





The practice of physical medicine and rehabilitation at UPMC, and the application of its guiding principles, extends far beyond the confines of the hospital or outpatient clinic. The role that this discipline plays within the greater UPMC system is expanding to meet both the evolving trends in health care delivery and the evolving needs of patients.

Through consistent dedication to groundbreaking research that moves our discipline forward and by implementing the latest rehabilitation technologies that keep our patients engaged in their recovery, we continue to provide cutting-edge care to our patients. The knowledge derived in our laboratories and research corridors continues to drive our fundamental understanding of the importance of rehabilitation medicine across the entire spectrum of health care.

Our comprehensive programs provide a continuum of care from the hospital and clinic to the skilled nursing facility and into the home. We are achieving this in innovative ways that challenge the existing paradigms of patient care to continuously improve. We build on our collective past endeavors to inspire the changes and updates necessary to be better doctors, better therapists, and better innovators — sometimes incrementally, and sometimes with bold leaps forward.

This report enables us to share our work with our colleagues across the country in the hope that collectively we can inspire each other toward the breakthroughs of the future that will change the lives of those entrusted to our care.

Respectfully,

A handwritten signature in black ink, appearing to read 'G Sowa', written in a cursive style.

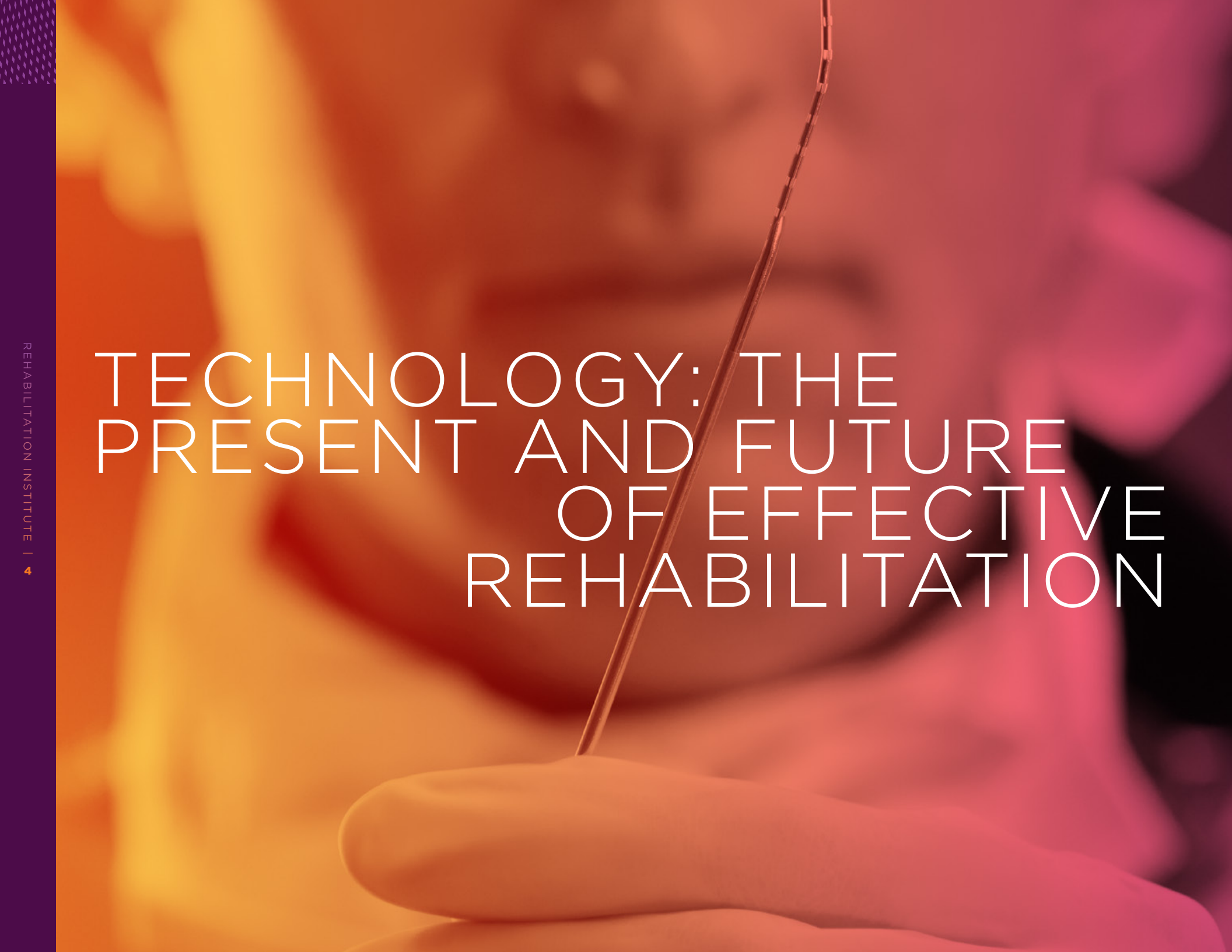
Gwendolyn Sowa, MD, PhD

Director, UPMC Rehabilitation Institute

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A hand holding a thin, curved metal rod against a blurred background of warm colors. The background is a mix of orange, yellow, and pinkish-red tones, suggesting a soft, glowing light. The hand is positioned at the bottom, with the rod extending upwards and curving to the right. The overall mood is one of precision and care.

TECHNOLOGY: THE PRESENT AND FUTURE OF EFFECTIVE REHABILITATION

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 study¹, 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.



OEC

“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

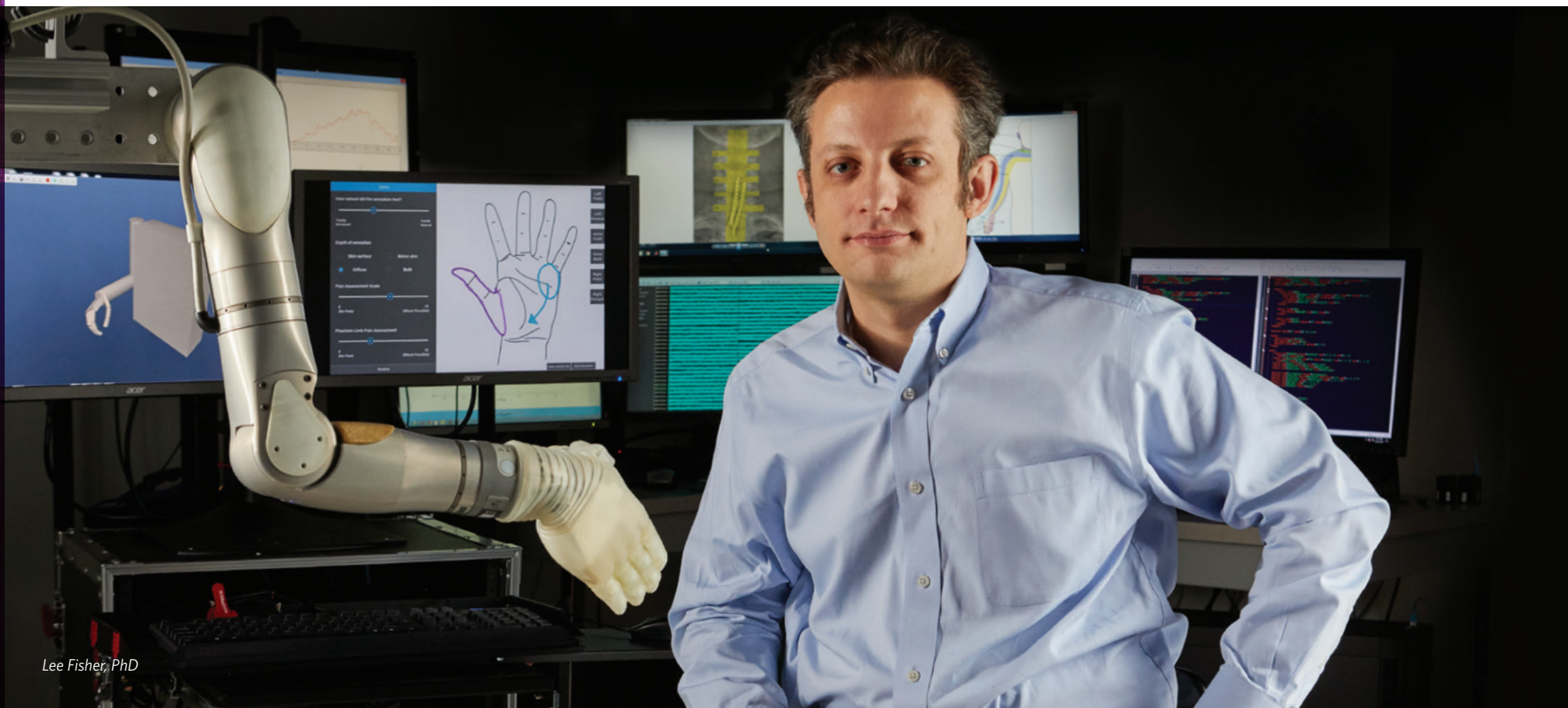
Lee Fisher, PhD, a biomedical engineer and assistant professor in the Department of Physical Medicine and Rehabilitation, is working with Dr. Helm and Doug Weber, PhD, associate professor of bioengineering at the University of Pittsburgh and director of the Rehab Neural Engineering Lab, to investigate 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.



“WHAT WE’RE TRYING TO ACCOMPLISH WITH OUR RESEARCH IS THE PRODUCTION OF SENSATION THAT FEELS NATURAL.”



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.

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



**“I AM HOPEFUL THAT AS TIME GOES ON,
WE WILL SEE MORE PRECLINICAL STUDIES
IMPLEMENT AND MODEL OUR CLINICAL
PRACTICES MORE EFFECTIVELY.”**

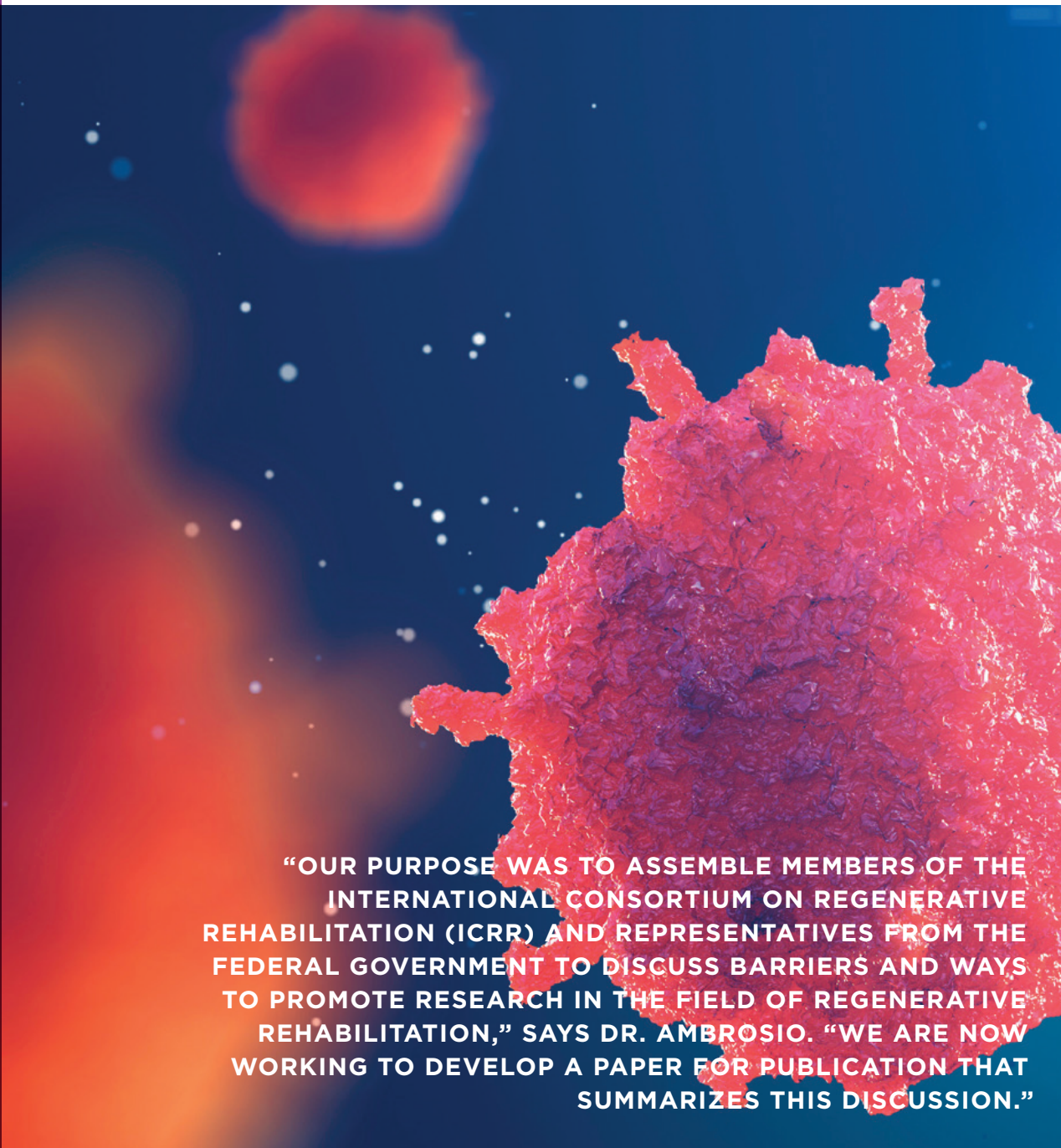
Leading the Field in New Directions

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 TO DISCUSS BARRIERS AND WAYS TO PROMOTE RESEARCH IN THE FIELD OF REGENERATIVE REHABILITATION,” SAYS DR. 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 (AR³T) 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

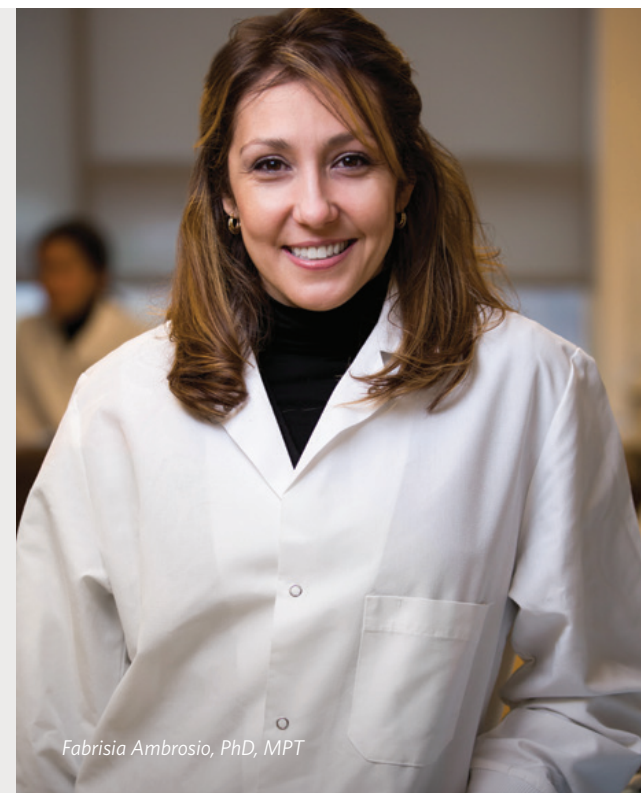
The ICRR was created by Dr. Ambrosio and her colleagues at the University of Pittsburgh and the Palo Alto VA Rehabilitation R&D REAP Center in 2014. Since its inception, the ICRR has continued to grow and now includes 15 institutions in North America, Asia, and Europe. In 2018, three new institutions 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.



Fabrisia Ambrosio, PhD, MPT

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

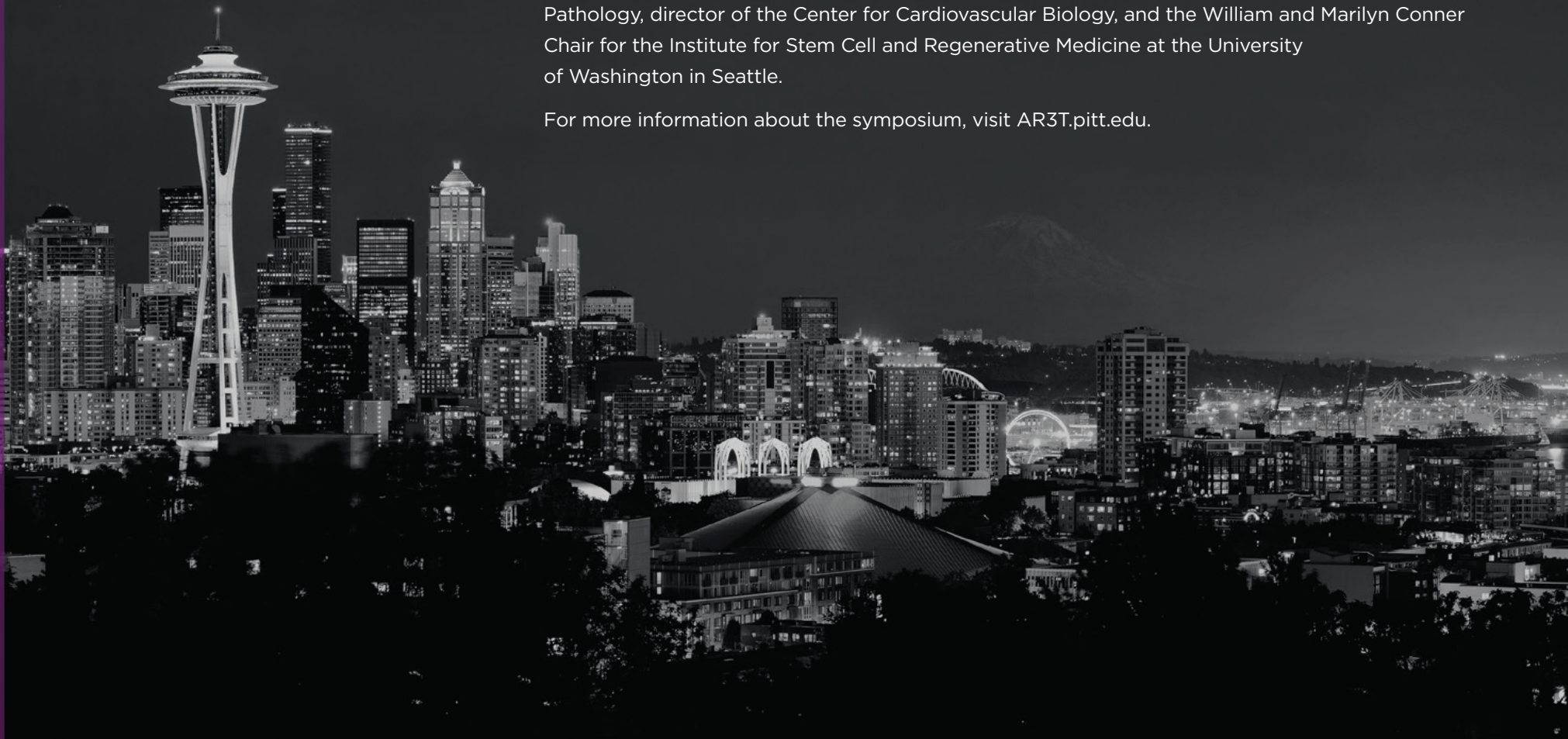
*"Where Applied Biophysics Meets Tissue
Engineering and Cellular Therapies"*

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, 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.

A close-up photograph of a man wearing a VR headset. The image is overlaid with a digital particle effect consisting of many small, semi-transparent squares and rectangles in shades of blue and white, creating a sense of motion and data. The man has a beard and is wearing a blue and white striped shirt. The background is dark and out of focus.

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.

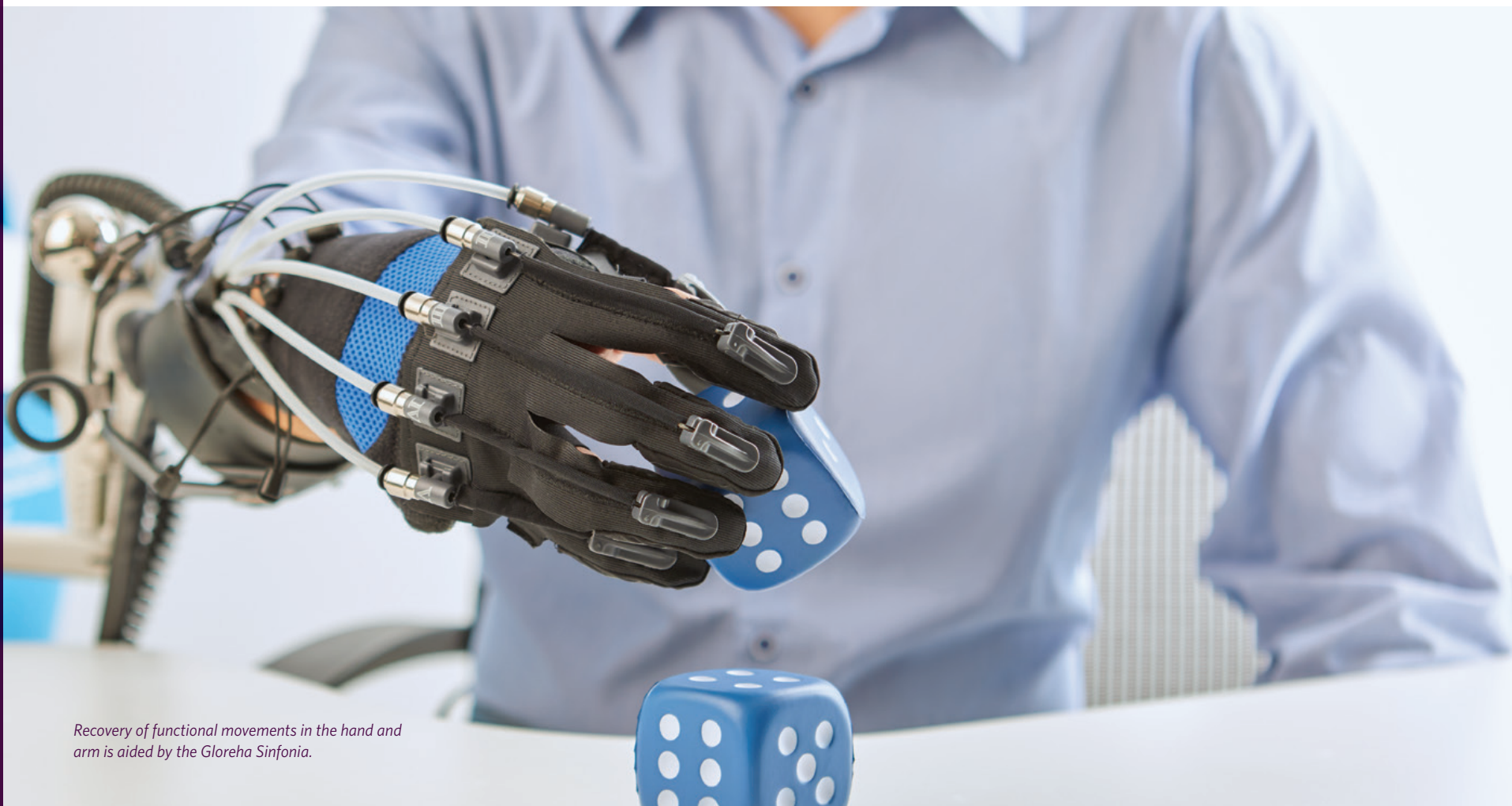
Gloreha Sinfonia: An upper limb rehabilitation glove for all phases of neuromotor recovery

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.





A FOCUS ON MEDICALLY COMPLEX PATIENTS:

REHABILITATIVE CARE FROM HOSPITAL TO HOME

Burn Rehabilitation: Caring for Medically Complex Patients

Part of the largest rehabilitation network in western Pennsylvania, the UPMC Rehabilitation Institute offers specialized inpatient and transitional care for a variety of conditions. This specialized care centers on medically complex patients, including individuals sustaining burn injuries who require a unique combination of medical intervention and rehabilitation.



Members of the burn rehabilitation care team meet with a patient.

“Contact with burn patients begins as soon as they’re admitted to the ICU,” says Maria Twichell, MD, assistant director of the UPMC Rehabilitation Network. “Physicians from the Department of Physical Medicine and Rehabilitation (PM&R) are consulted immediately upon admission, and they follow the patients through their series of surgeries, hydrotherapy sessions, and the acute course of treatment, which can be prolonged depending on the severity of their injuries.”

UPMC is nationally recognized as a leader in providing quality care to individuals of all ages with severe burn injuries. The rehabilitation team works closely with the burn team throughout the patient’s rehabilitation, including the coordination of discharge plans and follow-up appointments for each patient. Together, these highly specialized services focus on delivering expert medical care and developing therapeutic plans that help the patient transfer from hospital to home.

Once admitted to the UPMC Rehabilitation Institute, burn patients have wound management in the morning, followed by three to four hours of comprehensive therapy each day, as directed by a physiatrist. Rehabilitation protocols also include physical therapy for improved endurance and stamina, transfer techniques, independent mobility, strengthening, and occupational therapy for improving fine motor skills and activities of daily living. Burn patients also work with their therapists on stretching, contracture prevention, learning self-management techniques, massage, and prevention of further complications. Some patients may require splinting.



Maria Twichell, MD



“SINCE REHABILITATION IS AN ONGOING PROCESS AS OPPOSED TO SOLELY A HOSPITAL-BASED PHENOMENON, INVOLVING FAMILY MEMBERS IN THE CARE AND RECOVERY PROCESS HELPS MOTIVATE OUR PATIENTS TO CONTINUE THEIR THERAPY ONCE THEY RETURN HOME.”

Physiatrists manage the return of function while ensuring that patients continue to recover clinically. There are many patient-specific medical issues to be addressed by the physiatrist while each individual is participating in rehabilitation. Physiatrists evaluate lab data for electrolyte imbalance from fluid shifts, monitor anemia that can be brought on by blood loss from wounds, and frequently check markers of impending infection.

Nutritional status, including adequate supplementation as patients go through therapy, is integral to wound healing and recovery. Many patients require respiratory support or tracheostomy management due to lung injury from inhalation of smoke. Orthostasis, from blood/fluid loss and prolonged immobility, is also addressed by the physiatrist. Finally, adjustment and management of pain medications to provide adequate analgesia as patients undergo therapy are integral to a successful treatment plan.

Another important component of burn rehabilitation at UPMC is neuropsychology. Therapy sessions are provided daily for all patients as many will have psychological concerns due to the physical limitations caused by their injuries. Patients often have significant worries about being able to provide for their family and how their role in the

family may change. Many must also deal with their altered physical appearance, which may cause psychological distress. They may also experience chronic pain, post-traumatic stress disorder (PTSD), anxiety, or difficulty sleeping. To aid in the patient's physical and mental recovery, the trauma and burn physicians, physiatrists, neuropsychologists, and rehabilitation therapists collaborate and involve family members from the outset of the patient's care.

“We start family training early in our patients' treatment and involve them in the entire process,” continues Dr. Twichell. “We teach family members to help with wound care, administer burn medications, and provide motivation for stretching and ongoing therapy.”

“Since rehabilitation is an ongoing process as opposed to solely a hospital-based phenomenon, involving family members in the care and recovery process helps motivate patients to continue their therapy once they return home.”

Reducing Avoidable Readmissions: The Home Transitions Program

With more than 90 inpatient, outpatient, transitional, and long-term care locations, UPMC has developed a network of services to meet patients' needs at each stage of recovery. As the healing process moves from hospital to home, UPMC Community Provider Services (CPS) steps in. An important part of the continuum of care, CPS helps patients reintegrate into the community and raises awareness of beneficial community resources to ensure that each patient continues to receive quality care, thereby reducing readmissions.



Michael Boninger, MD

"Ninety percent of our CPS patients are elderly, so we provide many services that help this patient population safely transition home postdischarge," says Michael Boninger, MD, senior medical director for post-acute care for the UPMC Health Services Division. "Our physical medicine and rehabilitation physicians often are consulted to help determine the discharge location for these patients to ensure their safety and enable them to maximize function after leaving the hospital. We are dedicated to helping our patients so they can continue living full lives, despite their health setbacks."



*Cindy Wilson, senior director of UPMC
Community Supportive Services*





“OUR PHYSICAL MEDICINE AND REHABILITATION PHYSICIANS ARE OFTEN CONSULTED TO HELP DETERMINE THE DISCHARGE LOCATION FOR THESE PATIENTS TO ENSURE THEIR SAFETY AND ENABLE THEM TO MAXIMIZE FUNCTION AFTER LEAVING THE HOSPITAL. WE ARE DEDICATED TO HELPING OUR PATIENTS SO THEY CAN CONTINUE LIVING A FULL LIFE, DESPITE THEIR HEALTH SETBACKS.”

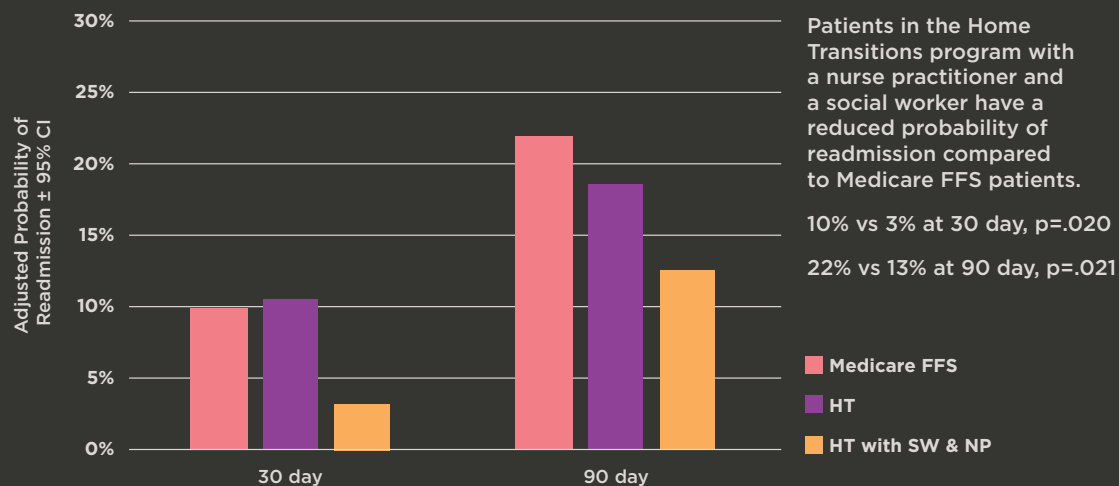
To help reduce potentially avoidable 30-day readmissions for patients identified as high-risk for readmission at the time of hospital or skilled nursing facility (SNF) discharge, CPS has created Home Transitions, a home-based transitional care program. The goal of the program is to prevent complications, identify early changes in the condition or deterioration of the patient, and intercede with the skilled home health plan of care, while involving the patient’s primary care physician (PCP).

As an integrated delivery and finance system (IDFS), UPMC serves as a preeminent health care provider and as the payer due to its own health insurance arm, UPMC Health Plan. The Home Transitions program is part of this payer-provider model. It is a collaborative effort between UPMC Home Healthcare and UPMC Health Plan. UPMC patients identified as medium- to high-risk for readmission are referred to UPMC Health Plan for approval and can then enter the Home Transitions program.

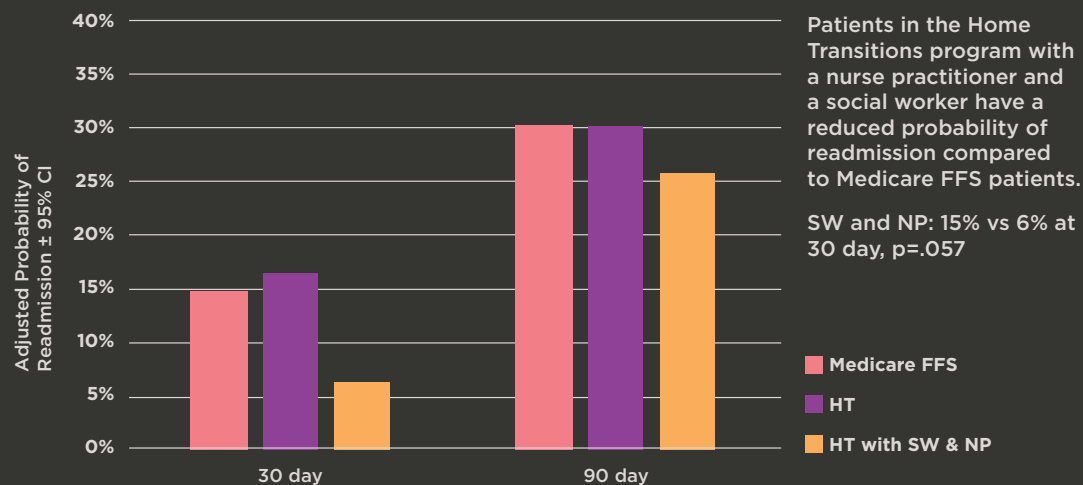
“We refer to the Home Transitions program as ‘home health on steroids,’” says Cindy Wilson, senior director of UPMC Community Supportive Services. “Our patients receive the same services as other home health patients, but there are many additional layers of care, including an expedited start of care, visits by certified registered nurse practitioners, and social workers.”

A care transitions coordinator (CTC) works as the “air traffic controller” of these complex patients’ needs. The patients’ certified registered nurse practitioner, social worker, pharmacist, PCP, and the medical director from UPMC Health Plan hold weekly interdisciplinary conferences to discuss these cases. In-depth review of patients’ care can reveal prescribed medications that aren’t being filled or a need for language translation.

Adjusted Readmission Results (Medium Readmission Risk)



Adjusted Readmission Results (High Readmission Risk)



“The CTC provides extra hands-on care coordination, and they can introduce patients to various resources in the community to help them return to the life they had before their injury or illness,” says Wilson.

In a soon-to-be published study done by The Wolff Center at UPMC, readmission rates were compared between UPMC Health Plan patients who accepted enrollment in the Home Transitions program and those in a matched Medicare fee-for-service (FFS) population. As the chart indicates, patients within the UPMC Home Transitions program have a reduced probability of readmission compared to those in the Medicare FFS program.

“With all the changes in reimbursement, and a focus on decreasing readmissions, our numbers speak volumes about the success of this program,” says Dr. Boninger, who is working on publication of the study. “The Home Transitions program clearly has a significant effect on readmissions, while enabling our patients to remain in the comfort of their own homes.”

Figure 1: 30-Day Readmission Rates¹


	Medium-Risk Patients	High-Risk Patients
Home Transitions Program	3%	6%
Medicare Fee-For-Service Program	10%	15%

¹Percentages are based on 5,000 patients from July 31, 2015 to April 30, 2017.

CI - Confidence Interval
FFS - Fee-For-Service

HT - Home Transitions
NP - Nurse Practitioner

SW - Social Worker

A man with a beard and glasses, wearing a grey long-sleeved shirt and blue jeans, is seated in a wheelchair. He is holding a smartphone in his hands and looking at the screen. The background shows a kitchen with wooden cabinets, a microwave, and a refrigerator. The lighting is warm and indoor.

“THE IMHERE SYSTEM WAS CREATED SO THAT PEOPLE WITH DISABILITIES ARE ABLE TO MANAGE THEIR HEALTH AT HOME AND LIVE MORE INDEPENDENTLY. THIS SYSTEM IS MEANT FOR LONG-TERM USE, SO PATIENTS CAN POTENTIALLY UTILIZE IT FOR A LIFETIME.”

imHere: Helping to Prevent Occurrence of Secondary Conditions Through Mobile Health

Studies show that 87 percent of people with disabilities have at least one chronic secondary condition.² This is due in part to a lack of accessible and responsive health care for this patient population. Chronic secondary conditions can be life threatening, but some are preventable. Finding a way to develop technologies to support and educate these individuals on self-care became a priority for researchers at UPMC this past year.

“IF SOMEONE SUBMITS INFORMATION THAT INDICATES THERE IS A SERIOUS PROBLEM, THEN THE WELLNESS COORDINATOR CAN CALL THEM TO MAKE SURE THEY COME IN FOR A VISIT. WE ARE CURRENTLY BUILDING FEATURES TO HELP PEOPLE SCHEDULE THEIR MEDICAL TRANSPORTATION.”

In collaboration with UPMC Health Plan, Brad Dicianno, MD, associate professor in the Department of Physical Medicine and Rehabilitation, and Bambang Parmanto, PhD, professor of health information management at the University of Pittsburgh School of Health and Rehabilitation Sciences, set out to find a way to overcome geographic barriers for people with disabilities and reduce hospital admissions by developing a mobile health platform called Interactive Mobile Health and Rehabilitation (iMHere).

The iMHere system includes a smartphone app with modules that enable individuals with disabilities to manage their own self-care routines, an app for caregivers, a web-based portal for the clinician or case manager, and two-way communication. The smartphone app functionality includes reminders, secure messaging, symptoms surveys and reporting, and photo uploads for assessing various conditions. The case manager can triage individuals and intervene quickly when issues arise by using a dashboard on the web-based portal.

“Some of my early research showed that a lot of complications in this patient population can be prevented if we do better with self-management at home,” says Dr. Dicianno. “The iMHere system was created for patients with disabilities, to manage their health and help them to live independently. This system is meant for long-term use, so patients can potentially utilize it for a lifetime.”

The iMHere system is one of the few mHealth systems that is accessible to people with disabilities and is adaptable to their changing needs and impairments over time.

After undergoing usability studies with focus groups and in-laboratory testing, the app was tested on individuals with spina bifida. Over a one-year period, 13 participants received usual care and used the iMHere system, while 10 control participants received only usual care without having access to iMHere. Positive changes in self-management abilities and less reliance on caregivers were seen with those utilizing the system often. A reduced incidence of preventable conditions and utilization of services was also witnessed. The estimated average cost savings on health care utilization was approximately \$27,000 per user per year.

According to Dr. Dicianno, one wellness coordinator could only handle approximately 25 patients at a time prior to development of the app, and self-management is costly. Mobile health is a way to scale up and make interventions economical while reaching many people simultaneously. This in turn improves health outcomes, improves the patient’s satisfaction, and delivers care at a reduced cost.



Brad Dicianno, MD, and Bambang Parmanto, PhD, developed the Interactive Mobile Health and Rehabilitation (iMHere) mobile health platform.

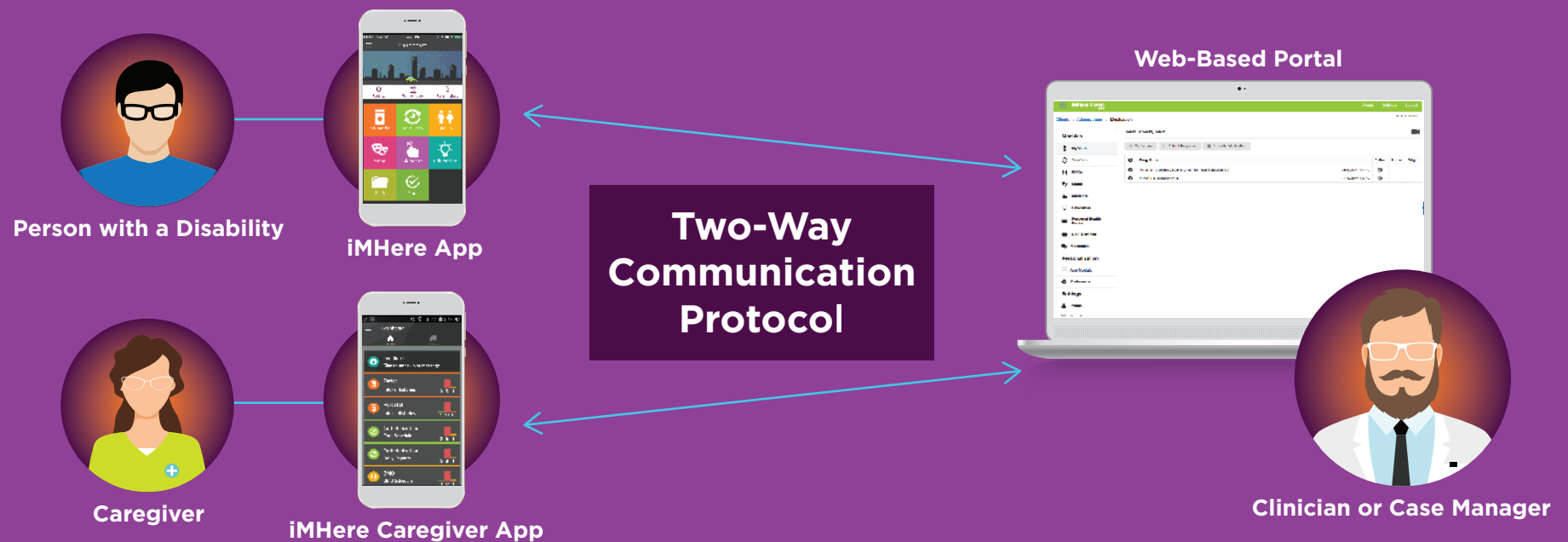


Figure 2. iMHere system that includes a smartphone app for individuals with disabilities and caregivers, and a web-based portal for case managers and clinicians.

“For health systems, the app was developed to be used in a variety of ways, depending on how an institution’s care model is set up,” says Dr. Parmanto. “It’s not meant for emergency care. It operates more like how we provide services in an outpatient setting.”

There are several functions of the app, including:

- Helping patients with self-care, such as knowing which medications to take, self-catheterization needs, skin care, ordering supplies, and making appointments
- Facilitating communication with a wellness coordinator who can provide clinical advice and provide guidance on what patients can do
- Providing new and updated information to patients through the education module

“The app supports people in a number of different ways, not just to manage medical conditions but also to actively participate in and coordinate their care,” says Dr. Parmanto.

One of the main reasons this patient population is rehospitalized is because of secondary conditions, such as urinary tract infection, pressure ulcers, sepsis, pneumonia, and bowel issues. Education is key, which is why the app is so valuable. Some of the educational modules on the app are targeted to these conditions so patients can learn more about them.

“There are a lot of things we can deliver and empower patients to do without actually having to physically visit them,” says Dr. Dicianno.

Usability, feasibility, and clinical trials are ongoing to study the impact of the iMHere system on larger, more diverse cohorts of patients and their caregivers to continuously improve the technology. The preliminary work on this app demonstrates that a scientifically sound mobile health platform can support delivery of many types of health and wellness interventions for those living with chronic conditions.

²Kinne S, Patrick DL, Doyle DL. Prevalence of Secondary Conditions Among People with Disabilities. *Am. J. Public Health.* 2004; 94(3): 443-445.

Accuracy of Activity Monitors and Step Count Recording in Older Adults

Maintaining activity levels in older adults promotes a more independent lifestyle and provides a number of other health benefits. However, many older individuals become less active with age and fall victim to the sedentary cycle, a pattern of limited participation in daily activities that one needs to do, wants to do, or is expected to do.



Inactivity and the sedentary cycle can lead to:

- Physical deconditioning
- Decline in cognition or mood
- Increased hospitalization
- Disease onset
- Decreased life expectancy
- An overall decreased quality of life

Opportunities to stimulate the mind and body, as well as motivation to sit less and move more, must be provided to positively impact this cycle. Two researchers with the University of Pittsburgh Department of Physical Therapy set out to do just that when they conducted the “Step Count Recording in the Elderly” study. The study determined the efficacy of 10 different activity monitors, and the results were applied to an activity intervention program as motivation for older adults.

Andrea Hergenroeder, PhD, assistant professor of physical therapy at the University of Pittsburgh, and Jennifer Brach, PhD, associate professor of physical therapy at the University of Pittsburgh, looked at the accuracy of these devices in counting steps for older people, especially those who walk slowly and use assistive devices for walking.

“The main challenge for this study was to determine which activity monitor could track steps in older adults who walk slowly, shuffle their feet when they walk, or use a cane or walker,” says Dr. Brach. “We wanted all steps to be counted, even ones taken at a slower pace, to motivate this older population to walk more.”

At an average age of 82, there were 43 people residing in independent living facilities who participated in this study, which included an initial gait speed assessment. The accuracy of each of the 10 monitors was determined by having each participant complete two walking trials consisting of 100 steps each while wearing all the devices simultaneously. The devices were designed to be worn on the wrist, waist, ankle, leg, or clipped on to clothing.

After the walking trials, the participants completed questionnaires about the usability features of the monitors. Difficulty assessing the step display and inability to put the devices on were common barriers to monitor use. The most important feature was found to be monitor accuracy, and the least important feature was the ability to interface with a smart device. A commercially available, waist-worn device proved to be the clear winner among the study participants. Results of this study have not yet been published, but plans are already in place to continue building on this research.

“Now that we know what type of activity monitor works best for older adults, we want to focus on how we can apply our findings to those who are going home after discharge from the hospital,” says Dr. Hergenroeder. “How can physicians and other health care providers assist patients who would benefit from increasing their physical activity level or those who are just starting to become more physically active? This question can be addressed as we move forward with this research.”

Hergenroeder and Brach found that most commercial activity monitors lack accuracy when used by older adults who use walkers or canes and walk slowly. However, a few of the monitors performed better than others, were easier to put on, and were cost effective. The self-monitoring capability keeps the users accountable, so they are more likely to want to increase their daily steps and continue on a path of activity and wellness, thereby breaking the sedentary cycle.



Andrea Hergenroeder, PhD, and Jennifer Brach, PhD, tested the accuracy of 10 activity monitors to motivate older adults to be less sedentary.


“THE MAIN CHALLENGE FOR THIS STUDY WAS TO DETERMINE WHICH ACTIVITY MONITOR COULD TRACK STEPS IN OLDER ADULTS WHO WALK SLOWLY, SHUFFLE THEIR FEET WHEN THEY WALK, OR USE A CANE OR WALKER. WE WANTED ALL STEPS TO BE COUNTED, EVEN ONES TAKEN AT A SLOWER PACE, TO MOTIVATE THIS OLDER POPULATION TO WALK MORE.”

Primary Spine Practitioner Certification Program: Helping Patients, Reducing Costs

Despite steps being taken to improve health care delivery in the United States, the dramatic increase in health care costs has not led to better clinical outcomes or an improved health care experience for patients. In no area of medicine are these issues more obvious than in the area of spine-related disorders. With more than 80 percent of the U.S. population being affected by some type of spine-related disorder in their lifetime, many of whom go on disability, a solution had to be found.³

The financial burden of spine-related disorders on individuals and society equates to \$102 billion annually, and hovers around \$14 billion in lost wages.³ Between 1996 and 2013, low back and neck pain were identified as the third most expensive disease category in the United States after cancer and heart disease, with direct costs of treatment estimated at \$87.6 billion in 2013. By changing the way spine care is delivered, the triple-aim goals of improved care, improved outcomes, and reduced costs can be achieved.

Central to this process is the establishment of the Primary Spine Practitioner (PSP) Certification Program™, a national certification program offered to chiropractors and physical therapists that will soon be instituted at UPMC. With this program, spine care is coordinated and managed, evidence-based clinical guidelines are followed, and a process is implemented that ensures that patients are involved in treatment decisions.⁴

A photograph of two men in business suits engaged in a conversation. The man on the left, Tony Delitto, is wearing glasses and gesturing with his hands as he speaks. The man on the right, Michael Schneider, is listening attentively. In the background, a large screen displays two side-by-side MRI scans of a human spine, showing the vertebrae and intervertebral discs in a blue-tinted image.

“We’ve found that the majority of our patients with spine-related disorders have no idea what causes their back pain,” says Tony Delitto, PhD, PT, dean of the School of Health and Rehabilitation Sciences at the University of Pittsburgh. “A lot of time, money, and energy are spent on unnecessary procedures, such as MRIs, x-rays, and administering medications because the patient’s condition isn’t being properly managed and the cause of the problem is elusive.

“To alleviate the cost and time burden of doctor-shopping and undergoing fruitless procedures, we’d like to bring the PSP-trained chiropractor or physical therapist in to manage spine-related disorders early on, to be involved in the patient’s care from the outset.”

The three main portals of entry to the health care system for patients with spine-related disorders are chiropractors, primary care physicians, and emergency departments. PCPs and EDs aren’t equipped to spend a lot of time explaining nonpharmacological approaches to pain management, so they may refer patients to a PSP to do so. In the primary care setting, patients can complete a questionnaire that helps determine if they have an acute or chronic back issue. Since the PSP has expertise in painful spinal conditions, he or she can explain in detail the nonsurgical options that are available, and ensure that only necessary tests and drugs are ordered for patients.

*Tony Delitto, PhD, PT, and
Michael Schneider, DC, PhD*

“TO ALLEVIATE THE COST AND TIME BURDEN OF DOCTOR-SHOPPING AND UNDERGOING FRUITLESS PROCEDURES, WE’D LIKE TO BRING THE PSP IN EARLY ON, TO BE INVOLVED IN THE PATIENT’S CARE FROM THE OUTSET.”



Tony Delitto, PhD, PT

“There is a primary care physician shortage in the United States, and back pain sufferers are overwhelming the primary care system,” says Michael Schneider, DC, PhD, associate professor in the Department of Physical Therapy at the University of Pittsburgh, who is another key figure in bringing the PSP program to UPMC.

The PSP can do a more extensive review of the back pain issue and modify a physical therapy or a chiropractic approach so it is better tailored to the patient. If the patient has a more complicated problem with biobehavioral overlay, the PSP can help them explore all treatment options by quickly referring them for multidisciplinary management at a musculoskeletal clinic, such as UPMC Total Care — Musculoskeletal Health.

After nearly three years of planning and research, the University of Pittsburgh School of Health and Rehabilitation Sciences launched the certification program to train PSPs. The Primary Spine Practitioner Certification Program has been underway for less than a year through the Department of Physical Therapy at the University of Pittsburgh. It is currently only being offered in Pittsburgh,

with plans to expand to other locations nationally. The current participants in the training program consist of local chiropractors and physical therapists, although many have come from other states and even abroad to participate.

“We’ve built the program, we’ve started to educate people, and now the third phase is implementing it into the UPMC system so that we have the algorithms in place to pick out these spine-related disorder patients and have them sent to a PSP,” says Dr. Delitto. “We haven’t put the plumbing in place where we are finding the patients, routinely screening for them, getting them referred to a PSP, and making sure they go. We’re still working on establishing that cross-talk between the original referrer and the PSP, and creating those strong links with the musculoskeletal health clinics.”

While there are other successful PSP models across the country, UPMC is the first health system to offer a PSP certification program. Once the framework is established, allowing spine-related disorder patients to be identified at the outset of their first appointment, the program will be fully operational at UPMC in spring 2018.

References

³Murphy D, Justice B, Paskowski I, Perle S, Schneider M. The Establishment of a Primary Spine Care Practitioner and Its Benefits to Health Care Reform in the United States. *Chiropr Man Therap*. 2011; 19: 17.

⁴Goertz C, Weeks W, Justice B, Haldeman S. A Proposal to Improve Health-care Value in Spine Care Delivery: The Primary Spine Practitioner. *Spine J*. 2017; 17(10): 1570-1574.

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TRAUMATIC BRAIN INJURY

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PATIENT OUTCOMES

UPMC Rehabilitation Institute Patient Outcomes

January 1, 2017 to December 31, 2017 Facility Type: Rehab Unit

	Key Outcome Indicators	UPMC Rehabilitation Institute	Nation (Acuity-Adjusted)	
All Patients	Number of patients	4,709		
	FIM™ change per day	2.54	2.39	Higher is better
	Average admission FIM	54.9	57.5	Lower = more complex
	Average FIM change	30.5	28.4	Higher is better
	ALOS (days)	14.7	14.3	
Stroke Patients Only	Number of patients	1,406		
	FIM change per day	2.22	2.04	Higher is better
	Average admission FIM	48.9	52.7	Lower = more complex
	Average FIM change	29.6	27.5	Higher is better
	ALOS (days)	16.1	16.1	
Spinal Cord Injury Patients Only (traumatic and nontraumatic)	Number of patients	248		
	Case mix index	2.0	1.47	Higher = more complex
	FIM change per day	1.85	1.84	Higher is better
	Average admission FIM	49.5	53.8	Lower = more complex
	Average FIM change	30.7	27.8	Higher is better
	ALOS (days)	22.3	20.1	

Source: UDSMR*

Key

The FIM™ (Functional Independence Measure) instrument is a measure of disability. The scale measures an individual's ability to carry out an activity independently against the need for assistance from another person or device. Lower FIM scores mean greater dependence.

The need for assistance, or burden of care, translates to the time and energy that another person must expend to serve the needs of the individual with a disability so that they can achieve and maintain a certain quality of life.

The FIM instrument measures the following domains:

- Bladder/bowel management
- Cognition
- Mobility/locomotion
- Self-care
- Transfers

Case mix index — the acuity level of patients

FIM change per day — average FIM change per day

Average admission FIM — total score for all FIM categories at time of admission

Average FIM change — difference between admission and discharge FIM scores

ALOS — average length of stay for patients in this impairment category

UPMC Centers for Rehab Services Systemwide Visits

January 1, 2017 to December 31, 2017

Outpatient	Visits	Inpatient - Hospitals	Visits
Women's Rehabilitation	36,149	PT	488,135
Physical Therapy (PT)	481,430	OT	278,449
Occupational Therapy (OT)	13,066	ST	45,906
Hand Therapy	43,317	Total Inpatient - Hospitals	812,490
Industrial Rehabilitation	1,367	Long Term Care (LTC)	Visits
Neurorehabilitation	50,643	PT	38,696
Speech Therapy (ST)	14,970	OT	34,894
Facial Nerve	1,652	ST	9,811
Total Outpatient	642,594	Total LTC	83,401
Grand Total UPMC Centers for Rehab Services			1,538,485

With more than 70 convenient locations throughout western Pennsylvania, UPMC Centers for Rehab Services (CRS) has been providing outpatient physical, occupational, and speech therapy, as well as other specialized rehabilitation services, for more than 30 years. At CRS, the treatment approach is individualized, patient-centered, and evidence-based.

The CRS clinical and management teams are comprised of national leaders, authors, educators, and researchers in the fields of physical, occupational, and speech therapy. Leveraging those experiences contributes significantly to the level of care CRS provides. Through robust continuing education, ongoing training, and collaboration with the physical medicine and rehabilitation physician teams, CRS therapists are positioned to apply state-of-the-art clinical practices and the latest research to their treatment approach.

Due to its relationship with the UPMC Rehabilitation Institute, CRS' authentic patient-focused collaboration and continuity of care are real and tangible possibilities every day.



200 Lothrop St.
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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.