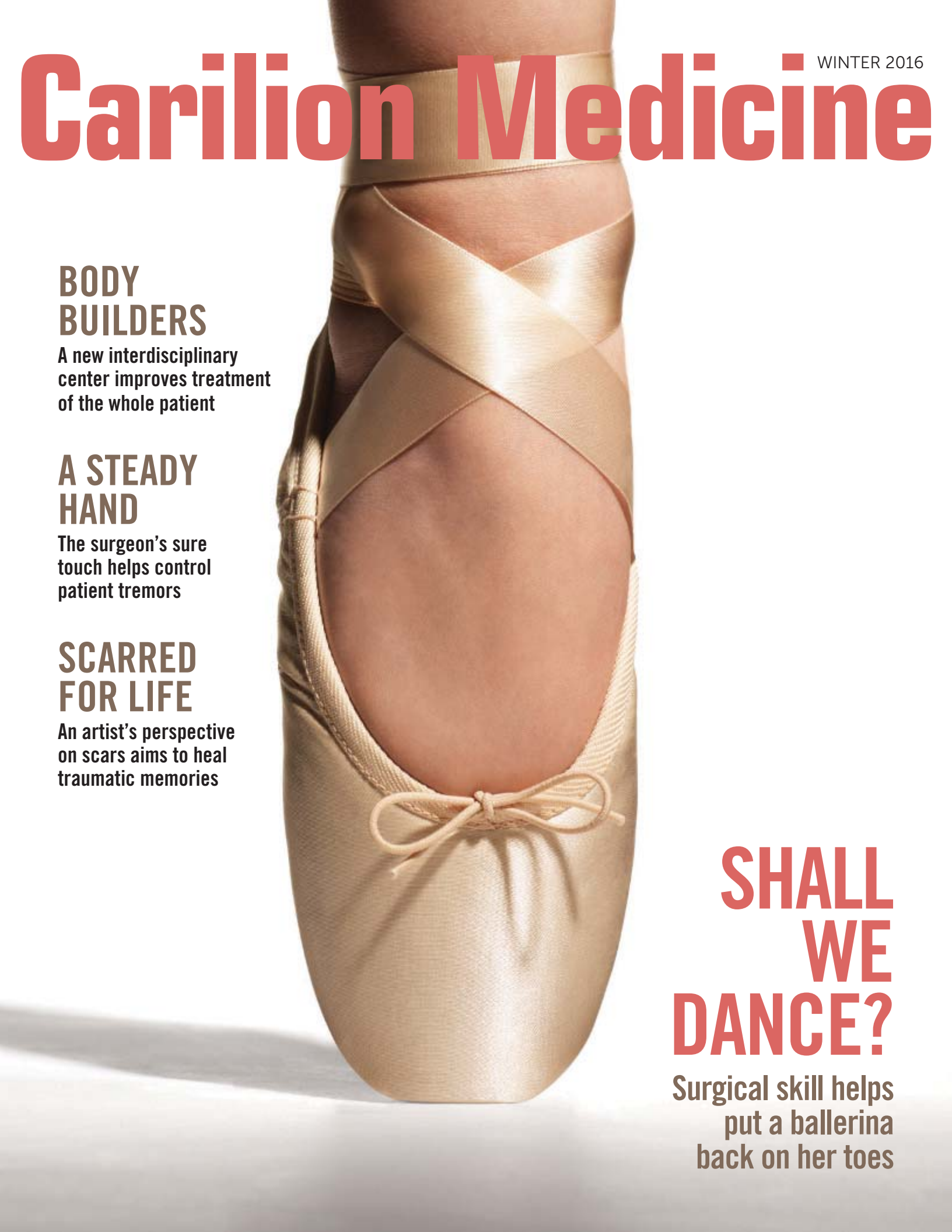
Carilion Medicine

WINTER 2016



BODY BUILDERS

A new interdisciplinary center improves treatment of the whole patient

A STEADY HAND

The surgeon's sure touch helps control patient tremors

SCARRED FOR LIFE

An artist's perspective on scars aims to heal traumatic memories

SHALL WE DANCE?

Surgical skill helps put a ballerina back on her toes

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PHOTOS: BRUCE PETERSON, COVER; DARRYLE ARNOLD, ABOVE

ILLUSTRATION: JAMES STEINBERG

AS PHYSICIANS, WE OFTEN TALK ABOUT "patient-centered care." This phrase may seem redundant; of course the patient is at the center of care. Yet there was a time when many physicians focused more on the technical aspects of the profession.

More than a century ago, Sir William Osler helped transform the practice of medicine when he established the first residency and insisted that students spend time at the bedside as well as in the classroom, engaging their eyes and ears in examining their patients.

"Listen to your patient," Dr. Osler said. "The patient is telling you the diagnosis."

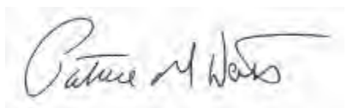
Dr. Osler asked his residents to use their eyes and ears as tools. In his time, the microscope, stethoscope, and X-ray machine were the tools that advanced clinical care. Medical technology has come far since then; genomic sequencing, functional brain imaging, and robotic surgery are just a few of the tools available now. They are great tools—but they are just tools. It's when we add our eyes and our ears that they become something more, something life-changing and even lifesaving.

In another hundred years, medical technology will look dramatically different. Our hospitals may be unrecognizable. Yet the human aspect of medicine will remain constant. The patient will still be at the center of everything we do. And our eyes and our ears will retain their value as essential tools of doctoring.

I'm thrilled to introduce this first edition of *Carilion Medicine*, which showcases some of the medical advances that are allowing us to achieve small miracles in helping our patients. This issue also reveals the human side of medicine, how we can help our patients, support each other, and work together to achieve more than we could do individually.

Our patients seek us out not just for our technical knowledge, but also for our ability to sense their suffering, their hope, their joy. Our eyes and ears allow us to go beyond limbs, organs, and symptoms to truly see and hear the patients who trust us to heal them.

Decades ago, when I was asked why I wanted to go into medicine, I would answer that nothing is more fascinating than the human body. Now, after nearly 25 years of caring for patients, I understand that nothing is more invigorating than the human spirit.



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Chief Medical Officer and Executive Vice President
Carilion Clinic

Carilion Medicine

President and Chief Executive Officer
Nancy Howell Agee

Chief Medical Officer and Executive Vice President
Patrice M. Weiss, M.D.

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CARILION CLINIC
1906 Belleview Avenue
P.O. Box 13367
Roanoke, VA 24033
CarilionClinic.org
800-422-4842

Carilion Medicine is published twice a year at:
213 McClanahan Street, Suite 200
Roanoke, VA 24014
Phone: 540-266-6586 **Fax:** 540-266-6608
Email: CarilionMedicine@carilionclinic.org

Carilion Clinic is a nationally ranked integrated health care system headquartered in Roanoke, Virginia. Its flagship, Carilion Roanoke Memorial Hospital, is the clinical affiliate of the Virginia Tech Carilion School of Medicine and Jefferson College of Health Sciences.

PHOTO: DARRYLE ARNOLD

in brief

On the pulse of the Carilion Clinic community

LEADERSHIP IN THE OPERATING ROOM

When it comes to leadership skills, some surgeons may be better at coordinating specific tasks than at sharing information and encouraging cooperation, a recent analysis suggests.

The distinction between task-focused leadership and team-focused leadership may make the difference between achieving minimum standards and inspiring performances that exceed expectations, according to the study in the *Journal of the American College of Surgeons*.

"It is important to study surgeons' leadership styles because they influence how the team performs in this complex work setting," said study coauthor Sarah Parker, Ph.D., Carilion's director of human factors research. "Studies in other high-reliability organizations—including nuclear power, manufacturing, and aviation—have shown that leadership can augment a team's performance, such as increasing efficiency and decreasing miscommunication."

The researchers videotaped five surgeons performing complex procedures and then assessed behavioral aspects of their interactions with team members. All five surgeons received similar ratings on such skills as delineating expectations and setting goals. On "transformational" skills requiring more emotional intelligence, though, the surgeons varied.

The research team found that the surgeon with the highest transformational score demonstrated those qualities even before the operation started. The surgeon prompted more information sharing and encouraged team members to speak up during procedures to ask questions, confirm instructions, and offer suggestions.

The researchers conducted the study at Brigham and Women's Hospital in Boston.

PEOPLE WATCHING: Dr. Sarah Parker, Carilion's director of human factors research, has conducted observational studies on surgical leadership styles.

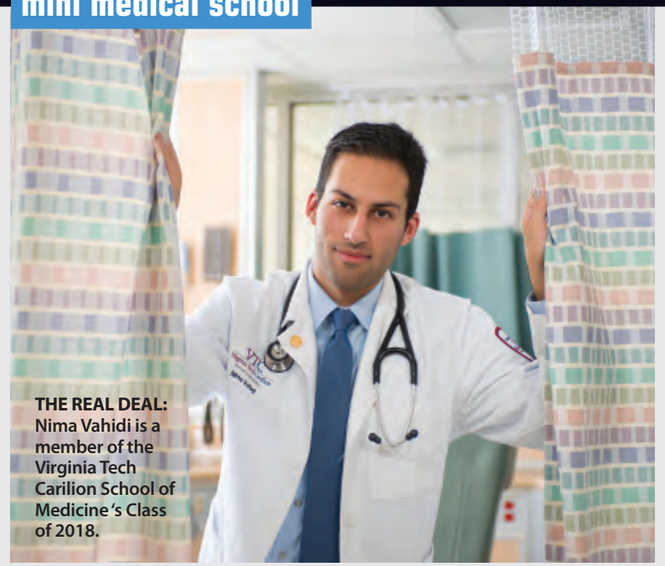
PHOTO: DAVID HUNGATE

Pediatric Care Takes Flight

Carilion Clinic has brought all its pediatric services—its practices, specialists, and inpatient care—together under the unified name of Carilion Children's.

"Our wonderful new logo—a colorful, stylized butterfly—provides a sense of movement, freedom, and youthfulness to our brand without being childish or infantile," said Alice Ackerman, M.D., Carilion's chair of pediatrics. "Carilion Children's ties our inpatient facilities with all our services for children."

mini medical school



THE REAL DEAL: Nima Vahidi is a member of the Virginia Tech Carilion School of Medicine 's Class of 2018.

Drawing Back the Curtain

What goes on behind the Hokie stone walls and sleek glass exterior of the Virginia Tech Carilion School of Medicine? Members of the Roanoke community took the opportunity to find out this past fall. The school's second annual Mini Medical School, *Drawing Back the Curtain: How Medical Students Learn to be Doctors*, offered a behind-the-scenes look at what medical school is like.

"We explored how the Virginia Tech Carilion School of Medicine creates exceptional physicians from the day our students enter until the day they graduate," said David Trinkle, M.D., the school's associate dean for community and culture. "That's four years of medical school condensed into four nights!"

Each of the evening presentations focused on one of the school's value domains: basic science, clinical science, research, and interprofessionalism.

On the first night participants were introduced to the school's problem-based curriculum. They received a fictionalized medical case—a middle-aged man with diabetes—and worked in facilitator-guided small groups to learn about the disease and devise a treatment plan.

In the second session, participants used a range of clinical simulation tools. They also worked with several of the school's standardized patients to learn diagnostic approaches and practice simple clinical skills. These standardized patients are local community members who have been trained to portray patients with a range of conditions, to enable students to conduct medical interviews and perform basic clinical exams.

On the third night, participants learned the concept of translational research through a presentation on a basic research finding that led to a promising clinical treatment.

In the final session, members of Carilion Roanoke Memorial Hospital's Emergency Department presented clinical simulations involving professionals across a range of specialties. To illustrate the value of interprofessionalism in medicine, they followed the demonstration of a lackluster clinical response with one by a team using best practices and honed communications skills.

"We often hear how well prepared our students are when they enter their residencies," Dr. Trinkle said. "Through our Mini Medical School series, we hope to get the public as excited about medicine—and our innovative way of teaching it—as we are."

COLLABORATING ACROSS BORDERS

Nearly 800 people from a half-dozen countries descended upon Roanoke this past fall for the fifth international Collaborating Across Borders (CAB V) conference, the latest installment in the premier North American conference series on interprofessional education and collaborative practice in health and social care.

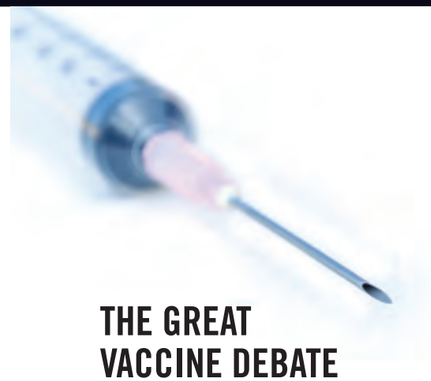
"The conference was intended for health care professionals and students in medicine, public health, and veterinary medicine—and anyone interested in the concept of teamwork," said David Trinkle, M.D., associate dean for community and culture at the Virginia Tech Carilion School of Medicine. "This conference brought together a growing community of people, professions, and organizations committed to collaboration as the best way of providing quality care for our patients and better health outcomes."

The conference was co-hosted by the American Interprofessional Health Collaborative and the Canadian Interprofessional Health Collaborative. Locally, the event was hosted by the Virginia Tech Carilion School of Medicine, Carilion Clinic, Jefferson College of Health Sciences, Virginia Tech, and the Virginia Tech Carilion Research Institute.

The conference, *The Interprofessional Journey: Advancing Integration and Impact*, included sessions on education, research, and clinical practice in interprofessionalism; best practices; and the advancement of interprofessional collaboration to improve health outcomes. Interprofessional education—in which students in a range of health care programs learn together with the goal of fostering a collaborative team approach—promotes more effective, patient-centered care.

The Virginia Tech Carilion School of Medicine and Jefferson College of Health Sciences are both recognized national leaders in interprofessional education. More than two dozen faculty members from those institutions were selected as conference presenters.

PHOTO: DAVID HUNGATE



THE GREAT VACCINE DEBATE

The national vaccine debate involves questions of clinical practice, policy, and ethics. Is there a limit to the number of acceptable vaccines for children? Who should assess the level of risk? What risks are acceptable to demand in the interest of public health?

These were just a few of the thought-provoking questions that were explored at a Virginia Tech Carilion School of Medicine event in September. *What's the Point? Vaccination Skepticism and Controversy* featured Bernice Hausman, Ph.D., a professor of interprofessionalism at the school, and Zach Adelman, Ph.D., an associate professor of entomology at Virginia Tech's Fralin Life Science Institute.

The event was not designed to take a stand on vaccinations one way or the other. Instead, the speakers sought to present user-friendly, scientifically based information aimed at helping people form their own opinions.

In an effort to promote better communication among doctors, public health professionals, patients, and parents, the speakers addressed the concerns surrounding vaccinations and the origins of those concerns. They also discussed the history and culture behind modern vaccine practices, including vaccine development and the regulatory process.

Dr. Adelman noted that vaccine-related risks, while small, are real, and it's important for health care providers not to dismiss parents' concerns as mere ignorance.

digital leadership

Carilion Roanoke Memorial Hospital's continued leadership in adopting digital technologies has led to its being named to the *U.S. News & World Report*'s Most Connected Hospitals list for 2015–16. Just 159 of the country's nearly 6,000 hospitals made the list, and in Virginia, only seven were included. In addition, for the seventh year in a row, the American Hospital Association recognized Carilion's digital leadership with the Health Care's Most Wired designation.

Among its other services, Carilion offers virtual doctor visits through MyChart, an online health care management tool; educational resources for patients through GetWellNetwork; expanded options for patient interaction through video visits; and virtual psychiatric care.

PHOTOS: SHUTTERSTOCK (TOP); DOLLAR PHOTO CLUB

briefings

Best in Class

Carilion Roanoke Memorial Hospital was named to the *Becker's Hospital Review* list of 100 hospitals and health systems with great orthopaedics programs.

In the Right Vein

The Virginia Blood Foundation has awarded Paul Dallas, M.D., a grant to assess the impact of physician education on implementing best practices for blood transfusions.

Next Top Model

In November, the Virginia Tech Carilion School of Medicine and Research Institute received the Excellence in Virginia Government Award for Public-Private Partnership from the L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University.

"The Virginia Tech Carilion partnership is the epitome of a good idea that evolved into something great," said Cynda Johnson, M.D., dean of the medical school. "Together, we have been able to build a medical curriculum and a research agenda in parallel. No other new medical school has been able to offer its students the benefits of such an innovative partnership."

Within sight of Carilion Roanoke Memorial Hospital, the school and the institute share a state-of-the-art facility that serves as the hub of the university's campus in Roanoke.

"The public-private partnership that Virginia Tech Carilion represents has been a catalyst for positive change within our local academic and medical communities," said Michael Friedlander, Ph.D., executive director of the research institute. "It also serves as a model for advancement of academic medicine nationwide."

grand rounds

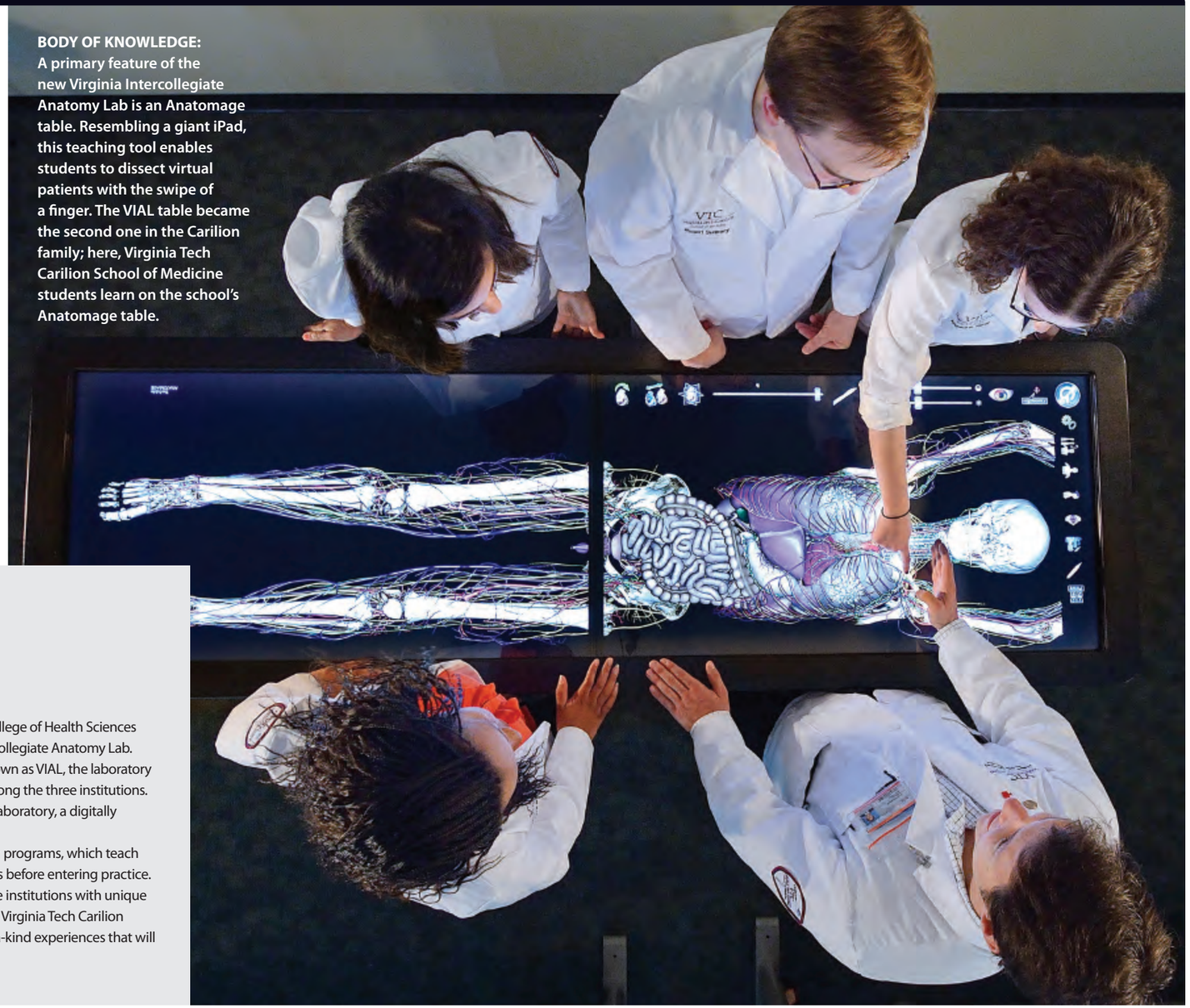
Education at Carilion Clinic and its affiliates

A NEW TEACHING ACADEMY

The first annual TEACH Education Day, held in October, marked the launch of the Teaching Excellence Academy for Collaborative Healthcare, or TEACH. More than 100 faculty members, 80 students and trainees, and 60 members of educational leadership participated in the daylong event.

Principally sponsored by Carilion Clinic's Office of Continuing and Professional Development, TEACH works to promote learning excellence at Carilion, the Virginia Tech Carilion School of Medicine, Jefferson College of Health Sciences, and the Virginia Tech Carilion Research Institute by creating a community of educators and fostering their development as teachers, learners, and educational researchers.

"We're working to create an environment that promotes and rewards teaching excellence to enhance the education not just of students, but also of residents, fellows, and faculty members," said Shari Whicker, Ed.D., director of TEACH. "We're trying to capture best practices and offer inspirational examples of effective teaching."



BODY OF KNOWLEDGE: A primary feature of the new Virginia Intercollegiate Anatomy Lab is an Anatomage table. Resembling a giant iPad, this teaching tool enables students to dissect virtual patients with the swipe of a finger. The VIAL table became the second one in the Carilion family; here, Virginia Tech Carilion School of Medicine students learn on the school's Anatomage table.

PHOTO: JIM STROUP/VIRGINIA TECH

spotlight

Virginia Intercollegiate Anatomy Lab

The Virginia Tech Carilion School of Medicine and Jefferson College of Health Sciences have joined Radford University in launching the Virginia Intercollegiate Anatomy Lab.

Housed at Carilion Roanoke Community Hospital and known as VIAL, the laboratory is the culmination of a $2.5 million, yearlong collaboration among the three institutions. The 8,000-square-foot space includes a cadaveric dissection laboratory, a digitally advanced classroom, and a cool-temperature storage facility.

VIAL supports the institutions' interprofessional education programs, which teach health care students to work collaboratively in clinical settings before entering practice.

"Laboratories like this one provide the students of all three institutions with unique opportunities to learn," said Cynda Johnson, M.D., dean of the Virginia Tech Carilion School of Medicine. "Our students will graduate with one-of-a-kind experiences that will ultimately help them provide superior care to their patients."

NEW DOCTORAL PROGRAMS

Jefferson College of Health Sciences has added two new doctoral programs to its lineup of 25 health-care-focused degree and certificate programs. The new programs—the doctorate of nursing practice and the doctorate of health sciences—will welcome their first students in the fall of 2016.

"Jefferson College of Health Sciences has grown to become a leader in health care education in the Roanoke Valley and beyond," said Nathaniel L. Bishop, D.Min., president of the college. "We created these advanced degree programs in response to the region's rapidly changing health care environment and needs."

PUBLIC HEALTH WALKING TOUR

In August, first-year students at the Virginia Tech Carilion School of Medicine participated in the school's annual Let's Talk Public Health Walking Tour, which seeks to teach the value of public health, one literal step at a time, during a stroll through the city.

"Many people think of doctors only in clinical settings," said David Trinkle, M.D., the school's associate dean for community and culture. "We want our doctors to think of their patients at all times. We want our doctors to see how trees affect air quality. We want them to understand how a busy street with no sidewalks can be deadly. And we want them to consider how they might help make positive changes to the communities they serve—because it's always better to prevent an injury or illness than it is to treat it."

RESIDENCY PROGRAM NEWS

Carilion's adult neurology residency program began recruiting its first class of trainees upon receiving accreditation last summer.

Carilion will use a recent $2.14 million, five-year grant from the U.S. Health Resources and Services Administration to expand its dental general practice residency program.

The emergency medicine residency programs at Carilion Roanoke Memorial Hospital and Carilion New River Valley Medical Center will merge in July 2016. That same month, Carilion will launch a new wilderness fellowship.

SHALL WE DANCE?

SURGICAL SKILL HELPS PUT A BALLERINA BACK ON HER TOES.

By Charles Slack

WHEN BALLERINA MARIA JESSEE LEAPS INTO THE AIR, she lands so softly it almost seems that coming back to earth is a matter of choice rather than a law of nature.

Creating that illusion of effortless flight demands countless hours of discipline—not to mention everything your body has to give, and more. Since starting to dance seriously at the age of seven, Jessee, now 21, has suffered her share of foot-related aches and pains. When you set out to become an elite ballerina, that just goes with the territory.

"People may not consider ballet to be a contact sport, but that's exactly what it is," says J. Randolph Clements, Jessee's podiatrist at Carilion Clinic. As a foot and ankle

PHOTO: KALI9/GETTYIMAGES

specialist, Dr. Clements has treated many members of the Southwest Virginia Ballet.

"Ballet is beautiful," he says, "but it's not natural. You're asking the foot to do things it's not meant to do."

When Jessee developed a painful knot on the inside of her left foot sometime around middle school, she says, "I thought it was tendonitis, which dancers pretty much always have. You just push through. My love for dance has been so strong, nothing stops me."

Over the years, however, the pain became intense and distracting for the Roanoke native. The culprit, Dr. Clements discovered, was not tendonitis but a small extra bone in Jessee's foot, located about halfway between her big toe and ankle. Non-dancers with the same congenital anomaly, known as an accessory navicular, often go through life blithely unaware. Through normal daily living, scar tissue fuses the extra bone to the native navicular bone, which anchors the main tendon supporting the arch of the foot.

In Jessee's case, pressure and repeated impact kept the bones in flux and the tendon perpetually inflamed.

Awarded the lead role in Southwest Virginia Ballet's production of the classical ballet *The Firebird* as a high school senior, Jessee finished her final performance through tears of pain. Having exhausted nonsurgical remedies, Jessee now faced a moment of truth: undergo surgery or stop dancing. She had just been admitted to the prestigious dance program at Indiana's Butler University and hoped to pursue a career in ballet.

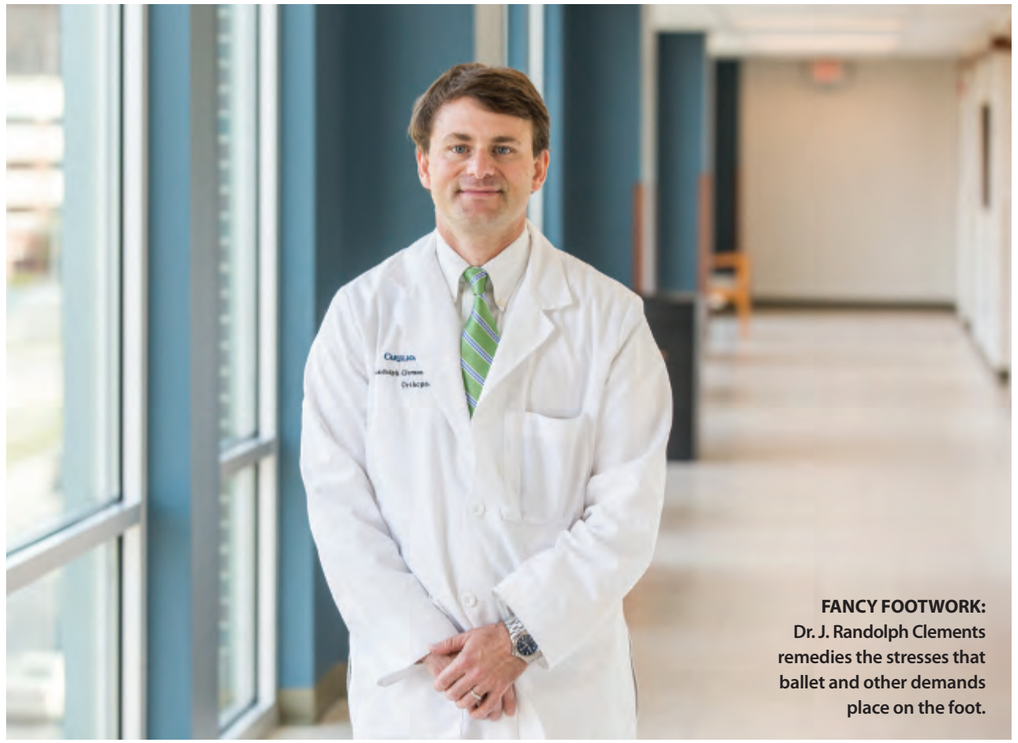
"If the surgery didn't work, I knew my career would be over," she says. "That's what terrified me most. There were no other options—but I had faith in Dr. Clements."

During the delicate surgery that followed, Dr. Clements and his team made an incision on the inner side of Jessee's left foot large enough to reach and remove the accessory bone. Because the arch-supporting tendon had connected to the extra bone, the surgeon detached it, and then, using a small, corkscrew-shaped anchor and suture threads, secured the tendon firmly in place.

The operation concluded smoothly, but only time would tell whether it had saved Jessee's dream.

The Human Touch

That's one bone, one foot, one life, one need. The human musculoskeletal system is a vast interconnected network of bones, tendons, and nerves. Each injury or congenital condition—whether a rotator cuff torn on a high school football field, a hip worn out from 80 years of walking, or a spinal deformity in a small child—represents an urgent need in the lives of those affected.



FANCY FOOTWORK: Dr. J. Randolph Clements remedies the stresses that ballet and other demands place on the foot.

PHOTO: JARED LADIA

"IF THE SURGERY DIDN'T WORK, I KNEW MY CAREER WOULD BE OVER. THAT'S WHAT TERRIFIED ME MOST." *—Maria Jessee, dancer and Carilion patient*

And for each condition, it seems, there are specialists dedicated to restoring the freedom of motion. Specialists in Carilion's orthopaedic and neurosurgery spine team, for example, perform some 300 minimally invasive surgeries a year for patients needing decompression or fusions, or to correct deformities—as well as offering a host of nonsurgical treatments. For challenges involving younger patients, Carilion's pediatric orthopaedic specialists treat and manage conditions associated with children's unique bone and muscle issues.

Often, the advanced methods these doctors employ are ones they have played an important part in developing. As an example, patients with ailing hips are back on their feet faster after surgery, with far less pain, thanks to an innovative technique known as anterior hip replacement. The technique enables surgeons such as Joseph Moskal, M.D., Carilion's chair of orthopaedic surgery, to avoid cutting through major muscle groups on their way to the hip.

"It's about more than comfort," Dr. Moskal says. "People are busier than ever before, and getting back on their feet is vital to them. The new techniques and technologies that we've adapted and helped develop are enabling people to return to their normal lives quickly."

From Supermarket to Super Care

Carilion Clinic's Institute for Orthopaedics and Neurosciences opens in January 2016, bringing dozens of specialists together under one roof. Nearly 120,000 total square feet are devoted to movement conditions, from pediatric spinal conditions to sports medicine to hand injuries.

Located in a former supermarket in Roanoke, the institute houses 120 examination rooms, along with consultation rooms, imaging suites, procedure rooms, treatment and therapy stations, and a gymnasium for rehabilitation. Specialists range from hand surgeons to spine specialists, in addition to those with special expertise in joint replacement, pain management, foot and ankle care, and arthritis and osteoarthritis.

Bringing all these and other related subspecialties together in one place is about much more than just convenience or administrative ease. It's an acknowledgement that, despite the great benefits that specialization represents, the fields of orthopaedics and neurosciences are bound together as surely as the human body is.

"All caregivers share a common purpose, as we understand that patients are more than the sum of their parts," Dr. Moskal says. "To me, the institute is bigger than a building, and more than a merger of practices. We're creating common ground for different fields of medicine. And that common ground is the patient."

The new institute is just the latest in a series of notable developments as Carilion takes on an ever more prominent role in orthopaedics on both the Virginia and national stages. In 2010, for example, Roanoke Orthopaedics Center joined Carilion Clinic. The resulting Carilion Clinic Orthopaedics brought together 33 physicians and 16 advanced care professionals into the largest academic orthopaedic group in the state.

In 2014, that growth in prominence was officially recognized when orthopaedics, traditionally under the aegis of surgery, became its own department. The Department of Orthopaedic Surgery was the first new department since Carilion restructured to an integrated care model in 2007.

PHOTO: DALE DONG

Drawing Top Talent

At any given time, the department's physicians are engaged in dozens of research projects, writing peer-reviewed journal articles, and presenting at conferences around the world. Success, as they say, breeds success. Carilion's growing reputation as a center for research and education in addition to high-quality clinical care is a powerful drawing card for some of the most promising researchers, innovators, and caregivers in orthopaedics.

"Many top graduates want to be involved in education and research," Dr. Moskal says. "The combination of Carilion Clinic and the Virginia Tech Carilion School of Medicine and Research Institute fulfills all the desires that any of these candidates have. Top recruits can have all of that and yet live in one of the most beautiful areas of the country. That's why so many of them are approaching us now."

Even as the emphasis on research and education expands, Carilion is no ivory tower of medical knowledge—the focus remains, as always, on addressing individual lives with immediate, hands-on care. Nowhere is that more obvious than in the field of sports medicine.

From a strictly orthopaedic perspective, in a perfect world there would be no marathon runners pounding miles of pavement each day, no rock climbers risking shattered bones, no weekend warriors topspinning their way to tennis elbow, and no high school boys in helmets colliding at full speed under Friday night lights. It's human nature to test our limits, though, and when a bone or joint breaks, dislocates, or frays from overuse, the greatest reassurance is having an expert nearby to provide immediate care.

THE CUTTING EDGE: Patients around the world seek the surgical skills of Dr. Joseph Moskal, whose anterior hip replacements have patients going home within 23 hours, with faster recoveries and less pain.

Where the Action Is

High school football player Connor Bronson of Troutville, Virginia, learned that one night when he turned the corner on an option play and headed up the sidelines. When a defender knocked him out of bounds, he felt an agonizing pop in his knee. Within moments, Thomas K. Miller, M.D., vice chair of orthopaedic surgery and chief of sports medicine at Carilion, was at his side.

"He let me know everything would be all right," Bronson recalls.

Dr. Miller and Carilion were there the next morning as well, assessing Bronson's torn ACL. And they were there through surgery and the difficult months of rehabilitation.

"The recovery was really long, but physical therapy got me back in shape," Bronson says. "I feel like I'm 100 percent again."

Having a physician on the sidelines was not a stroke of luck, but part of a concerted effort by Carilion to provide coverage of many high school football games in western Virginia. Carilion doctors also act as team physicians for a number of high schools.

At the collegiate level, Carilion physicians provide sports clinics as well as onsite coverage for games at Ferrum College, Radford University, Southern Virginia University, Virginia Military Institute, and Washington and Lee University.

To support them, Carilion employs a team of certified athletic trainers who work with athletes at area high schools to prevent, evaluate, and diagnose injuries and, when necessary, provide immediate and emergency care. Having these trainers on staff eases the communication process, Dr. Miller says. "It's a whole lot easier for someone you work with on a regular basis to pick up the phone. You know who they are and why they're calling. It makes it much easier to coordinate care."

And because the extent of some injuries may not be apparent until the day after a game, Carilion has instituted Saturday Sports Clinics from August through November, during the busiest months for scholastic sports injuries.

"The clinics help decompress emergency rooms and prevent injured athletes from waiting through the weekend for an appointment, and then missing school," Dr. Miller says. "It just gives us another outlet for treating athletic injuries."

It's also another way to get athletes on their way to recovery, so they can pursue their passions with confidence.

To Dance Again

Maria Jessee spent the spring and summer after her surgery in a state of nervous anticipation. After two months with no pressure on the foot, she graduated to a walking boot and began practicing at the ballet barre as best she could. By the time she enrolled as a freshman at Butler, the walking boot was gone. Because of the normal post-surgery pain, she still had no way to gauge success or failure. Yet she pressed on with her dancing, not wanting to fall behind in the competitive program.

And then one magical October afternoon, while going through her usual practice routine in a studio at Butler, she says, "I suddenly realized I didn't have any pain. It was the first time in five or six years I could say that."

These days, the occasional toe inflammation or bout with tendonitis seems almost like a gift, reminding her that she's still dancing at the top of her abilities.

Through four years and numerous high-level performances at Butler, the pain that nearly sidetracked her has never returned. Now a senior, Jessee aims to join a major city ballet company—first as a dancer, and then as a teacher.

"I appreciate everything Dr. Clements and Carilion have done for me," she says. "I can't thank them enough. They saved my career, and my dream." CM

GAME TIME: Dr. Thomas K. Miller takes sports medicine on the road during high school and college matchups.

JOINING THE TEAM

Carilion Clinic's Department of Orthopaedic Surgery, one of Virginia's largest orthopaedic groups, has added five new specialists, further bolstering its ability to offer the widest range possible of specialty orthopaedic care. The specialists include:

Peter J. Apel, M.D., Ph.D.
Hand and Upper Extremity

Dr. Apel joined Carilion from the Guthrie Clinic in Corning, New York, where he served as attending surgeon. He holds both a medical degree from Loyola University's Stritch School of Medicine and a doctorate in neuroscience from Wake Forest University. He completed his residency in orthopaedic surgery at Wake Forest and a fellowship at the Hospital for Sick Kids, also known as SickKids, in Toronto. He has a special interest in hand and upper extremity surgery.

Benjamin R. Coobs, M.D.
Adult Reconstruction

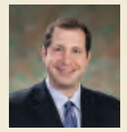
Dr. Coobs completed his residency in orthopaedic surgery at the University of Minnesota. He completed a fellowship in joint preservation, resurfacing, and replacement at Washington University in St. Louis. He has special interests in adolescent and young adult hip preservation surgery, adult reconstructive surgery, and orthopaedic trauma.

Jonathan R. Maher, M.D. Sports Medicine

Dr. Maher served for 14 years in the medical corps of the U.S. Navy, taking care of the orthopaedic needs of members of the U.S. Marine Corps and Navy SEALS. A graduate of Jefferson Medical College, he served as an assistant team physician for several Harvard University sports programs and a team doctor for the Boston Celtics. He has a special interest in cartilage preservation and reconstruction, shoulder instability, and rotator cuff repair.

Robert B. Schopf, D.P.M. Foot and Ankle

A former battalion assistant operations officer with the U.S. Army Special Forces engaged in the war on terrorism, Dr. Schopf was the first podiatry resident in Carilion's history. He is a graduate of the Temple University School of Podiatric Medicine, and his interests include foot and ankle reconstruction, diabetic deformities, and sports injuries.



Jesse Seamon, M.D. Trauma

Dr. Seamon, who joined Carilion in September, served as the orthopaedic surgery administrative chief resident at the University of Virginia Health System before completing a fellowship in orthopaedic surgical trauma at Saint Louis University Hospital. Dr. Seamon has conducted research into ligament injuries of the knee and fractures of the femur.

PHOTO: DARRYLE ARNOLD

PHOTOS: DAVID HUNGATE, TOP; DARRYLE ARNOLD AND JARED LADIA, SIDEBAR

A STEADY HAND

DEEP-BRAIN STIMULATION HELPS CONTROL MOVEMENT DISORDERS.

By Veronica Meade-Kelly

IMAGINE LOSING CONTROL OF YOUR OWN BODY. Your hands tremble, your body shakes, your limbs twist in painful and impractical ways. Activities once taken for granted—speaking, eating, walking—become difficult, and long-loved interests such as tennis or painting are no longer manageable.

Perhaps, though, you don't have to imagine: for the more than 10 million Americans suffering from movement disorders such as Parkinson's disease, essential tremor, or dystonia, these challenges are part of daily life.

Raymond Conner was one such person. The Martinsville, Virginia, resident suffers from essential tremor, a neurological disorder that causes uncontrollable shaking in the hands and elsewhere in the body.

"I shook so bad that my cereal or whatever I had in my hand would go everywhere," he says of his condition. "I knew something had to be done."

PHOTO: SHUTTERSTOCK

Conner turned to Carilion Clinic, which offers deep-brain stimulation (DBS), a minimally invasive surgery used to control the disrupted neural signals at the root of movement disorders. DBS has proved effective in treating the tremors, stiffness, and rigidity associated with Parkinson's in a subset of patients. It is also used to treat essential tremor and dystonia, another neurological condition that causes shaking as well as painful, twisting muscle contractions and repetitive movements.

The treatment is part of an increasingly robust program in Parkinson's disease—and movement disorders more generally—that is being forged at Carilion.

Carilion has offered DBS for the past year, after investing in state-of-the-art equipment and facilities and recruiting an integrated team of specialists in such fields as neurology, neurosurgery, and psychology.

"It took several years to bring everything together, but DBS has already proved a great service to patients in need," says Gary Simonds, M.D., chief of neurosurgery at Carilion. "The service is really a long-term effort between neurology and neurosurgery to identify the patients who would most benefit from the procedures, to perform the procedures, and then to follow up on patient responses and outcomes. It's not something a lone wolf could do."

An Enduring Challenge

Descriptions of movement disorders have been around since ancient times, but it wasn't until the 19th century that distinct disorders began to be characterized and studied. During the same period, experiments with animals, as well as observations of brain damage in humans, were helping scientists understand how the brain worked. Scientists began to understand that some behaviors and functions, such as speech and movement, are controlled by specific regions of the brain.

Since then, rigorous investigation and new information from modern imaging technology have enabled scientists to home in on the regions and neural networks responsible for these functions, and to better understand how those structures can falter, causing disease.

"The center of the brain has internal circuitry that coordinates everything you do in terms of movement, posture, and stance, and this takes a tremendous balance across various parts of the brain to ensure movement is indeed fluid and problem-free," Dr. Simonds says of the origins of movement disorders. "That balance can get disrupted, though, by various disease processes, in which you lose certain connections, certain neurochemicals—or both. When that happens, all of a sudden you can no longer make the same movements you've always made effortlessly."

DBS aims to restore some of this balance using electrical stimulation. The treatment, which was first performed in humans in 1987 and gained federal approval in the 1990s, involves the implantation of a three-part device that doctors liken to a pacemaker. The first part of the device, called an "electrode," is inserted in the brain, targeting the site of the disrupted signals. The target site, which can be as small as an almond, varies depending on the condition being treated and the part of the brain affected.

The thalamus, a region of the brain involved in relaying sensory and motor signals to the cerebral cortex, is often targeted for Parkinson's and tremor; the globus palladus, a subcortical structure that helps regulate voluntary movement, can be targeted for Parkinson's and dystonia; and the subthalamic nucleus, a region thought to be involved in inhibiting movement, is also targeted in some Parkinson's cases.

Before beginning the procedure, doctors use magnetic resonance imaging and computed tomography scanning to home in on the precise target for each patient. From there, computers are used to help guide a microelectrode-recording device to the identified site; the device allows the surgeons to listen for sounds that are inherent to each of the brain's nuclei. When they hear the correct corresponding sound, they know they've found the right spot.

The surgeons are then able to insert the first part of the device—the lead, or electrode—at the neurological source of the patient's condition. When activated, the electrode emits an electrical pulse that blocks and, in a sense, overrides the disruptive signal causing the disorder.

Patients are typically kept awake for this part of the procedure so doctors can monitor their response. Since brain matter carries no pain receptors, only local anesthetic is used at the site of the incision in the scalp.

HELPING HANDS: Dr. Joseph Ferrara, a neurologist, left, and Dr. Gregory Howes, a neurosurgeon, confer on which patients would benefit most from deep-brain stimulation.

"ONCE WE HAVE VERIFIED THAT THE ELECTRODE IS IN THE RIGHT PLACE, WE TURN IT ON. THE EFFECTS ARE OFTEN PROFOUND."

—Gregory Howes, D.O., Carilion Clinic neurosurgeon

"Once we have verified that the electrode is in the right place, we turn it on," says Gregory Howes, D.O., a neurosurgeon with the Carilion team. "The effects are often profound. We ask the patient to perform tasks like writing and tracing, and we can see immediate improvement in the tremor."

Approximately a week later—once the implantation site has started to heal—the patient returns for a second surgery. This time, a small, battery-operated device—an implantable pulse generator—is inserted under the patient's skin, near the collarbone. The surgeons then run a wire under the skin from the electrode to the device. That wire serves as the conduit for the current that stimulates the brain.

Once the device is turned on, if all goes as planned, symptoms abate immediately.

VITAL STATISTICS: Since the beginning of his neurosurgical career, Dr. Gary Simonds has performed well over 10,000 procedures.

Customized Treatment

Patient selection is a key part of ensuring success with DBS. The treatment best serves those who respond well to certain medications, but whose symptoms cannot be fully controlled by the drugs. Parkinson's patients whose disease has progressed to dementia are not good candidates for the surgery, and can even see their condition worsen. DBS also fails to treat a number of disorders that are similar to—and can be mistaken for—Parkinson's disease.

At Carilion, a team of neurologists led by Joseph Ferrara, M.D., are charged with finding the right candidates for treatment.

"We select patients we believe will benefit significantly from DBS—and not subject patients to an unnecessary surgery if it's unlikely to help them much," Dr. Simonds says. "I tip my hat to Dr. Ferrara and the neurology team. So much of it depends on neurology—selecting patients; working with them, often for many years; and eventually bringing them to surgery."

Patients who are well suited for the treatment often see extraordinary and immediate results.

"You rarely, in my business, get that kind of immediate gratification from seeing the results of your work," Dr. Simonds says. "Right there in the operating room, when we put the device where it's supposed to be for the patient and turn it on, you can watch their hands go from trembling uncontrollably to being suddenly steady. They can drink from a cup or draw spirals on a piece of paper. The transformation can be absolutely stunning at times."

The greatest relief can be seen in the reduction of tremor, rigidity, and bradykinesia, a slowness of movement manifested in Parkinson's disease. Patients successfully treated with DBS can stop or reduce medicine, control their tremor without medicine, and be able to undertake more activities, including work and hobbies once made impossible by the tremors.

"People with Parkinson's can gain an average of five hours a day without tremor, so the quality of life goes up dramatically," Dr. Howes says of the treatment.

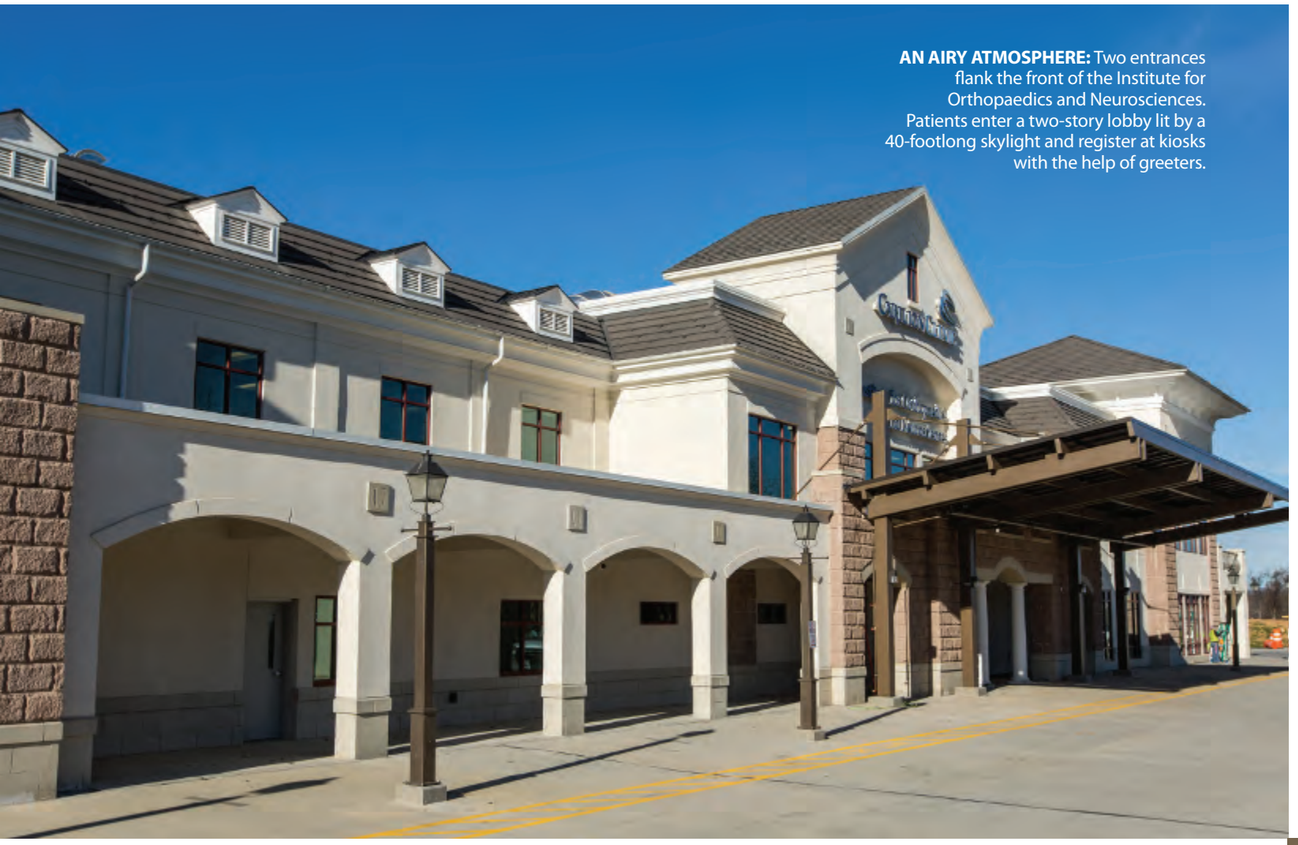
The team emphasizes, though, that while DBS relieves some of the worst symptoms of movement disorders, it is not a cure. If the implantable pulse generator system is turned off or the batteries fail, the movement disorder symptoms will return until the electrical pulse is restarted. In addition, DBS can do nothing to counteract the neurodegenerative effects and cognitive decline that Parkinson's causes.

For the right patient, though, the results can be life-changing.

For Raymond Conner, DBS meant a return to productivity and independence. He can once again work, write, and prepare his own meals.

"After the operation, it was just like bringing my life back," he says. "I can do just about anything I want." CM

PHOTOS THIS SPREAD: DARRYLE ARNOLD



AN AIRY ATMOSPHERE: Two entrances flank the front of the Institute for Orthopaedics and Neurosciences. Patients enter a two-story lobby lit by a 40-footlong skylight and register at kiosks with the help of greeters.

BODY BUILDERS

CARILION CLINIC'S INSTITUTE FOR ORTHOPAEDICS AND NEUROSCIENCES WILL HEIGHTEN COLLABORATION AMONG NATIONALLY RECOGNIZED SPECIALISTS.

By Veronica Meade-Kelly

PHOTO: JARED LADIA

THE THIGHBONE MAY BE CONNECTED TO THE HIPBONE, BUT that doesn't prevent medical care from sometimes being disjointed. "Although physicians tend to treat certain body parts—bones, joints, tendons, muscles, the spine, the brain—bodies and patients do much better when they're treated as a whole," says Joseph Moskal, M.D., chair of orthopaedic surgery at Carilion Clinic. "The best care is not only specialized, but also customized for the entirety of each patient's condition."

Patients with complex conditions often take countless trips to disparate locations as they navigate decentralized facilities. They also face frustration as disconnected teams of health care providers struggle to manage patient care across time and space.

"In modern medicine, the patient can become almost a shuttlecock, bouncing among five or six different specialists at any time," says Gary Simonds, M.D., chief of neurosurgery at Carilion.

Now, a new vision—matched by new construction—promises a more comprehensive approach. In January 2016, Carilion's Institute for Orthopaedics and Neurosciences opens its doors, providing care in a number of complementary specialties—orthopaedics, neurosurgery, pain management, physical medicine and rehabilitation, outpatient therapy, and diagnostic imaging—all under one glass-covered roof.

To say that the 117,000-square-foot facility—a big-box grocery store turned state-of-the-art medical facility—will offer one-stop shopping for patients is to diminish its value: the merging of these specialties on one site will not only save patients time and travel, but it will also provide a new, collaborative model of patient-centered care.

Doctors from once-distinct disciplines will confer on the care of individual patients in hybridized clinical spaces, and interdisciplinary teams of physicians will see those with certain specialty-spanning conditions—such as rheumatoid arthritis, scoliosis, osteoporosis, and spina bifida—in specialty clinics. An advanced imaging center will serve as the hub for the entire institute, providing timely diagnostic support to teams throughout the building.

"As medicine becomes more and more complex, it's difficult for one provider or even one specialty to have all the angles on a problem," Dr. Simonds says. "This new model of integrated medical care will make it easier for physicians to collaborate, exchange ideas, and offer innovative approaches to delivering high-quality care. And for patients, it eases logistics by providing a seamless stream of consultations in a single visit."

Dr. Moskal believes the integration will create a destination center locally, regionally, and even nationally.

"By taking a patient-focused management approach," Dr. Moskal says, "the institute shows Carilion's true commitment to improving the care we provide." CM

ILLUSTRATIONS: COURTESY OF AECOM

SHAPING THE FUTURE OF BREAST SURGERY

A cardiac research finding may aid women recovering from breast reconstructive surgery. BY JESSICA CERRETANI

FOR MANY WOMEN WHO HAVE SURVIVED BREAST CANCER or undergone an elective mastectomy to reduce a genetically increased risk of the disease, reconstructive surgery signals a new beginning. The results can boost self-esteem and body image. Perhaps that's why more than 100,000 women in the United States opted for this procedure last year alone.

Unfortunately, breast reconstruction isn't the final surgery these women must endure. Despite advances in implants and surgical techniques, up to a third of women who undergo the procedure develop scarring that eventually requires at least one revision surgery—often within just a decade of the initial procedure, says Kurtis Moyer, M.D., chief of plastic

ILLUSTRATIONS AND EMBROIDERY: LAURA MCFADDEN

and reconstructive surgery at Carilion Clinic and an associate professor at the Virginia Tech Carilion School of Medicine.

"Women worry about their implants rupturing, but newer implants are quite strong," Dr. Moyer says. "It's the formation of thickened tissue around the implants that's the problem."

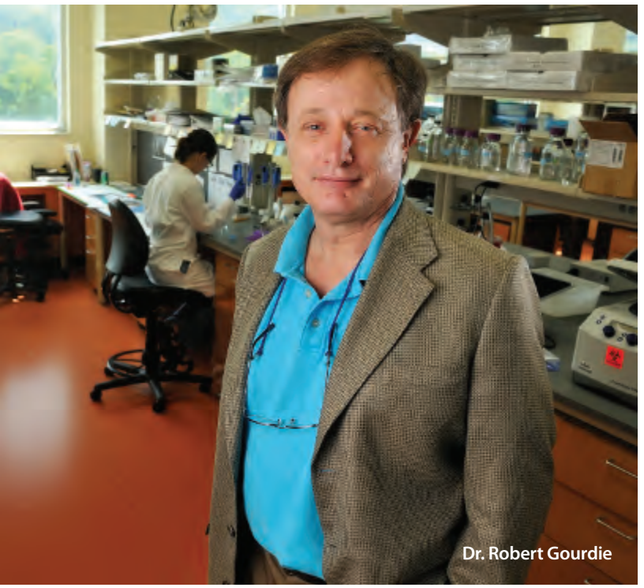
Until now, it's been an issue that even the most highly skilled plastic surgeons have been unable to prevent. That may be about to change, though, thanks to an inspired research collaboration between Dr. Moyer and Robert Gourdie, Ph.D., director of the Center for Heart and Regenerative Medicine Research at the Virginia Tech Carilion Research Institute. Together, they're investigating a promising new approach that has the potential to transform breast reconstruction by slowing the growth of scar tissue and significantly delaying the need for revision surgery.

Insult to Injury

The process of breast reconstruction usually begins after a woman has finished cancer treatment. Typically, a surgeon inserts an expander—an inflatable sac that can be enlarged with increasing amounts of saline solution—over the course of several months. This allows the skin and muscle to stretch enough to accommodate permanent breast implants.

Just as it would with any foreign substance, however, the body launches an immune response to the permanent implants, creating an envelope of thickened tissue and collagen called a capsule. Made of the patient's own living tissue, this capsule is "almost like another organ," says Dr. Gourdie. Over time, the capsule can shrink, squeezing the implant, which changes the feel and appearance of the breast, a problem known as capsular contracture.

Although this complication can occur with any implanted device—including cosmetic breast implants—it's more noticeable in women who have undergone a mastectomy because they lack the breast tissue that can hide these changes. As a result, the new breast can look dimpled and distorted and cause discomfort, necessitating revision surgery.


Dr. Robert Gourdie

The mechanism behind capsular contracture is clear. That doesn't mean, though, that it's easy to treat.

"It's impossible to prevent capsular contracture," says Dr. Moyer. "Plenty of people are investigating the problem, but there have been no real solutions. If we could slow down the process of scar formation, however, we could possibly delay the need for revision surgery by decades."

Drs. Moyer and Gourdie think they've found a way to do just that.

The Heart of the Matter

At first blush, the heart has little to do with breast reconstruction. In truth, though, the seeds of Drs. Moyer and Gourdie's collaborative work lie deep within this vital organ. The latter laid the initial groundwork before he had even arrived at Virginia Tech. Fascinated by the science behind heartbeats, Dr. Gourdie was investigating electrical signaling in the heart when he made an unexpected finding. He and his colleagues at the Medical University of South Carolina had created a peptide called ACT1, which was designed to enhance electrical communication between cardiac cells.

"It was," Dr. Gourdie says, "a fundamental cell biology project."

ACT1, it turns out, plays another critical role in the body: By preventing the proteins connexin 43 and Z01 from binding, the peptide securely confines cell contents within cell walls. That's crucial in wound healing, because cardiac cells damaged by a heart attack or another trauma typically spill their innards into the surrounding area, triggering an immune response that results in inflammation, scar tissue formation, and delayed healing.

By introducing ACT1 into this scenario, Dr. Gourdie and his team found that they could modulate the immune response. In one notable experiment, they implanted silicone disks that had been coated with either ACT1 or a control substance into male rats. They discovered that ACT1 modulated the wound-healing response to silicone implants by decreasing white blood cells and other immune activity around them. This, Dr. Gourdie speculated, could someday help address the capsular contractures that develop in response to implanted medical devices in humans.

OVER TIME, THE CAPSULE CAN SHRINK, SQUEEZING THE IMPLANT, WHICH CHANGES THE FEEL AND APPEARANCE OF THE BREAST.

PHOTO: JIM STROUP/VIRGINIA TECH


Dr. Kurtis Moyer

Using Dr. Gourdie's discovery as a springboard, his former postdoctoral associate Gautam Ghatnekar, Ph.D., established FirstString Research, which aims to further develop ACT1 for medicinal use. The company is already making impressive progress: Dr. Ghatnekar and his team have conducted three separate Phase 2 trials of a gel containing ACT1, looking at its effect on chronic wounds and scar reduction in people with foot and leg ulcers—common complications of diabetes that can lead to amputation if not treated.

These multicenter, randomized, controlled trials have found that people whose foot or leg ulcers were treated with ACT1 gel were significantly more likely to experience wound closure. They also had less scarring and faster healing compared to controls, with no notable side effects. FirstString Research is currently planning Phase 3 trials, which the scientists hope will lead to U.S. Food and Drug Administration approval of the gel.

All Together Now

At the same time Dr. Gourdie was exploring the possible uses of ACT1 in South Carolina, Dr. Moyer was at Penn State College of Medicine, working with renowned wound-healing researcher H. Paul Ehrlich, Ph.D., to shed light on the mechanisms behind capsular contracture formation.

"WOMEN WORRY ABOUT THEIR IMPLANTS RUPTURING, BUT NEWER IMPLANTS ARE QUITE STRONG." *—Dr. Kurtis Moyer, Chief of Plastic and Reconstructive Surgery, Carilion Clinic*

Later, after Dr. Moyer joined Carilion Clinic, he met Dr. Gourdie, who was about to accept a position at Virginia Tech. Their collaboration, they say, came naturally. Dr. Gourdie needed a clinical research partner, while Dr. Moyer had hoped to connect with someone conducting basic science on wound healing. They were brainstorming projects before Dr. Gourdie had even signed his contract.

"It was all very serendipitous," says Dr. Gourdie. "Our collaboration benefits translational research, but it's also a wonderful example of how Virginia Tech and Carilion can work together to provide clinically useful outcomes for patients."

It's a partnership that is paying off. The pair is now exploring ways to harness the clinical potential of ACT1 in women with breast implants. The two-pronged approach aims to predict which women are most likely to develop severe capsular contractures following breast reconstruction, and to then use the peptide to help slow contracture formation.

The team—including Katie Degen, a Virginia Tech graduate student in bioengineering—has been collecting tissue samples from women with temporary saline expanders in place as part of breast reconstruction. The scientists then analyze the samples using RNA sequencing to determine whether the presence of certain proteins correlates with the severity of future capsule formation. Early findings confirm the value of this predictive tool.

"When I know which women are most prone to heavy scarring," says Dr. Moyer, "I can have meaningful conversations with my patients about what to expect."

Drs. Moyer and Gourdie are also investigating the effects of ACT1 on the contracture itself. Within the next few years, they hope to have developed a delivery method that enables the peptide to be tested in an animal model that mimics breast reconstruction in humans.

Ideally, the scientists say, ACT1 will someday be available as an aerosol that surgeons can spray on breast implants and other devices before inserting them into the body—a simple yet game-changing approach that the scientists believe could delay the need for revision surgery by decades.

"There's nothing out there like this right now," says Dr. Moyer of the pair's work on ACT1 and breast reconstruction. "We're poised to put something forward that could have a huge impact on women undergoing breast reconstruction." CM

PHOTO: JARED LADIA

PHOTOS: DAVID HUNGATE

Medical students who train with other future health care providers end up delivering better patient care. **by Paula Byron**

CONNECTING THE DOCS

A BOMB HAD TORN THROUGH THE CROWD, and now the emergency department was swamped with victims. Panic and injuries alike were causing respirations to become jagged. Glass shards pierced skin; broken limbs abounded. A traumatized young woman had gone into early—and earsplitting—labor. • Among the wounded was a thin young man who had been fingered as the bomber. A police officer stood guard while a doctor and nurse tended to the gashes on his arms and legs. Suddenly his mother burst into the room, sobbing and demanding her son's release. A physician assistant spoke to her soothingly, while the officer tried to remove her from the chaos.

> GOOD COMMUNICATION IS KEY WHEN FOCUSING ON POSITIVE PATIENT OUTCOMES.
>
> —DR. NATHANIEL L. BISHOP

The goal is excellent patient care

70%

the estimated number of medical errors that are the result of miscommunication

The mother's hysterics did more than heighten the drama. They also inspired barely concealed grins among the onlookers, reflecting the reality that no lives were actually at risk. The woman was an administrative assistant from a nearby office; the bomber, a student with elaborate wounds fashioned from makeup; the guard, a Carilion Clinic police officer, but one who wouldn't later be called to testify.

The scenario was a fabricated one, intended to help students across health professions learn to work in teams. What the designers of the mock exercise couldn't have foreseen during their months of planning, though, was an eerie coincidence: the event took place on the very day that Boston was on lockdown as police searched for the surviving Boston Marathon bomber.

Making the Team

The bombing simulation was a sobering reminder that seemingly unfathomable emergencies can happen anywhere and at any time, and teams of health care providers must be prepared.

The three institutions running that particular drill—Jefferson College of Health Sciences, Carilion Clinic, and the Virginia Tech Carilion School of Medicine—have been at the ready for years, employing a critical tool in medicine: interprofessional teamwork.

Nearly two decades ago, Jefferson College of Health Sciences launched a pioneering program in interprofessional education, in which students in a range of health care programs learn together with the goal of fostering a collaborative team approach.

In 2006, Carilion became an early adopter of Team Strategies and Tools for Enhancing Performance and Patient Safety, or TeamSTEPPS, an evidence-based teamwork system aimed at optimizing patient care by improving communication and teamwork skills among health care professionals.

And in 2010, when the Virginia Tech Carilion School of Medicine opened, its founders chose to adopt interprofessional education as one of the school's core tenets, as the approach has been shown to promote more effective, patient-centered care.

The institutions' shared interprofessional education program has been so successful, in fact, that Roanoke was chosen as the site of Collaborating Across Borders, the premier North American conference series on interprofessional education and collaborative practice in health and social care. All three institutions served as local hosts of the 2015 conference, along with Virginia Tech and the Virginia Tech Carilion Research Institute. Nearly 800 professionals from a half-dozen countries attended to learn the latest best practices.

Reinvention of Medicine

The importance of interprofessional teamwork has become increasingly clear over the past few decades. An estimated 70 percent of medical errors are the result of miscommunication—or a lack of communication—among care providers.

In 2001, the Institute of Medicine issued a landmark report, *Crossing the Quality Chasm,* that called for a reinvention of the delivery of medical care. Teamwork became a hallmark of that transformation.

"Today no one clinician can retain all the information necessary for sound, evidence-based practice," the report stated. "Effective working teams must be created and maintained. Physicians groups, hospitals, and other health care organizations operate as silos."

"Health care is no longer run by doctors in Lone Ranger style," says David Trinkle, M.D., associate dean for community and culture at the Virginia Tech Carilion School of Medicine. "Self-sufficiency has given way to interdependence and a reliance on others. We've traditionally trained and worked in silos, but in today's world we have to work in teams. The earlier we train in teams, the better."

In 1970, Dr. Trinkle points out, a typical hospitalized patient would see, on average, two health care workers. Today, that number is 15.

"The health care environment has changed drastically over the past 30 years, from solo practitioners who could rely on their own knowledge, to teams of health care professionals managing complex patients in complex situations," Dr. Trinkle says. "Teamwork among care providers has been cited by many experts as one of the greatest factors in improving patient outcomes and reducing the number of medical errors."

Dr. Trinkle uses the pit crew analogy first offered by Atul Gawande, M.D., an advocate for patient safety internationally. When a racecar comes off the track, crew members are responsible for specific tasks—refueling, changing tires, adjusting the suspension. To work with speed and tight synchronicity, crew members must understand not only their own roles, but also the roles of their crewmates. Without that understanding, they cannot send car and driver off safely.

"Learning to work like a pit crew member in health care isn't easy," Dr. Trinkle says. "It involves humility, creativity, and a recognition that other team members have something important to offer no matter where they fall in the traditional hierarchy. Mastering those skills is critically important."

Early and Often

From the start, Virginia Tech Carilion School of Medicine students are educated alongside Jefferson College of Health Sciences students, particularly those in training to become nurses and physician assistants. In a reflection of that close coordination, Nathaniel L. Bishop, D.Min., president of the college, also serves as the medical school's chair of interprofessionalism.

"Good communication among care providers is key when focusing on positive patient outcomes," Dr. Bishop says. "Interprofessional education gets students used to communicating and collaborating with each other while respecting the expertise and opinions of others. The result is better patient outcomes."

The Virginia Tech Carilion School of Medicine was the first medical school in the country to thread interprofessionalism throughout its four-year curriculum. The groundwork is laid during year one, in the Interprofessional Leadership Course. There, students develop interprofessional knowledge and skills through personal reflection, conflict resolution, and teamwork-building exercises. Students also explore the roles, responsibilities, and biases of different health care professions.

The teamwork building extends beyond the classroom and into the community, where medical, nursing, and physician assistant students collaborate on an intensive service learning project. These projects offer the students the opportunity to work both as a team and with a range of community members. In the past several years, student teams have assisted dozens of local organizations with disparate missions, from warning new parents about the dangers of shaking infants to helping women in recovery from addictions.

"We're looking to educate well-rounded physicians, both inside the hospital and out," Dr. Trinkle says. "The service learning projects are just one more way to connect our students to the full reach of medicine. The students need to understand their patients' daily challenges and have the confidence that their own hard work and passion can make a difference. By the end of their projects, the students have added value to the communities they live in—and to themselves."

In their second year, the students focus on ethics, legal issues, and medical humanities as they relate to interprofessionalism. When students undertake clinical rotations in their third and fourth years, they continue to participate in team exercises, and their clerkship evaluations incorporate an assessment of their interprofessional skills. A real test of what they've learned, of course, is the annual disaster drill.

Recipes for Disaster

During the drill, held at Carilion Roanoke Community Hospital each year, teams of medical students and Jefferson College of Health Sciences students in a range of programs—including nursing, physician assistant, respiratory therapy, and emergency services—are assigned mock patients. The students aren't informed of the nature of the disaster until the exercise begins. They have to assess the situation and treat their patients on the spot as a team.

They're also thrown a series of curveballs intended to simulate real challenges—unrecognized internal bleeding, preexisting conditions, hysterical family members.

"Although each year the scenario is one of a mass-casualty disaster, the goals of the simulation are not related to disaster preparedness," says Bruce Johnson, M.D., the medical school's associate dean for faculty affairs and a key architect of the annual event. "Instead, they're intended to improve leadership skills and encourage interprofessional collaboration."

Dr. Johnson likens the drill to language immersion. "You may have spent years studying a language, but when you find yourself in a country where everyone speaks only that language, you suddenly realize that you don't know all the idioms, and everyone is speaking much faster than you expected," he says. "That can be a shock."

The drill has revealed that some medical students initially struggle to find their place in the team. Students in the other disciplines look to them for leadership, but the medical students often find themselves deferring to emergency medical technicians with far more hands-on experience.

Dr. Johnson points out that it's much better for medical students to experience any deer-in-the-headlight moments early in their training, when patient care is not compromised.

"Our graduates report to us that they're ahead of their peers when they start their residencies," he says. "They find they're confident in their roles. They understand and respect what other members of the clinical team have to offer, and their communications skills are well honed. Ultimately, we hope, their patients will benefit, with better, safer care." CM

THE TRUST TEAM PROVIDES SUPPORT TO SECOND VICTIMS—CLINICIANS WHO FEEL TRAUMATIZED BY ADVERSE PATIENT OUTCOMES.

By Paula Byron

Bearing Witness

JOSHUA CLARK WAS A NEW NURSE WORKING THE NIGHT SHIFT in a busy intensive care unit when he accidentally grabbed norepinephrine instead of saline while flushing the intravenous central line of a young man. Clark discovered his blunder within minutes, but by then his patient's heart rate—and his own—had skyrocketed. Fortunately, the patient's pulse stabilized the instant Clark righted his error.

While the patient suffered no ultimate harm, Clark remained traumatized long after, joining the ranks of what is now known as the second victim.

ILLUSTRATION: STUART BRADFORD

The "second victim" is a term increasingly used to describe a health care provider who has been involved in a medical error, a patient-related injury, or another unexpected, adverse patient event.

"Health care providers become victimized in the sense that they're traumatized by a patient-related event," says Clark, a registered nurse with extensive experience in intensive care units. "Second victims often feel personally responsible for unanticipated patient outcomes. They feel they've failed their patient, and they may end up second-guessing everything—their clinical skills, their knowledge, even their personal worth. Some end up leaving the profession."

Clark's own brief yet traumatic experience led to his becoming a founding member of the TRUST Team, Carilion Clinic's coordinated and compassionate response to health care providers who have experienced a significant patient event.

The TRUST Team launched in 2014, with Patrice M. Weiss, M.D., Carilion's chief medical officer, and Clark leading the charge. Dr. Weiss and Clark have since partnered with Carilion's Employee Assistance Program, recruited team members from a range of specialties, and hung out their shingle.

Silent Witnesses

The TRUST Team takes its acronym from what has been called the five rights of second victims: **T**reatment that is fair and just; **R**espect; **U**nderstanding and compassion; **S**upportive care; and **T**ransparency and opportunity to contribute.

The TRUST Team operates on several principles, Clark says. "First, research has found both that emotional distress can elevate the likelihood of subsequent adverse events, and that support of second victims can reduce that emotional distress. Second, when health care institutions don't support their people, they lose trust and respect, which ultimately harms the culture of the organization. Finally, it's the right thing to do."

The team has found that both patient outcome and degree of personal responsibility help determine the impact on second victims: the more severe the patient outcome, the greater the trauma, and the more responsibility for an error, the more distress to the health care provider. Caregivers can also be traumatized by being mere witnesses to patient suffering. The more unexpected a patient death, the higher the emotional toll.

High Stakes

Patients, of course, are the principal concern when it comes to medical errors. A study in the *Journal of Patient Safety* estimates that 210,000 to 440,000 Americans die from preventable medical errors annually, and the Institute of Medicine has found that medication mistakes affect an estimated 1.5 million people in the United States each year.

Those same errors cause ripple effects among the care providers involved.

In one well-publicized case in Cleveland, Emily Jerry, a toddler with a malignant tumor at the base of her spine, had nearly completed chemotherapy. Her tumor had shrunk dramatically, and her prognosis was excellent. She was scheduled for one final treatment before being discharged.

Within an hour of that treatment, though, Emily was on life support. She died several days later. A technician in the hospital pharmacy had inadvertently used a solution containing sodium chloride at a concentration more than 20 times higher than normal saline.

An investigation into the tragic incident revealed that many circumstances contributed to the error. The pharmacy's computer system was down, and a backlog of physician orders was piling up. The pharmacy was short-staffed and rushed.

The hospital ended up paying a $7 million settlement. The technician, charged with negligent homicide, was found not guilty. The supervising pharmacist, though, was charged with involuntary manslaughter and sentenced to six months in prison and six months of home confinement.

The personal consequences proved even higher in another well-publicized case, this time in Seattle. Kimberly Hiatt made the first error in her 24-year career as a critical care nurse when she miscalculated a calcium chloride dose, leading to the death of an eight-month-old baby.

The hospital fired Hiatt, and the state board put her on probation. Seven months after the fatal error, she committed suicide.

Team Spirit

At Carilion, the TRUST Team has expanded to two dozen members, including physicians, employee assistance and human resources professionals, nurses, pharmacists, and chaplains. The team identifies caregivers at risk and offers them the help of a trained peer mentor, who will listen to them and guide them through the process of recovery. Caregivers with particularly acute needs receive counseling referrals.

"Some people are resilient enough to process an event and return to baseline with limited support," says Neely Conner, a licensed clinical social worker who serves as the practice manager of Carilion's Employee Assistance Program and as coordinator of the TRUST Team. "Others may have underlying depression or another issue that leaves them more vulnerable. We take a customized approach to making sure they survive and return to thriving."

The event itself doesn't absorb the focus, Conner adds. "The person's ability to cope and return to a baseline of normal takes center stage," she says. "We don't encourage mulling over details about the event. We want to know just enough to be helpful. Our focus is on how they're doing, what supports they have in place."

The TRUST Team has already worked with a dozen health care professionals, several of whom, Conner suspects, might have left the profession if they hadn't received quality, coordinated, and compassionate care.

Several of those cases involved the unavoidable loss of a patient. Others were medication errors or misdiagnoses that caused no ultimate harm to the patients. And one involved the witnessing of a particularly heartbreaking patient event.

The team's experiences have echoed the latest research findings. Second victims are three times more likely to fall into depression. They tend to experience an increase in burnout, a drop in overall quality of life, and persistent feelings of distress, guilt, and shame.

Once they've healed, though, second victims may also be the best candidates for becoming effective, nurturing peer mentors, Conner says.

A study in the *Journal of Patient Safety* estimates that 210,000 to 440,000 Americans die from preventable medical errors annually.

"When they're ready," she says, "those same professionals may be able to impart the wisdom of their experience."

Patient Safety

In explaining the concept of the second victim, Clark, who now serves as director of quality management at Carilion New River Valley Medical Center, likes to quote Lucian Leape, M.D., whom he calls "the godfather of patient safety." Leape, a former pediatric surgeon, has spent decades promoting the application of systems theory to prevent medical errors.

In a twist on the famous aphorism by Francis Peabody, M.D.—"The secret of the care of the patient is in caring for the patient"—Dr. Leape told a conference of nurses, "The secret of the care of the patient is also in caring for the caregiver."

Clark believes that caring for caregivers is inextricably linked with patient safety.

"When there's a crisis, there's stress," he says, "and if we don't address the source of the stress and dissolve it, the impact can worsen, causing physical, emotional, social, cognitive, behavioral, and even spiritual symptoms."

Research has found, for example, that surgeons who believe they have made a medical error are three times more likely to consider suicide than those who don't.

"Caregivers in crisis," Clark says, "may experience everything from fatigue, anxiety, and sleep disturbance to poor concentration, slowed problem-solving, and destructive self-medicating habits—all of which place patient safety at risk."

A Cultural Shift

What's needed beyond the counseling of individuals, Conner says, is a shift in the health care culture.

"In the mental health field we have a saying—that our secrets keep us sick," Conner says. "When we internalize feelings of guilt and carry our burdens in silence, it perpetuates our sense of shame and isolation. Providers may lose the passion they'd felt for their profession. They may even want to avoid patients at all costs."

The shift, she says, should be away from dealing with medical errors punitively. Instead, institutions should scrutinize processes and systems, and add safeguards against human fallibility.

"We need to change our shame-and-blame culture," Clark says. "We need to have a transparent and just culture, in which caregivers can feel supported rather than stigmatized. In the past, even talking about traumatic events was viewed as a weakness. Caregivers need compassion. They need to be able to grieve. If they don't, they can easily fall into a psychological emergency."

Compounding the problem for doctors especially, says Mark Greenawald, M.D., is the issue of burnout, which affects an estimated half of all physicians and leaves them especially vulnerable to crises.

"People talk about recharging batteries, but the analogy fails when it comes to doctors," says Dr. Greenawald, vice chair of family and community medicine at Carilion and a key participant in developing the TRUST Team. "When physicians' batteries drain, we still press on. We've been socialized to never show weakness. Yet the practice of medicine is difficult; despite its rewarding nature, it takes an emotional toll."

Ahead of the Pack

"When we first started the TRUST Team program at Carilion, we were among the pioneers nationally," Conner says. "In the short time since, this approach has become a wave across health care systems. People are recognizing the high stakes involving second victims."

A mental care professional for nearly three decades, Conner speaks from personal experience. Despite all her attentive care, she says, over the years she has lost several patients to overdoses or suicide.

"It's so hard to lose a patient," she says. "It's easy to fall into the *what if* trap. What if I'd done this, or that, what if I'd worked harder, longer? I need to have faith, instead, that I provided those patients with more time, or perhaps eased their pain even a little.

"In the mental health field, we understand the importance of taking care of one another," Conner adds. "We all need a community of people validating our feelings and experiences."

Clark agrees.

"We need a shift in priorities," he says. "As a clinical care system, we've always placed our focus on how we take care of our patients. We need to understand, though, that an essential part of taking care of our patients is taking care of ourselves and each other." CM

learn more

The TRUST Team can be reached at the_trust_team@carilionclinic.org or 540-981-TRST.

Read Dr. Mark Greenawald's essay on physician burnout, which is more chronic and widespread than the acute cases the TRUST Team addresses, on page 36.

SCARRED FOR LIFE

An artist's perspective on scars offers opportunities to heal from trauma.

BY LINDA STALEY

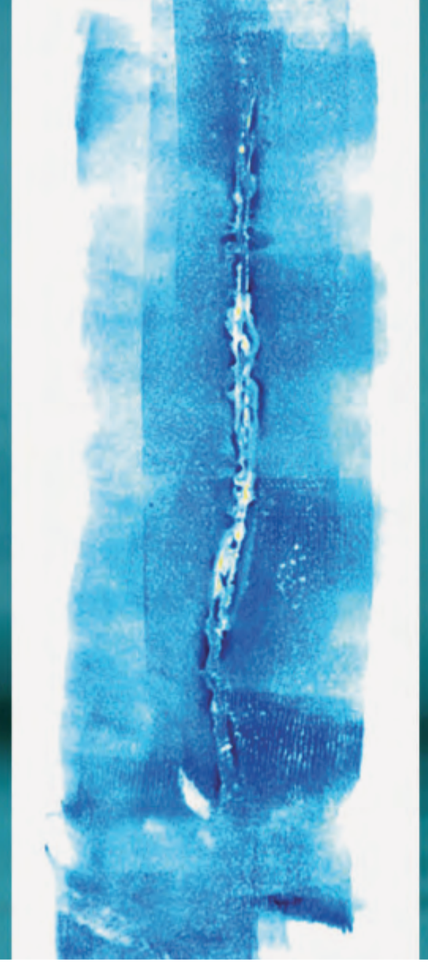
EVERY SCAR TELLS A STORY. *SCARRED FOR Life: Remnants of Trauma into Objects of Beauty,* an art exhibition featuring the work of Los Angeles–based artist Ted Meyer, tells nearly a hundred of those stories. From "Open Heart Surgery" to "Lost Lung During Botched Suicide Attempt," Meyer's photographs, narratives, and scarred-tissue monoprints together capture the events—often traumatic ones—that have transformed lives.

"I accentuate the details of each scar with a special technique for body color and colored pencil," Meyer said. "My hope is to turn these lasting monuments, often thought of as unsightly, into things of beauty."

One of Meyer's goals is to highlight the emotional impact of pain and healing on patients, their families, and health care professionals. Much of his work has been influenced by his own experiences with Gaucher's disease, a hereditary condition in which fatty substances accumulate in cells and organs. Meyer's early artwork depicted contorted and pained skeletal images, before new treatments and joint replacements restored his health and mobility.

Meyer's work has been featured in national media outlets and displayed internationally in museums, hospitals, and galleries. He and his *Scarred for Life* exhibition were in Roanoke last fall as part of an art show series sponsored by the Virginia Tech Carilion School of Medicine's Creativity in Health Education Program.

Meyer is an artist in residence at UCLA Geffen School of Medicine, where he curates exhibitions of artwork by patients whose subject matter coincides with the school's curriculum. CM



INJURY MEETS ARTISTRY

A. A chance meeting with Joy Mincey Powell, an actress and dancer who became partly paralyzed in a fall, inspired Ted Meyer to begin capturing scars in art. **B.** A piece of china shattered in a rage created a scar—and a valued reminder of the cost of unbridled anger. **C.** The scar running beneath his shoulderblade, the result of open-heart surgery when he was a month old, has been a lifelong emblem of how lucky he feels to be alive. **D.** A mastectomy scar prompts its proud bearer to raise awareness of breast cancer among men. **E.** A surgical scar helps a young woman with aortic stenosis remember all her reasons for living.

ARTWORK: TED MEYER

cheers for peers

Dentistry

CHARLES "BUD" CONKLIN, D.D.S., a former chief of dentistry who retired in 2015 after 35 years with Carilion, received the Dr. Manuel Album Award from the American Academy of Pediatric Dentistry at the academy's annual session in Seattle. This award is presented annually to the individual or organization that has made the greatest contribution to the oral health of children with special needs.

Emergency Medicine

MATT BORLOZ, M.D., was named a senior reviewer and outstanding/top reviewer for the journal *Annals of Emergency Medicine* four years in a row, ranking him among the top 1 percent of reviewers with the journal.

JOHN BURTON, M.D., chair of the Department of Emergency Medicine and vice president of medical affairs, was the invited speaker at the International Conference of Geriatric Emergency Medicine, in Taipei, Taiwan, in December. Dr. Burton's talk was titled, "Procedural Sedation of the Geriatric Emergency Department Patient."

COREY HEITZ, M.D., received the CORD Academy for Scholarship in Education in Emergency Medicine Distinguished Educator Award in the category of Enduring Educational Materials. The award recognizes outstanding educators who have met rigorous standards of academic excellence within the previous five years.

DAMON KUEHL, M.D., director of the Emergency Medicine Residency Program, was appointed to the editorial board of the journal *Academic Emergency Medicine.*

Family Medicine

MARY BETH SWEET, M.D., was selected as the 2015 Virginia Academy of Family Physicians James P. Charlton, M.D., Teacher of the Year. The award is given annually to someone who demonstrates excellence in teaching in family medicine.

Gastroenterology

DARIO SORRENTINO, M.D., was nominated to the American Gastroenterological Association's International Committee. The two-year term, with the possibility for a third year, began in June. Dr. Sorrentino was also nominated to be a section editor of the *Inflammatory Bowel Diseases Journal.*

General Surgery

CURTIS BOWER, M.D., was asked to serve on two committees of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)—the Hernia Task Force and the Quality, Outcomes and Safety Committee.

Internal Medicine

PAUL DALLAS, M.D., received the American College of Physicians Virginia Chapter's Paul Florentino Volunteerism Award in 2015. He will also be presented with the ACP's national volunteerism award, the Oscar E. Edwards Memorial Award for Volunteerism and Community Service, at the national ACP meeting in May 2016.

PAUL DALLAS, M.D.; VISHAL PATEL, M.D.; AND MICHAEL WIID, M.D., joined together to direct a daylong, hands-on precourse on "Ultrasound-Guided Procedures" at the American College of Physicians' centennial meeting in Boston.

DON STEINWEG, M.D., published an essay titled "Happy Tears" in the summer edition of *The Pharos,* the quarterly journal of the Alpha Omega Alpha Honor Medical Society.

Obstetrics and Gynecology

GRETCHEN GLASER, M.D., received the Gynecologic Oncology Group Scholarship Award for Exxcellence in Clinical Research and was accepted into the Exxcellence in Clinical Research workshop in Jackson, Wyoming, in May 2016.

Orthopaedic Surgery

JOSEPH MOSKAL, M.D., chair of the Department of Orthopaedic Surgery, was inducted into the Hip Society. The Hip Society advances knowledge of hip disorders, promotes evidence-based treatment, and refines hip surgery to improve the lives of patients. Being inducted into the society is considered the highest honor a hip specialist can receive.

Psychiatry

MARK KILGUS, M.D., PH.D., the newly retired founding chair of the Department of Psychiatry, coauthored the textbook *Essential Psychopathology & Its Treatment.* The textbook, now in its fourth edition, is considered a leading textbook in the field of psychiatry.

THOMAS MILAM, M.D., interim co-chair of the Department of Psychiatry, received the Nancy C.A. Roeske, MD Certificate of Recognition for Excellence in Medical Student Education. This annual award from the American Psychiatric Association is given to an association member who has made outstanding and sustainable contributions to medical student education.

Pediatrics

ALICE ACKERMAN, M.D., chair of the Department of Pediatrics, was asked to serve as a mentor through the Association of Medical School Pediatric Department Chairs' Pediatric Leadership Development Program.

Radiology

EVELYN GARCIA, M.D., chair of the Department of Radiology, was appointed to the American College of Radiology Abdomen Appropriateness Criteria Panel 2. This panel will review current literature and develop guidelines for appropriate imaging for solid abdominal organs and the genitourinary system.

DANIEL KAROLYI, M.D., PH.D., earned a Certificate of Achievement from the Academy of Radiology Leadership and Management. The achievement recognizes his commitment to pursuing advanced training in leadership skills, including earning 50 education credits across a spectrum of business and leadership disciplines.

Trauma Surgery

CAROL GILBERT, M.D., has received the Legacy Award from the Near Southwest Preparedness Alliance, a regional emergency management organization. The Legacy Award is given to someone who has demonstrated longstanding support and service to regional health care emergency management.

Urogynecology

JONATHAN GLEASON, M.D., has created PelvicMatters, a mobile app for assessment of pelvic floor disorders in women. Dr. Gleason is a founding member of the Collaborative Research in Pelvis Surgery (CoRPS) Consortium, which focuses on the development of new technologies for the assessment and treatment of pelvic floor disorders in women.

PHOTOS: DARRYLE ARNOLD

THE FOURTH AIM

Sometimes while treating patients, sacrificing family time, and running on overdrive, doctors are the ones who need fixing. **BY MARK GREENAWALD, M.D.**

HIS TEARS CAUGHT ME BY SURPRISE. It was a routine administrative meeting, and my off-the-cuff, "How are you doing?" to a fellow physician had clearly touched something raw right below the surface. His eyes grew moist, and though he struggled to pull himself together, he couldn't. It was too late to hold back the floodgates.

He spoke of mistakes, of times when patient care had gone awry, and of the self-blame he carried with him and had never shared with anyone.

He lamented the times when he had refused to let his patients' pain become his, even a little, when—despite every professional fiber of his being, despite his mentors' voices telling him that caring was at the heart of what it meant to be a physician—he just didn't care. That he simply wanted to get to the end of the day so he could flee the relentless deluge of need and suffering, of demands and complaints, of forms and phone calls and never-ending charting.

He spoke of the frustration of not being able to keep up with the latest medical information. He expressed doubt about his own competence. And he spoke of the guilt of not spending more time with his family, whom he dearly loved.

He diverted his gaze, wondered aloud whether it had all been worth the sacrifice—and then wept. This highly respected physician was now a shell of a man, broken by a profession and a system he had pledged to serve.

In the medical literature it's called burnout. My friend had joined the more than half of the members of the medical profession who at any moment are experiencing a combination of emotional exhaustion, depersonalization, and a sense of futility.

He could have just said, "I'm fine," and left it at that. He'd likely done that many times before. But this time he had allowed himself to be honest, to be real, and that small shift has since set him on the road toward healing, becoming whole again, and renewing his joy in medicine.

The leading cause of physician burnout is simply the nature of the work we do. We help people in distress, day in and day out, under enormous pressure. It's no coincidence that emergency medicine doctors have the highest rate of burnout, nearing 70 percent.

At Carilion Clinic, we have a TRUST Team that cares for health care providers in crisis, whether they've been involved in a medical error, lost a patient unexpectedly, or witnessed the terrible suffering of a patient.

No less significant than the acuteness of crises, though, is the chronic condition of burnout. While external resources and systemic tweaks can help, ultimately physicians have to solve our own culture of suffering in silence. We are not superheroes. We are human, and pretending we're not leaves us vulnerable not just to burnout, but also to compassion fatigue, moral distress, depression, anxiety, and even suicidal thoughts and actions.

We've all heard about the Triple Aim—enhancing care quality, improving population health, and reducing costs—as the key to optimizing the performance of health systems. Increasingly, though, there's been a call for a "Fourth Aim," which incorporates the explicit goal of improving the quality of life of health care providers.

Breaking our conspiracy of silence is important beyond physicians. It's also a quality-and-safety issue for patients, as burned-out providers deliver burned-out provider care.

Burnout is a complex, multifaceted, and contextual problem. Intricate challenges are a physician specialty, though, and I have confidence that we're the right people to show leadership in healing ourselves. As we work to achieve the Triple Aim, may "The Fourth" be with us. CM

Mark Greenawald, M.D., is vice chair of the Department of Family and Community Medicine at Carilion Clinic and chairs the Carilion Clinic Professional Wellness Committee.

ILLUSTRATION: JAMES STEINBERG

CARILION CLINIC
P.O. BOX 13727
ROANOKE, VA 24036-3727

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