Part of the 2017 UPMC Rehabilitation Institute Highlights Report

UPMC
LIFE CHANGING MEDICINE

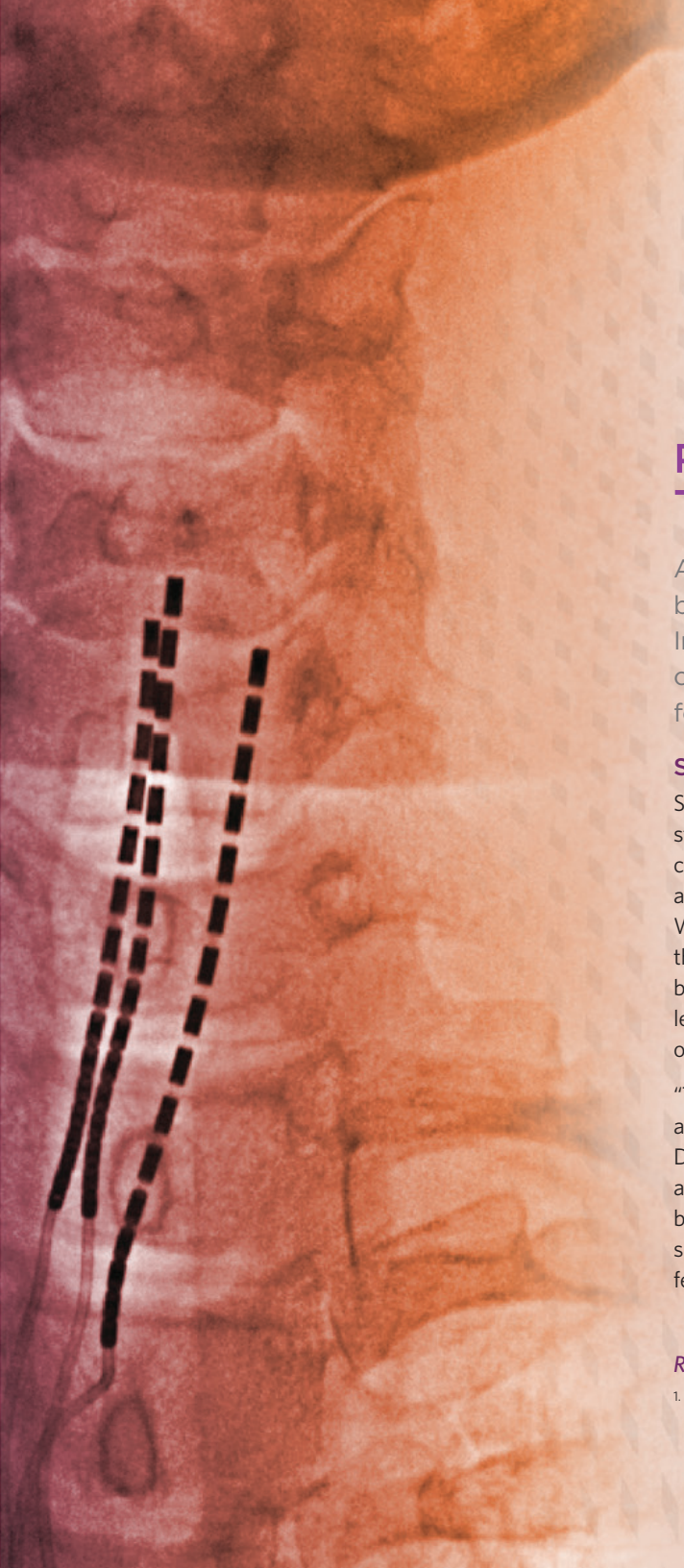
UPMC RESEARCH HAS RESULTED IN ADVANCEMENTS IN DIAGNOSTIC MECHANISMS, TREATMENTS, AND REHABILITATION THERAPIES, AND INCREASED INDEPENDENCE FOR PATIENTS.

The world of rehabilitation medicine has been, and continues to be, an incubator for some of the most advanced technology being designed and applied in the field of medicine. The development and application of technologies are important components of our rehabilitation program at UPMC, and this will continue as we pursue new and novel therapies for complex injuries and illnesses.

But technology is not the heart of our program. That place is reserved for the men and women of our department who design and create the radical new approaches that cutting-edge science and medicine demand. We adapt and explore the use of current technologies and modes of care to expand boundaries and shift the paradigm of what is possible.

We apply our expertise, our creative abilities, and our forward-thinking approaches to rehabilitation medicine and science to mold and shape the tools of our trade, with the understanding that it is all focused on one mission: to help make whole again those individuals who need our help.

The stories in this report, and the technological and research advances they explore, are part of our continuing efforts to reshape and evolve our field, both through the incremental work that is at the heart of science and through the lens of revolutionary progress.



Pain Management and Sensory Feedback Through Spinal Cord Stimulation

A hallmark of the rehabilitation research conducted at UPMC is the collaboration between researchers and clinical care providers to refine and improve patient care. In a new study[1], UPMC experts are combining the practical application of spinal cord stimulation technology with research to provide targeted pain management for amputees and those with chronic pain.

Spinal Cord Stimulation Implantation

Spinal cord stimulation is accomplished by placing three stimulator leads, each with 16 electrode contacts, in the cervical epidural space via a 14-gauge needle. The electrodes are placed on the dorsal columns, creating a neural pathway. When the pathway is stimulated, a paresthesia is generated that gives the patient pain relief in a specific area of their body. At UPMC, the implantation of the stimulator leads is led by Eric Helm, MD, assistant professor in the Department of Physical Medicine and Rehabilitation.

"The needles are x-ray guided with the goal of placing all three leads in the cervical epidural space," explains Dr. Helm. "Each lead targets four to five different nerve arrays in the patient's spinal canal. These arrays can then be turned on or off to steer currents that target different spinal nerves, to discover where the patient is feeling paresthesia."

Patients are conscious during this procedure, and only a local anesthetic is used where the three needles pierce the skin. This enables the patients to report if they are feeling an abnormal sensation, allowing the clinician to address where they feel a certain paresthesia. Dr. Helm performs between 75 and 100 lead placements each year.

Common clinical applications of this procedure include post-spinal surgery patients experiencing radiating pain initiating in the back or neck. The lead placement and nerve stimulation aims to alleviate this pain. Additional applications include complex regional pain syndrome, post-chemotherapy neuropathy treatment, and pain from diabetic complications.

Reference

1. Drakeley M, Ho SG, Helm ER, Levin J, Rosenquist RW. Spinal Cord Stimulation for Complex Regional Pain Syndrome (CRPS). *Curr Phys Med Rehabil Rep*. 2016. Vol 4, Pgs 1-4.

"EACH LEAD TARGETS FOUR TO FIVE DIFFERENT NERVE ARRAYS IN THE PATIENT'S SPINAL CANAL. THESE ARRAYS CAN THEN BE TURNED ON OR OFF TO STEER CURRENTS THAT TARGET DIFFERENT SPINAL NERVES, TO DISCOVER WHERE THE PATIENT IS FEELING PARESTHESIA."

Eric Helm, MD

Traditional spinal cord stimulation treatment provides care for a very large, generalized area, such as the entire back, leg, or arm. What sets Dr. Helm's work apart is the targeting of the dorsal root ganglion.

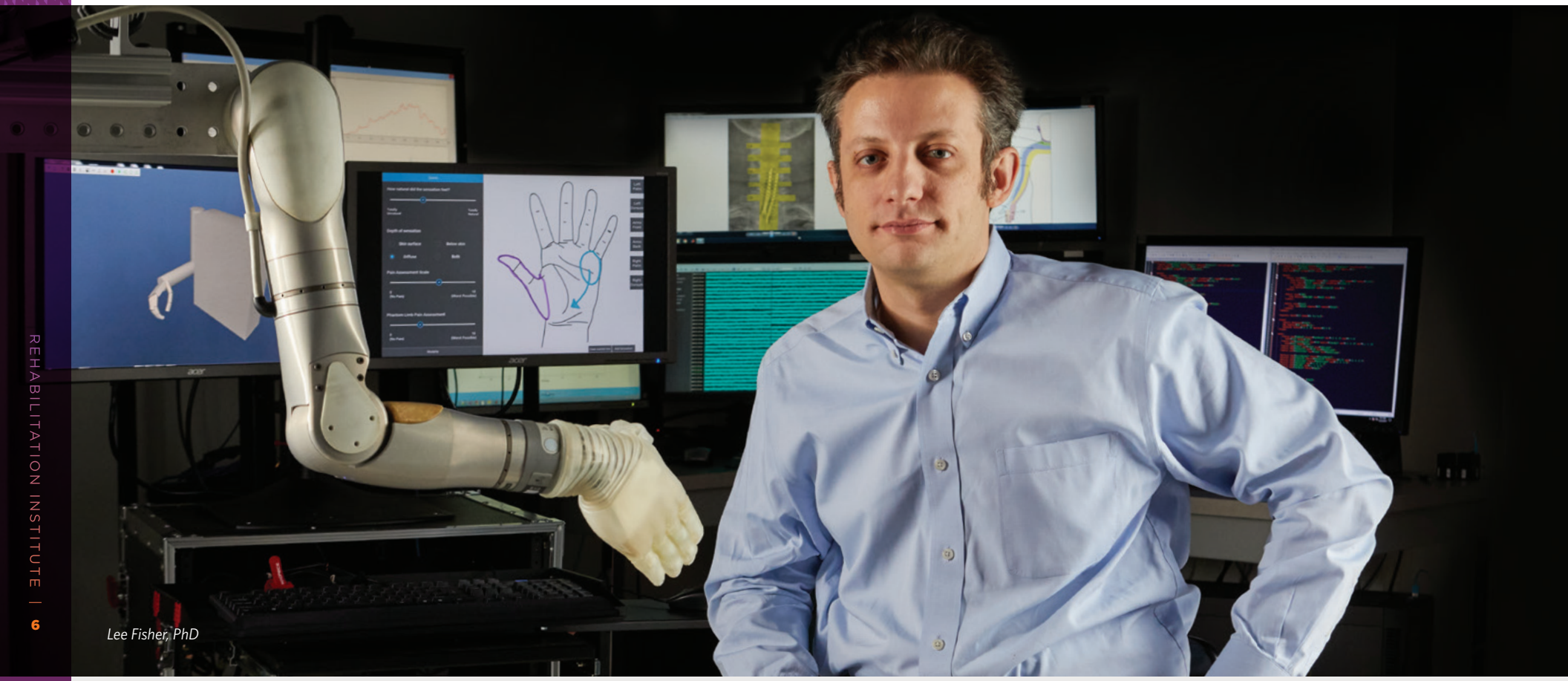
"In cases where patients have complex regional pain syndrome or amputees have phantom limb pain, their pain is localized to a specific area, such as the hand, foot, upper arm, and so forth," says Dr. Helm. "By focusing on the dorsal root ganglion, the nerve is targeted very specifically, and you don't need to reach any extraneous paresthesia that might not feel right to the patient."

Sensory Feedback Via Dorsal Root Ganglion Stimulation Research

Lee Fisher, PhD, a biomedical engineer and assistant professor in the Department of Physical Medicine and Rehabilitation, is working with Dr. Helm and Doug Weber, PhD, associate professor of bioengineering at the University of Pittsburgh and director of the Rehab Neural Engineering Lab, to investigate sensory feedback in patients who have undergone spinal cord stimulation implantation. The project to restore sensation in upper-limb amputees is funded by the Defense Advanced Research Projects Agency (DARPA).

"Studies show that if you stimulate either the lateral aspect of the spinal cord or the dorsal root, you can generate sensations that feel as though they come from the distal regions as opposed to the core proximal regions of the body," says Dr. Fisher. "If you stimulate the dorsal root ganglion in people with amputation, you can be fairly effective in reducing their phantom limb pain."

"The difference between those studies and what we're trying to accomplish with our research is, rather than an electrical buzzing sensation, we want to produce a sensation that feels natural to the subject, and feels like it's coming from the amputated limb," says Dr. Weber.



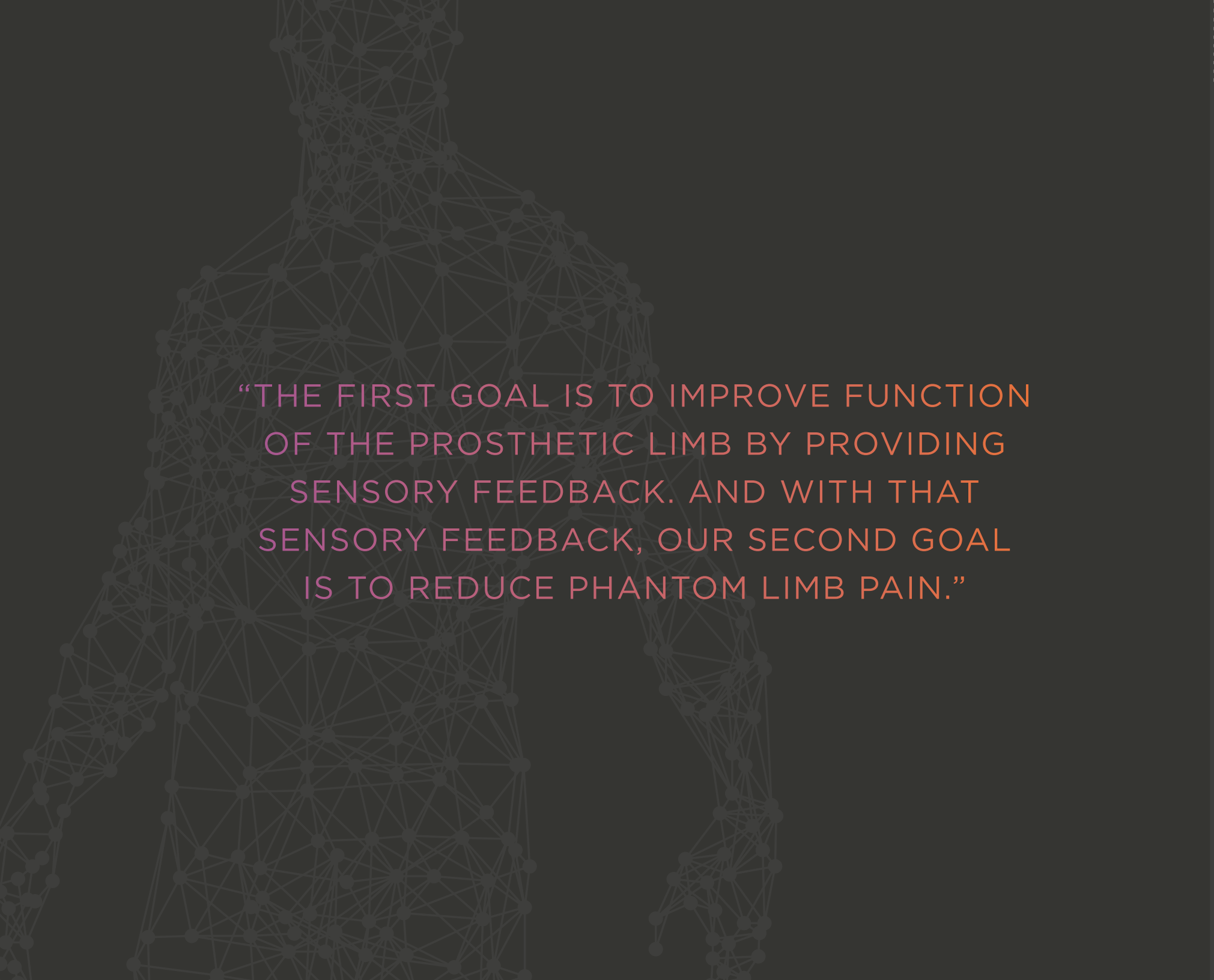
Lee Fisher, PhD

"By putting a sensor on the index finger of the subject's prosthetic hand and having it come into contact with a cup, we can measure the signal caused by that force and then stimulate so the subject feels contact in their phantom amputated hand. The first goal is to improve function of the prosthetic limb by providing sensory feedback. And with that sensory feedback, our second goal is to reduce phantom limb pain."

Drs. Fisher, Weber, and their research team are currently working with upper-limb amputees and will spend at least three more years studying these subjects. The team also plans to undertake a five-year study to look at lower-limb amputees, funded by the National Institutes of Health (NIH). There is potential to expand the research into other populations in the future.

More than 50,000 people in the United States receive fully implanted spinal cord stimulation devices each year, but the type of stimulation made possible with those devices is much simpler and targets the midline dorsal column rather than the dorsal root ganglion. Subjects in this research currently participate for 29 days, and at the end of that timeframe, their implant is removed. If these short-term studies prove to be successful, the next step will be to study patients with permanent implants. A more advanced, next generation of fully implantable stimulators is currently in development by medical device companies. These new devices will be able to target the dorsal root ganglion.

The outcome of this research could positively impact those living with chronic and phantom limb pain. By stimulating the dorsal root ganglion rather than just the dorsal column or brain, the collaborative work of Drs. Helm, Fisher, and Weber is making day-to-day life more manageable for this patient population.



"THE FIRST GOAL IS TO IMPROVE FUNCTION OF THE PROSTHETIC LIMB BY PROVIDING SENSORY FEEDBACK. AND WITH THAT SENSORY FEEDBACK, OUR SECOND GOAL IS TO REDUCE PHANTOM LIMB PAIN."

Advances in Regenerative Rehabilitation

Regenerative rehabilitation combines the strengths of physical medicine and rehabilitation and its ability to tap into the body's endogenous healing capacities with regenerative medicine technologies, such as tissue engineering, cellular therapies, and biomaterials. Regenerative rehabilitation seeks to translate the combinatory potential of these two disciplines for the creation of new clinical approaches to restoring and maximizing functional outcomes for patients.

Fabrisia Ambrosio, PhD, MPT, is director of rehabilitation for UPMC International and an associate professor of physical medicine and rehabilitation, with secondary appointments in the departments of Physical Therapy, Orthopaedic Surgery, Bioengineering, Microbiology & Molecular Genetics, and Environmental Health & Occupational Safety. Dr. Ambrosio is one of the nation's leaders in the rapidly growing field of regenerative rehabilitation research.

Dr. Ambrosio's personal research focus is on skeletal muscle healing and functional recovery through the repair or regeneration of damaged or lost tissues augmented by rehabilitation protocols that use physical and mechanical means to promote recovery. Her research includes investigations of the basic biology underlying declines in the regenerative potential of the body and its tissues due to aging and disease. Mechanical stimulation protocols are also examined by Dr. Ambrosio to determine if these approaches may be used to prevent or counteract declines in regeneration and regeneration potential.

With respect to cellular therapies for the restoration of function after injury or disease, Dr. Ambrosio seeks to understand the possibilities of rehabilitating transplanted cells as a means to enhance the survival and engraftment of donor cells, a large challenge with cellular therapeutics in general. Ongoing studies in relation to myopathies and volumetric muscle injuries have shown that when a rehabilitation protocol is added to stem cell transplant paradigms, it results in better transplantation efficiency. Cellular behavior occurs more in the manner that was intended, migrating throughout the tissue, forming new muscle, and showing the results to be functionally relevant. Studies of this nature have shown Dr. Ambrosio and colleagues that the synergies created between cellular therapies and rehabilitation protocols can unite the two fields in common goals.

Fabrisia Ambrosio, PhD, MPT

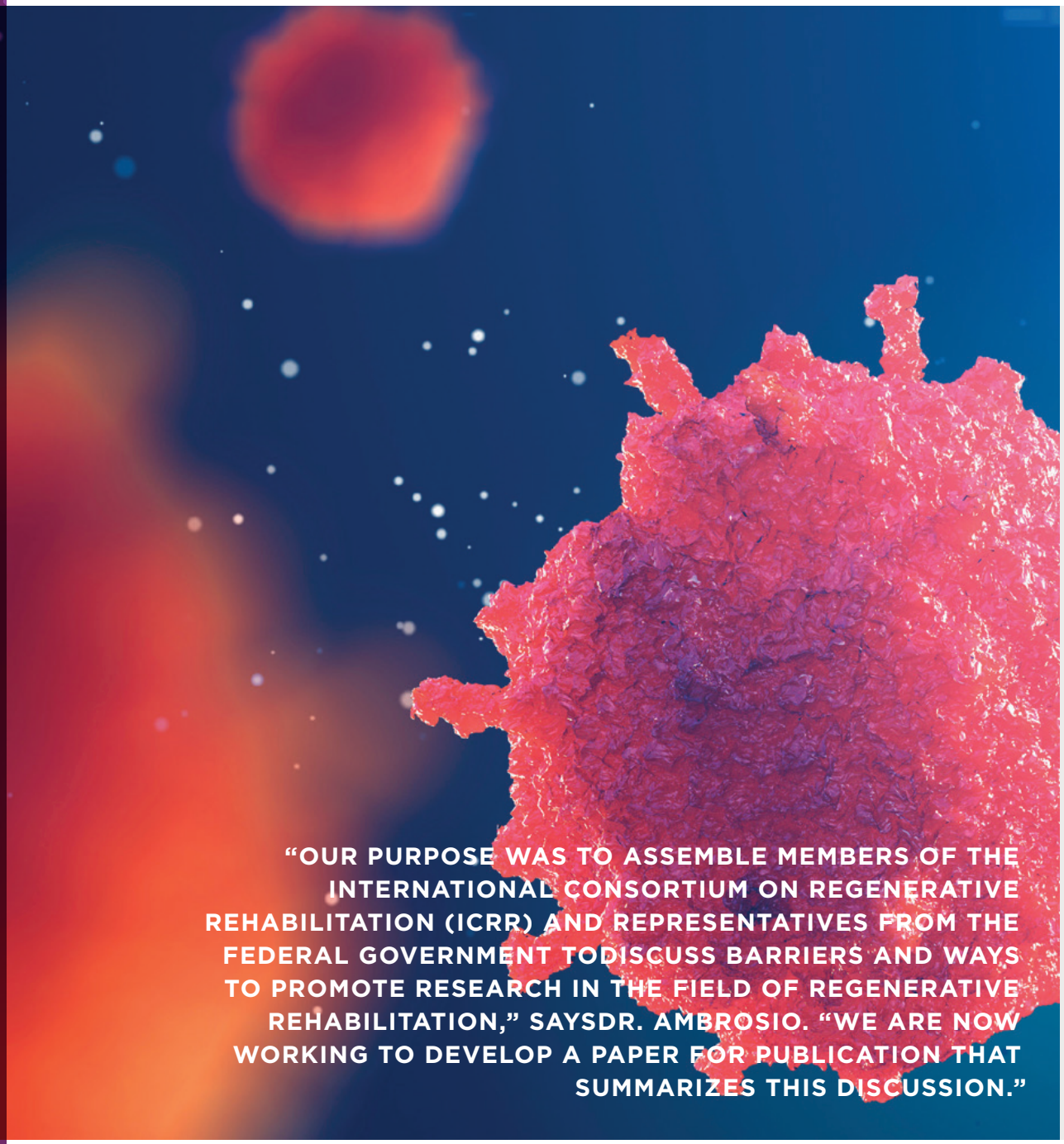
Leading the Field in New Directions

International Symposium on Regenerative Rehabilitation

Since the creation of the International Symposium on Regenerative Rehabilitation in 2011 by Dr. Ambrosio and colleagues, the annual event has continued to expand and attract some of the foremost experts in the world who come together to share research, ideas, and strategies for advancing the field as a discipline, but also advancing the search for new and better ways to treat many devastating injuries and illnesses that are routinely encountered in the world of physical medicine and rehabilitation.

The 2017 symposium was held November 1-3 in Pittsburgh, Pennsylvania, and was attended by a record number of scientists and clinicians (185, up from 135 the previous year) from around the world. The past year's event was co-hosted by the University of Pittsburgh, and for the first time with an international partner, Kyoto University. Co-directors of the event were Dr. Ambrosio and Professor Hiroshi Kuroki from the Kyoto University Graduate School of Medicine.

Dr. Ambrosio explains that a number of highlights from the most recent symposium point to its immediate and continued success. The most recent event featured a much larger presence of neural researchers and projects, providing more examples of regenerative rehabilitation studies across a broader range of model systems and applications.



"OUR PURPOSE WAS TO ASSEMBLE MEMBERS OF THE INTERNATIONAL CONSORTIUM ON REGENERATIVE REHABILITATION (ICRR) AND REPRESENTATIVES FROM THE FEDERAL GOVERNMENT TODISCUSS BARRIERS AND WAYS TO PROMOTE RESEARCH IN THE FIELD OF REGENERATIVE REHABILITATION," SAYSDR. AMBROSIO. "WE ARE NOW WORKING TO DEVELOP A PAPER FOR PUBLICATION THAT SUMMARIZES THIS DISCUSSION."

New Additions to the Symposium

New in 2017 was the addition of two post-symposium workshops, each attended by approximately 35 individuals. The first track, developed in partnership between the University of Pittsburgh and the University of Alabama, featured a clinical trials workshop designed to give participants a thorough understanding of aspects of regenerative rehabilitation research in the clinic. The second workshop focused on ways to enhance preclinical regenerative rehabilitation research, and provided attendees with tools and ideas for how to rigorously implement rehabilitation protocols in animal model studies.

Another first at the 2017 symposium, and a product of attendee feedback from previous years, was the inclusion of a clinician networking breakfast. "This was an opportunity, in an informal setting, for the more clinically oriented attendees to meet and share experiences with colleagues involved in various types of regenerative medicine interventions and applications," says Dr. Ambrosio.

As a supporter of the symposium, the Alliance for Regenerative Rehabilitation Research and Training (AR^3T) group helped to support the attendance of both domestic and international trainees with $20,000 in travel awards, which speaks to the overall commitment of the symposium to encourage the next generation of researchers and clinicians to participate and increase their knowledge base.

A full recap of the symposium is available for reading and downloading by visiting AR3T.pitt.edu.

Current ICRR Members

University of Pittsburgh	University of Virginia	Stanford University
Mayo Clinic	Emory University	Kyoto University
University of California, San Francisco	University of Pisa	Indiana University–Purdue University Indianapolis
Oregon Health and Science University	Wayne State University	University of Washington
Uniformed Services University of the Health Sciences	Kessler Foundation	Fondazione Don Carlo Gnocchi Onlus

Advocacy for Regenerative Rehabilitation: The Growth of ICRR

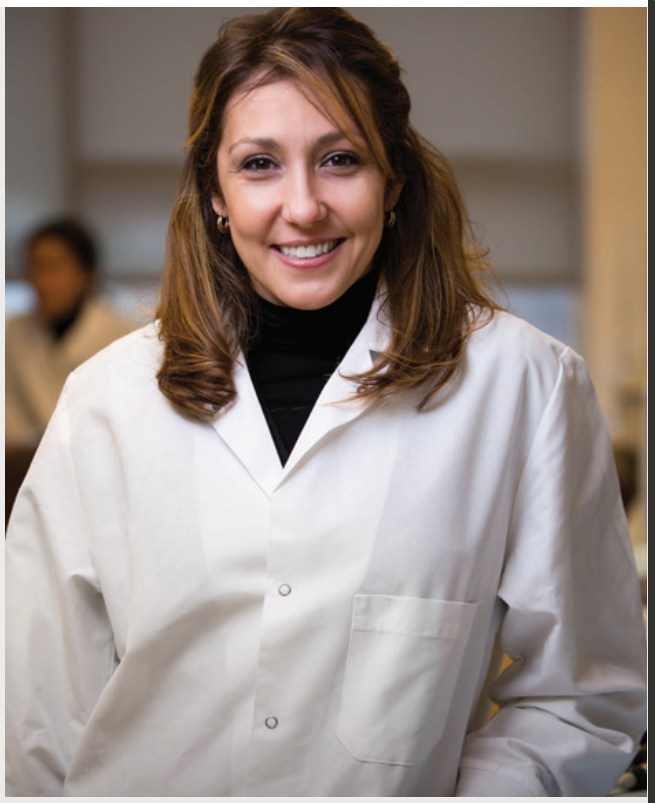
The ICRR was created by Dr. Ambrosio and her colleagues at the University of Pittsburgh and the Palo Alto VA Rehabilitation R&D REAP Center in 2014. Since its inception, the ICRR has continued to grow and now includes 15 institutions in North America, Asia, and Europe. In 2018, three new institutions joined the consortium: the Uniformed Services University of the Health Sciences, the Kessler Foundation, and the Fondazione Don Carlo Gnocchi Onlus based in Milan, Italy.

The ICRR has a number of goals in its mission, including the expansion of research and the clinical applications of regenerative rehabilitation through educational initiatives, research, pilot grant funding, and advocacy within federal government agencies and academic and health care institutions.

On November 1, 2017, ICRR held a roundtable event in Pittsburgh that brought together stakeholders from numerous federal agencies, including the NIH, U.S. Department of Veterans Affairs, and the Department of Defense, as well as organizational leaders, scientists, and rehabilitation medicine clinicians. The roundtable event explored opportunities and challenges facing the growing and rapid translation of regenerative medicine technologies into medical practice and the role of rehabilitation in accelerating the translational potential of these technologies. This interactive forum generated insights and strategies for how to best advance the field of regenerative rehabilitation.

A New Academic Collaboration in Regenerative Rehabilitation – the University of Pittsburgh and Kyoto University

November 2017 also saw the announcement of a new academic and research collaboration between the University of Pittsburgh and Kyoto University. The new agreement will foster an exchange of research and information between the two institutions related to their regenerative rehabilitation and regenerative medicine programs and projects.



Kyoto University has a thriving regenerative rehabilitation program with training, postdoctoral positions, and its own symposium series. They approached Dr. Ambrosio several years ago to discuss how the two institutions could collaborate.

"The agreement seeks to set up an infrastructure to encourage an exchange of scientists and trainees between our two institutions, as well as to promote collaborative efforts through research," says Dr. Ambrosio.

Save the Date

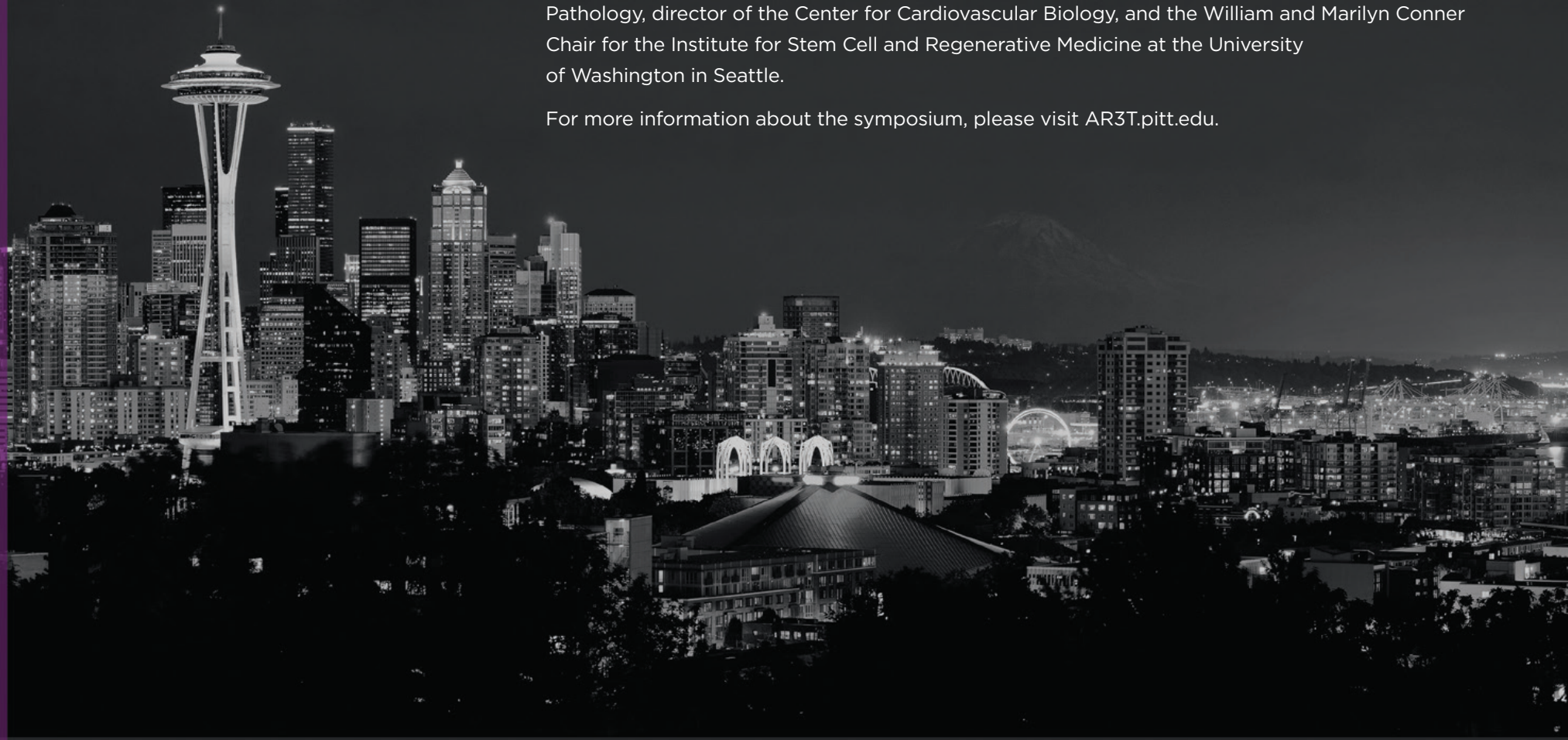
7th Annual International Symposium on Regenerative Rehabilitation

"Where Applied Biophysics Meets Tissue Engineering and Cellular Therapies"

October 11-13, 2018 Seattle, Washington

The 2018 event is being hosted by the University of Washington Department of Rehabilitation Medicine, Department of Medicine, and the Institute for Stem Cell and Regenerative Medicine. Keynote speakers at the 2018 event include David J. Reinkensmeyer, PhD, professor in the Departments of Mechanical and Aerospace Engineering and Biomedical Engineering at the University of California, Irvine, and Charles E. Murray, MD, PhD, professor in the Department of Pathology, director of the Center for Cardiovascular Biology, and the William and Marilyn Conner Chair for the Institute for Stem Cell and Regenerative Medicine at the University of Washington in Seattle.

For more information about the symposium, please visit AR3T.pitt.edu.



Occupational therapists encourage a patient using the Armeo®, which improves neural plasticity.

Effective and Engaging Rehabilitation Through Robotic Technologies

Numerous studies show that combining technologies with conventional therapy leads to better outcomes. Robotic and sensor-based therapies provide greater intensity and are more effective in motivating patients, while giving therapists more time to treat patients.

By providing access to the most current rehabilitation technologies, UPMC and its therapists are staying at the forefront of rehabilitative care. This helps patients maintain engagement in their recovery and maximizes their rehabilitative progress.

Robotics for Inpatient Rehabilitative Care

Armeo®: Task-oriented rehabilitation to improve arm movement

One of the technologies for upper extremity rehabilitation made available for inpatient care of stroke or brain injury patients is the Armeo®. Partially compensating for the weight of the arm, the Armeo allows patients to focus strength on the movements needed to promote neural plasticity. The UPMC Rehabilitation Institute was the first facility in the United States to receive the new Armeo®Boom, and it also uses Armeo's original device, the Armeo®Spring, both of which provide self-initiated movement therapy.

"The Armeo makes rehabilitation fun for our patients, and the therapists enjoy it, too," says Shelbey Rojik, PT, director of rehabilitation services at UPMC Centers for Rehab Services (CRS). "By using the device to play games, restoration of movement is promoted, and our patients are more motivated in their recovery."

Andago®: Mobile robot used for body-weight supported gait training

With units dedicated to stroke, spinal cord injury, and brain injury care, the UPMC Rehabilitation Institute is home to the Pittsburgh area's only Andago®, a mobile robot used for body-weight supported gait training. This technology enables upright, hands-free walking that bridges the gap between treadmill-based gait training and free walking.

Armeo® and Andago® are trademarks of Hocoma AG.

The Andago helps stroke and brain injury patients move from assisted gait therapy to unsupported walking sooner than traditional therapy typically allows.

"We have nearly 10 different technologies that we incorporate into our patient's care," Rojik continues. "This makes the hard work of rehabilitation more interesting and engaging for our patients. With devices like the Andago, we can also reduce fatigue in our therapists by relieving them of the need to support the patient's body weight."

"OUR PHYSIATRISTS AND THERAPISTS WORK TOGETHER TO DEVELOP INDIVIDUALIZED CARE PLANS FOR EACH OF OUR PATIENTS," SAYS ROJIK. "THEY INCORPORATE OUR REHABILITATIVE TECHNOLOGIES INTO THESE PLANS TO PROVIDE A ROBUST AND EFFECTIVE TREATMENT PROGRAM."

The Andago® provides therapists with an option for body-weight supported gait training.

Outpatient Care Via Advanced Rehabilitation Technologies

UPMC physiatrists, therapists, and a host of other clinical specialists provide outpatient care to a growing contingent of patients in numerous locations.

For individuals who undergo inpatient rehabilitation at one of the UPMC Rehabilitation Institute locations, the outpatient clinics provide a high degree of continuity of care that facilitates the ongoing rehabilitation process months, and at times years, into the future.

Advanced rehabilitation technologies, often initiated in the inpatient setting, are extended to the outpatient setting to promote effective recovery.

Blood Flow Restriction Technology: Specialized tourniquet to reduce blood flow while exercising

Another rehabilitation technology that is making great strides for those in the outpatient setting is the blood flow restriction (BFR) device, a tourniquet system used on an arm or leg that is in motion. The device is intermittently inflated to a personalized and specific pressure that reduces blood flow to the extremity, providing the benefits of heavy lifting at much lower loads. This makes it a safe choice for a variety of diagnoses throughout the rehabilitation process. BFR technology minimizes the effect of limited extremity use, shortens rehab time, and enhances outcomes. Both the NFL and the United States Army also utilize this device, which speaks to its efficacy in rehabilitating patients.

"We have witnessed extreme benefits from this form of rehabilitation in patients who have failed with traditional techniques," says Jim Burns, assistant regional director of UPMC CRS. "BFR works well for many patients. Those who have had ACL reconstruction, tendinopathy, tendon repair, or nonunion fractures have all reaped tremendous rewards from this form of rehabilitation. There are also significant benefits for older patients who need help navigating stairs and getting into and out of chairs. The BFR device can increase their strength and mobility so their basic needs of life are met."

Patients who may benefit from blood flow restriction rehabilitation include those recovering from:

- Achilles tendon repairs
- Fractures
- Inflammatory muscle wasting diseases, such as polymyositis and dermatomyositis
- Knee reconstructions and cartilage repairs
- Muscle strains
- Nerve injuries
- Rotator cuff repairs
- Severe musculoskeletal trauma
- Symptomatic knee osteoarthritis
- Tendinopathies
- Total joint replacement

The AlterG® uses anti-gravity components to rehabilitate patients.

AlterG®: NASA-created anti-gravity treadmill for nearly weightless exercises

An integral part of sports rehabilitation is the AlterG® Anti-Gravity Treadmill, which is used in conjunction with the rehabilitation services provided at UPMC Sports Medicine. Originally developed by NASA to help astronauts maintain fitness during space flight, the AlterG uses positive air pressure technology to lift patients off the ground and decrease their body weight by up to 80 percent. The anti-gravity components allow patients to work on balance and proprioception for walking, and then progress toward running to help maintain cardiovascular health and fitness.

"We're excited to have such a dynamic device in our rehabilitation technology repertoire," says Pat Garvey, DPT, MS, FAAOMPT, a facility director with UPMC CRS. "The AlterG removes the load from our patients' joints and muscles so they can tolerate more functional activities while still allowing the body to heal, and we can gradually reintroduce that load over the course of their rehabilitation. Some patients hesitate to exercise after injury and others want to push too hard. In both populations, the AlterG is a tool that enables rehabilitation professionals to safely and appropriately progress patients to reach their full potential."

WalkAide®: Neuroprosthetic that provides biofeedback to aid in walking

Addressing drop foot in patients with upper motor neuron foot injuries, the WalkAide® uses tilt sensors and functional electrical stimulation to optimize the muscle control needed for walking. This neuroprosthetic is a training tool that provides biofeedback and improves nerve-to-muscle signals in the leg and foot.

"I've worked with various rehabilitative technologies in my career, and from an efficiency standpoint, the WalkAide is user-friendly and allows us to see immediate outcomes," says Lisa Franz, PT, a facility director with UPMC CRS. "Some technology is labor intensive and the setup is quite time consuming, so therapists aren't willing to use it. We need something quick, easy to use, and effective so we can spend most of our time in patient care. The WalkAide fits that description, which is why so many of the therapists are fans of the unit."

WalkAide® is a trademark of Biomotion Ltd.

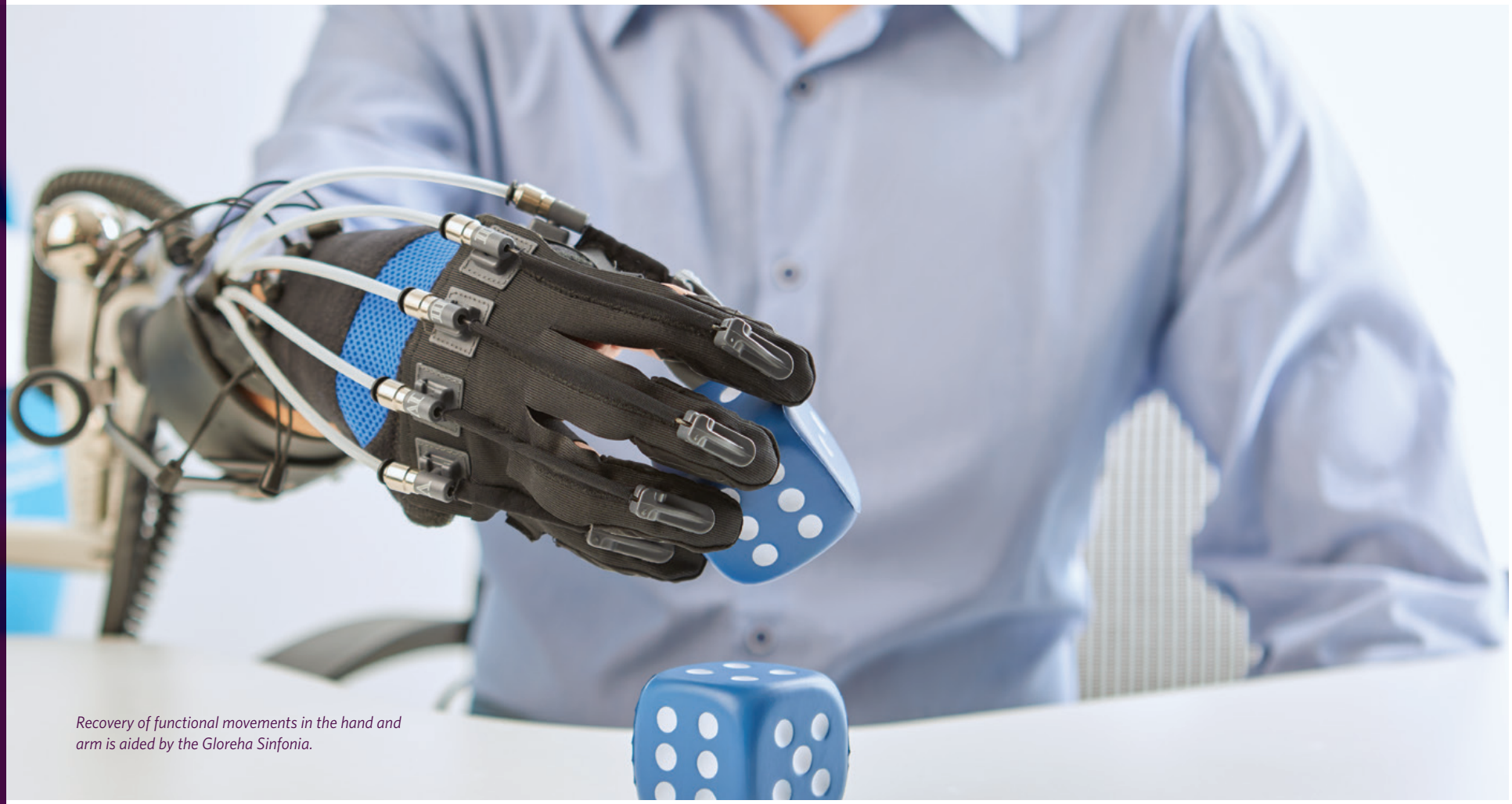
Preparing for the Next Generation of Rehabilitation Robotics

Research studies conducted by UPMC in partnership with the University of Pittsburgh are important components in determining the next generation of technologies that can be used to effectively rehabilitate patients. The outcomes of these studies bridge the gap between today's technologies and tomorrow's more advanced robotics for rehabilitative care.

Gloreha Sinfonia: An upper limb rehabilitation glove for all phases of neuromotor recovery

The Gloreha Sinfonia is a rehabilitation glove that supports joint motion in the fingers while detecting voluntary active motion, and is designed to help patients recover functional movements. Multisensory stimulation in the glove and 3D animation on the screen keep patients motivated during their motor exercises, which help them perform grasping, reaching, and picking exercises while interacting with real objects.

"The Gloreha Sinfonia represents the state-of-the-art in hand exoskeletons," says Jennifer Collinger, PhD, assistant professor in the Department of Physical Medicine and Rehabilitation. "We recently purchased one to support research on emerging therapies aimed at increasing neural plasticity in stroke and spinal-cord injured patients. We're hopeful that this device will help these patients achieve a critical level of function where they can engage effectively in tasks that promote recovery of grasp and manipulation functions."



Recovery of functional movements in the hand and arm is aided by the Gloreha Sinfonia.

VRSim® 3.0: Wheelchair training via virtual reality

The VRSim® 3.0 provides the technology for wheelchair users to enter a virtual environment where they can learn to safely navigate their surroundings, use different drive settings, and try out different wheelchairs without the risk of injury. An international collaboration between the researchers at the Human Engineering Research Laboratories (HERL) at the University of Pittsburgh, software programmers from MTech Games, and hardware designers from Bansen Labs LLC led to the development of VRSim 3.0, an Oculus Rift®-based virtual reality system that incorporates a virtual environment of an inpatient rehabilitation unit.

"Training people with significant disabilities who have difficulty operating an electric-powered wheelchair in a safe, controlled environment is the main strength of using a virtual reality system for wheelchair users," says Deepan Kamaraj, MD, a research associate at HERL who has been developing this virtual training platform and facilitating this study. "Programmers can build various virtual environments resembling the users' own homes and their community. This allows therapists to offer individualized, targeted training to improve the wheelchair users' independent mobility in their home, community, or place of employment."

Comprehensive Care, Better Outcomes

The assortment of technologies available at the UPMC Rehabilitation Institute and UPMC CRS is as comprehensive as the various areas of the body that are treated with these devices. The collaborative efforts of the physicians, physiatrists, and therapists, combined with a plethora of diverse rehab tools, allow patients to experience better outcomes and more complete recoveries, while keeping them entertained and engaged during their recovery process.

The VRSim® 3.0 enables wheelchair users to safely navigate their environment in a virtual setting.

The virtual world that is displayed helps acclimate the user to various surroundings.

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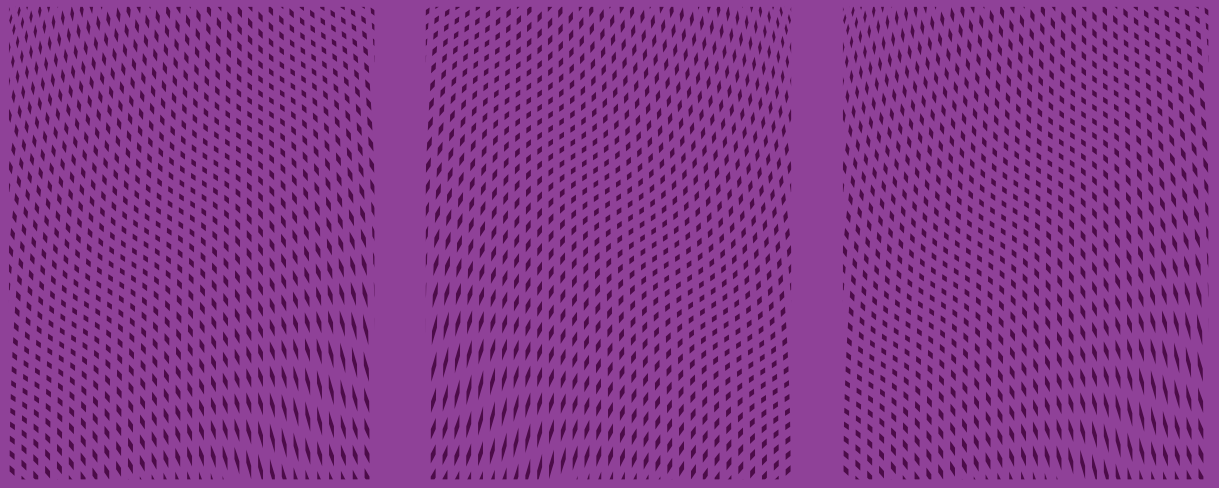

UPMC
LIFE CHANGING MEDICINE

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A $16 billion world-renowned health care provider and insurer, Pittsburgh-based UPMC is inventing new models of patient-centered, cost-effective, accountable care. UPMC provides more than $900 million a year in benefits to its communities, including more care to the region's most vulnerable citizens than any other health care institution. The largest nongovernmental employer in Pennsylvania, UPMC integrates 80,000 employees, more than 30 hospitals, 600 doctors' offices and outpatient sites, and a 3.2 million-member Insurance Services Division, the largest medical insurer in western Pennsylvania. As UPMC works in close collaboration with the University of Pittsburgh Schools of the Health Sciences, *U.S. News & World Report* consistently ranks UPMC on its annual Honor Roll of America's Best Hospitals. UPMC Enterprises functions as the innovation and commercialization arm of UPMC, and UPMC International provides hands-on health care and management services with partners on four continents. For more information, go to UPMC.com.

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