

METROHEALTH REHABILITATION INSTITUTE

2018 REPORT





John Chae, MD



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MetroHealth Rehabilitation Institute: Caring for Our Community and Our Nation

The MetroHealth System is pleased to present our 2018 Rehabilitation Report, which, in addition to highlighting our outstanding record, provides a comprehensive overview of the many services that The MetroHealth Rehabilitation Institute offers the northern Ohio region and our nation.

As one of our nation's first hospitals dedicated solely to rehabilitation, the mission of The MetroHealth Rehabilitation Institute is to restore function, societal participation and quality of life of persons with significant disabilities through a transdisciplinary approach that delivers outstanding rehabilitation care, trains the next generation of rehabilitation clinicians and scientists and discovers new knowledge that translates to clinical practice.

We treat the most complex rehabilitation patients in the region, many of whom are admitted through our American College of Surgeons verified Level I Adult Trauma Center and Adult and Pediatric Burn Center, and Joint Commission Comprehensive Stroke Center. Our premier Physical Medicine and Rehabilitation Residency Program; Spinal Cord Injury, Brain Injury and Pain Medicine Fellowships; and post-doctoral Research Fellowship provide outstanding training for our future physicians and scientists. And in partnership with Case Western Reserve University and the Louis Stokes Cleveland Veterans Affairs Medical Center, The MetroHealth Rehabilitation Institute is in the forefront of innovation and discovery that attracts research participants, clinicians and scientists from across the nation and internationally.

We hope you find the report that follows informative, and we look forward to working with you as the MetroHealth Rehabilitation Institute serves the northern Ohio community and the nation.

Sincerely,

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Table of Contents

Introduction: Physical Medicine and Rehabilitation	3
Neurological Rehabilitation	4
Musculoskeletal Rehabilitation	8
Community and Vocational Reintegration	12
Education and Training	13
Research	15



Physical Medicine and Rehabilitation: Improving Health, Function and Quality of Life

The MetroHealth Rehabilitation Institute was established in 1953 as one of only six hospitals in the nation dedicated solely to rehabilitation.

This exceptional leadership continues to be exemplified today by two members of the National Academies who serve as co-directors of the Institute, John Chae, MD, of the National Academy of Medicine and P. Hunter Peckham, PhD, of the National Academy of Engineering. Improving the health, function and quality of life of persons with significant disability is our mission. Our transdisciplinary approach leverages the expertise of multiple clinical and scientific disciplines, creating a culture of collaboration and learning.

The MetroHealth Rehabilitation Institute is an integral component of The MetroHealth System. The Institute works in partnership with our American College of Surgeons (ACS) verified Level I Adult Trauma Center and Adult and Pediatric Burn Center, and Joint Commission Comprehensive Stroke Center. These Centers refer the great majority of our most seriously injured or ill patients to our 67-bed acute inpatient rehabilitation facility, the only academic inpatient rehabilitation facility in the Greater Cleveland area accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF). We are the only facility in northern Ohio with dedicated units for stroke, brain injury and spinal cord injury (SCI)/major trauma rehabilitation. We are also one of only 14 federally designated SCI Model Systems in the U.S.

The MetroHealth Rehabilitation Institute is a major contributor to the System's musculoskeletal medicine population health initiative and strategy. Our Physical Medicine and Rehabilitation (PM&R) physicians work side-by-side with orthopaedic surgeons and neurosurgeons. We receive referrals from our primary care colleagues as the first line "non-operative" musculoskeletal specialists; we complete the diagnostic work-up, deliver the treatment and, as appropriate, make referrals to our operative colleagues. In 2018, the Institute recorded over 35,000 physician visits and over 95,000 therapy visits.

The MetroHealth Rehabilitation Institute is committed to helping all our patients reintegrate back into their communities and vocations; to this end, we are proud to be the region's only CARF accredited Comprehensive Vocational Rehabilitation Program.

Our commitment goes beyond our service area and extends to the advancement of PM&R care worldwide. In partnership with Case Western Reserve University, we are committed to training our students, residents and fellows and sending them out to "change the world." Since 1958, we have trained over 220 PM&R residents — more than 100 since 2000, with a 100 percent five-year pass rate on part I of the American Board of PM&R certifying

examination. We have trained 13 Accreditation Council for Graduate Medical Education (ACGME) SCI fellows since the start of the program in 2006 with a 100 percent pass rate on the SCI Medicine subspecialty certifying examination. In 2018, we graduated our first ACGME Brain Injury Medicine fellow. Our ACGME Pain Medicine Fellowship will enroll its first two fellows in July, 2019. We now have System commitment to start a Sports Medicine Fellowship in the near future.

Leadership in rehabilitation medicine also means conducting cutting-edge research that translates to clinical practice and transforms the rehabilitation process. In partnership with Case Western Reserve University and The Louis Stokes Cleveland Veterans Affairs Medical Center, we are the global leader in the development and implementation of functional electrical stimulation (FES) technologies for motor restoration for persons with central nervous system paralysis. Our research programs at the MetroHealth Rehabilitation Institute, from translational basic sciences to implementation science, are growing exponentially with present funding of over \$50 million. The department of PM&R is currently the second-largest recipient of NIH funding among U.S. medical school PM&R departments (NIHRePorter).

Neurological Rehabilitation

The MetroHealth Rehabilitation Institute helps patients recover from a full range of neurological conditions including stroke, brain injury and spinal cord injury.

KEY POINTS

- MetroHealth offers the highest level of care for stroke, brain injury and SCI.
- The MetroHealth System is a Joint Commission Comprehensive Stroke Center and 1 of 14 federally designated model centers for SCI.
- We offer a full spectrum of treatment that extends beyond discharge, including outpatient rehabilitation and access to comprehensive vocational rehabilitation services.

Our 67-bed, CARF-accredited acute rehabilitation hospital is divided into distinct units for stroke, brain injury and SCI/major trauma. Although our patients are more complex than the nation and the region, our functional outcomes are comparable with excellent patient satisfaction. Upon completion of inpatient rehabilitation, we offer comprehensive outpatient rehabilitation as well as special programs designed to facilitate community and vocational reintegration.

Stroke

MetroHealth is well-known for its acute emergency stroke care and critical care, and The MetroHealth Rehabilitation Institute has the distinction of having the only acute inpatient Stroke Rehabilitation Unit in Northeast Ohio.



Acute Inpatient Rehabilitation

2018 Case Mix Index*



In 2018, our median door-to-needle time was 36 minutes, well within the national benchmark and below the national median for Comprehensive Stroke Centers.

The MetroHealth System is recognized by the Joint Commission as a Comprehensive Stroke Center, the highest level of stroke certification. The Stroke Center admits approximately 500 acute stroke patients annually. This experience results in efficient care — In 2018, our median door-to-needle time was 36 minutes, well within the national benchmark and below the national median for Comprehensive Stroke Centers.

REHABILITATION BEGINS IMMEDIATELY

Rehabilitation evaluation begins on the acute stroke floor or in the Neurocritical Care Unit. PM&R physicians and therapists visit each stroke patient and assess his or her rehabilitation needs. Each year, approximately 170 individuals who have suffered a moderate to severe stroke with significant disabilities are admitted directly to our dedicated inpatient Stroke Rehabilitation Unit. Our PM&R physicians, psychologists, nurses and therapists are all specialty-trained in stroke rehabilitation.

ONLY AT METROHEALTH

MetroHealth PM&R physicians and scientists are national leaders in the development and implementation of new and evolving therapies for rehabilitating after a stroke not offered elsewhere nationally. For example, the MetroHealth team of PM&R physicians and scientists are experts in FES therapy, which has been shown to improve motor recovery and ease pain, particularly in the shoulder. Patients are routinely evaluated by our research group for

consideration for inclusion in ongoing clinical trials. After discharge from the Stroke Rehabilitation Unit, all patients are followed by our outpatient stroke rehabilitation team for a minimum of one year.

Brain Injury and Concussion

With more than four decades of experience, MetroHealth is the region’s leader in rehabilitation for mild to severe brain injury. We have built a program and a team that specializes in treatment of traumatic and atraumatic brain injuries. Brain injury cases that would be learning experiences at other facilities are routine for our staff.

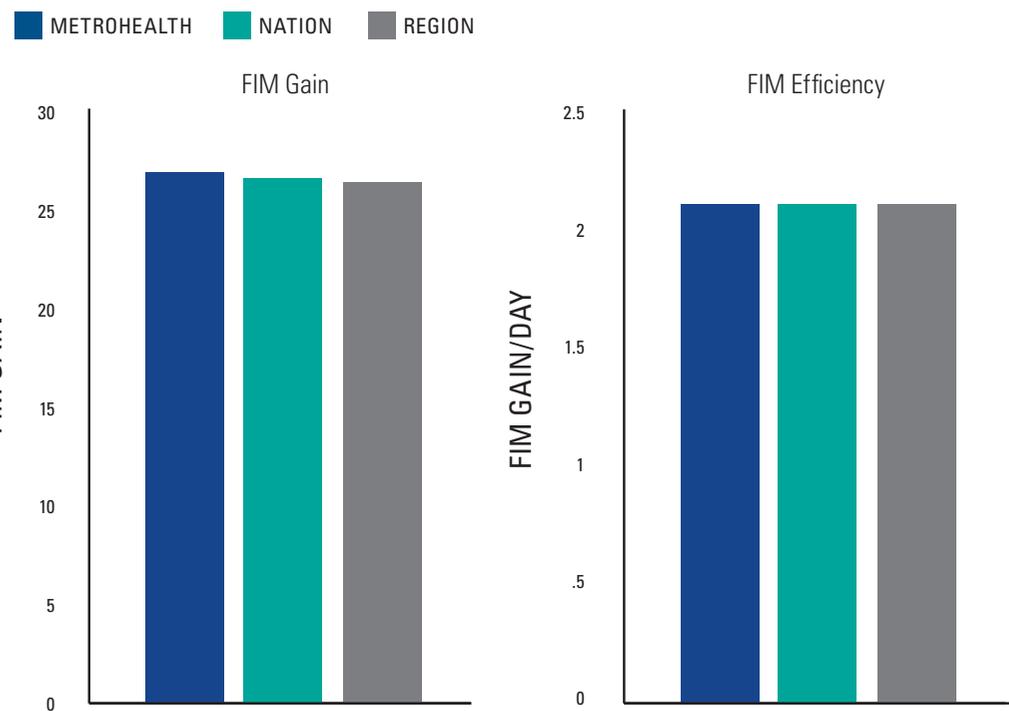
TEAM OF EXPERTS

Our entire team — PM&R physicians, psychologists, nurses and therapy staff — has dedicated their professional lives to treating patients with brain injury. Our PM&R physicians with subspecialty certification in Brain Injury Medicine treat all severity levels of injury. We also have PM&R physicians who are subspecialty certified in Sports Medicine who focus on the management of sports-related concussions.

A CAREFULLY DESIGNED UNIT

Inpatient brain injury rehabilitation occurs on a specially designed, dedicated unit that remains secured at all times. The environment in the Brain Injury Rehabilitation Unit is carefully managed to minimize sensory input that can be

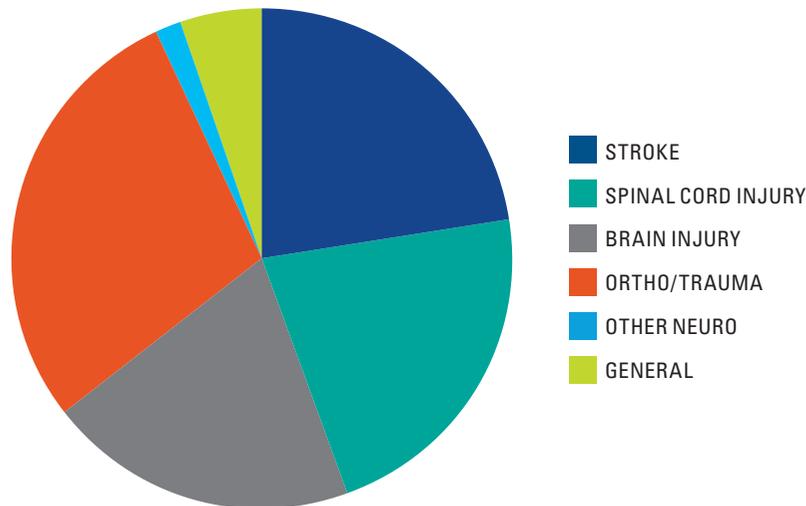
Acute Inpatient Rehabilitation



*Functional Independence Measure: change from admission to discharge (eRehab)

Acute Inpatient Rehabilitation

2018: 797 Discharges



distracting to brain injury patients. Patient rooms have been designed with adaptations to manage the cognitive and behavioral changes that accompany brain injury. All therapies are carried out on the unit and access to the gym is limited to just a few patients at a time in order to minimize noise- and activity-mediated distraction and agitation.

SPECIALIZED THERAPIES

The degree and presentation of brain injury vary widely from patient to patient. Our team of specialists is uniquely prepared to offer therapies for the many sequelae of these injuries, from gait training to visual perceptual therapy and methods for improving hand-eye coordination. Many of our physical therapists are specialists in balance therapy or vestibular rehabilitation and contribute substantially to the effective management of persons with concussion and severe brain injury. Our speech and language pathologists treat cognitive and language issues, as well as swallowing disorders.

Spinal Cord Injury

A MODEL SYSTEM

The MetroHealth Rehabilitation Institute is home to the Northeast Ohio SCI Model System. As one of only 14 SCI Model Systems in the United States, our program is recognized by the National Institute on Disability, Independent Living and Rehabilitation Research as a center that provides exceptional comprehensive care and services to patients with SCI from acute care hospitalization through rehabilitation and integration back into the community.

The inpatient SCI Rehabilitation Unit occupies one floor of our acute inpatient rehabilitation facility. We receive approximately 100 new SCI consults on patients with traumatic SCI from our ACS verified Level I Adult and Level 2 Pediatric Trauma Center each year, in addition to hundreds of referrals from facilities across Ohio, Pennsylvania, Illinois, Indiana, Kentucky and West Virginia.

EXPERT CARE AND TEAMWORK

Our staff includes PM&R physicians with subspecialty certification in SCI Medicine and a team of nurses; physical and occupational therapists; speech and language pathologists; psychologists; and social workers who are all subspecialty trained in SCI.

Our specially-equipped rooms accommodate patients who require ventilator or tracheostomy management. We are the only academic rehabilitation facility in Ohio that admits ventilator-dependent SCI patients. Many of these patients are successfully weaned off the ventilator.

CONNECTION TO THE COMMUNITY

We are also home to the Northeast Ohio chapter of the United Spinal Association, a 501c3 Group established in 2002 and 322 members strong. Members meet monthly for medical/psychosocial lectures, meetings with vendors to review new products and socializing with other individuals with SCI. They also provide peer support coordinated through The MetroHealth System for individuals and families with new SCI. Also, thanks to a grant from the Craig Nielsen Foundation, our providers are conducting a weight loss program for SCI patients.

Outpatient Neurological Rehabilitation

After discharge from acute inpatient rehabilitation, all neurological patients are followed by our outpatient team. We offer specialized physician and therapy services for stroke, brain injury, concussions and SCI. Other specialty clinic services include management options for tetraplegia, including nerve/tendon transfer and FES, spasticity management with intrathecal baclofen pumps and botulinum toxin injections, dysphagia clinic, wheelchair clinic, osteoporosis clinic, bracing and equipment management, rehabilitation psychology and neuropsychology. Other conditions treated in the outpatient setting include vestibular disorders, muscular dystrophy, polio, multiple sclerosis and Guillain-Barré syndrome.

Therapy, Nursing, Social Work and Case Management

At The MetroHealth System, rehabilitation care is very much a team effort. At the core of that team are our specialty-trained nurses, social workers, physical and occupational therapists and speech and language pathologists.

EXPERIENCED AND SPECIALIZED THERAPY STAFF

Our therapists are highly experienced — on average, our physical therapists have more than 12 years of experience, our occupational therapists more than 10 years and our speech and language pathologists 7.9 years of experience. Most of our therapists are also highly specialized with additional training and expertise in stroke, brain injury, SCI, musculoskeletal medicine, vestibular rehabilitation and chronic pain. Specific subspecialty certifications include Hand Therapy, Lymphedema, Manual Therapy, McKenzie, Orthopaedic Manual Therapy, Modified Barium Swallows, Pelvic Rehabilitation and Driver Rehabilitation.

SKILLED AND DEDICATED NURSING

Similarly, our inpatient nursing staff at The MetroHealth Rehabilitation Institute has unmatched experience with 10-15 years of clinical experience. Many have subspecialty certification or training in stroke, brain injury or SCI. Our nursing program is an American Nurses Credentialing Center Magnet-certified program. This gold-standard distinction is given to only the top six percent of all nursing programs in the country and recognizes expertise, excellence of care and leadership. The MetroHealth Rehabilitation Institute is the region's only Magnet-certified academic rehabilitation hospital.

COMPREHENSIVE CASE MANAGEMENT

Our inpatient Nurse Case Managers oversee and coordinate all inpatient and outpatient care and discharge plans. In addition to insurance reporting and care planning

for patients, the case manager also oversees training for family members and caregivers who will be transitioning a loved one home from inpatient care.



SPINAL CORD INJURY PROGRAM 2010-2018(Q3)

1,407
patients admitted to unit

725
traumatic spinal cord injury

682
non-traumatic spinal cord injury

Musculoskeletal Rehabilitation

MetroHealth's Musculoskeletal Rehabilitation Program is a dedicated, physician-supervised program that helps patients recover from musculoskeletal conditions using a combination of advanced imaging, physical and occupational therapies, pain management procedures, as well as the latest treatments made available through our clinical research programs.

KEY POINTS

- Our Musculoskeletal Rehabilitation Program applies the latest research to provide a full range of care for patients with musculoskeletal conditions.
- Advanced imaging and electrodiagnostics help inform patient treatment.
- Our service features a number of specialized programs designed to meet the unique circumstances of patients.

The program continues to grow substantially, with an average annual growth of 12 percent for physician and advanced practice provider outpatient visits. Outpatient therapy visit volumes are growing at 5 percent per year.

Musculoskeletal Medicine

Specialists at our multiple outpatient musculoskeletal rehabilitation sites address acute and subacute neck and back pain; facilitate recovery from sprains, strains, fractures, joint replacement surgery and rotator cuff tears; and provide management of arthritis, osteopenia, osteoporosis and temporomandibular joint syndrome.

Our physical therapists are board-certified in orthopaedic physical therapy or have specialized training in the treatment of specific musculoskeletal conditions. Occupational therapists are available to help patients return to their activities of daily living. We have a large number of occupational therapists who have subspecialty training and certification in hand therapy and work very closely with our hand surgeons.

Musculoskeletal Ultrasound

MetroHealth's Musculoskeletal Ultrasound Medicine program is helping PM&R physicians to quickly and accurately assess injuries to muscles, joints and tendons. Ultrasound is also used to guide interventions such as viscosupplementation and radiofrequency ablation. Therapeutic ultrasound that delivers high frequency soundwaves is being used to break down and remove scar tissue caused by chronically diseased tendons.



Spine and Pain Program

Healthcare providers in our spine and pain program diagnose and treat conditions including spinal stenosis, instability, nerve root entrapment, fractures, osteoarthritis, tumors, radiculopathy, disc herniation, spondylosis, spondylolisthesis, scoliosis, myelopathy, facet arthropathy and sacroiliac joint disorders.

AN INTERDISCIPLINARY TEAM

After conducting a thorough examination that may include high-resolution magnetic resonance imaging and diagnostic injections to localize the pain source, our PM&R physicians, nurses, physical therapists, interventional spine specialists, psychologists and vocational counselors create a comprehensive treatment plan to alleviate discomfort and improve function. Other members of the team include orthopaedic and neurological surgeons who are available for surgical consultations.

APPROACHES TO CARE

In addition to physical and occupational therapy and the judicious use of medications, treatment may include interventional injections under fluoroscopic guidance. These can include sacroiliac joints, facet joints and epidural injections of anti-inflammatory steroids or analgesics.

Radiofrequency ablation may be suitable for some patients with chronic pain. Similarly, implantation of a spinal cord stimulator offers relief for many patients. Other treatment options include intrathecal pain pump,

intravenous infusion therapy, intradiscal electrothermal therapy and nucleoplasty.

While reducing pain is an important goal, the primary objectives are to restore function and facilitate community and vocational reintegration and improve quality of life. Therefore, in addition to the above interventions, rehabilitation psychologists and vocational counselors have major roles in the interdisciplinary team.

Sports Medicine

The Sports Medicine Program addresses any acute or overuse sports-related injury, including fractures, sprains, strains, tendonitis, bursitis, rotator cuff tears and neck and spine injuries. Some of our treatment approaches include physical and occupational therapy, bracing and taping, injections for muscle, ligament and joint injuries, including platelet-rich plasma injections and viscosupplements and injections for spine-related pain. We also offer referrals to our concussion clinic or to orthopaedic surgery, when appropriate. Our surgeons can provide minimally invasive approaches to care such as arthroscopic surgery, fracture repair and ligament reconstruction.

Training room services are available to local high school athletes and to participants in community sporting events. Our certified athletic trainers evaluate acute injuries that occur during practices or games and refer patients to appropriate providers. Patients are typically seen within 48 hours of their initial assessment.

Musculoskeletal Rehabilitation

Future Sports Medicine Program goals are to expand services to more inner city high schools, collegiate athletes and recreational sports leagues.

Electrodiagnostic Medicine

Electrodiagnostic medicine enables our clinicians to hone in on the physiologic severity of neurologic and neuromuscular conditions. Some of the more common conditions we assess include carpal tunnel syndrome, diabetic polyneuropathy, entrapment neuropathy and radiculopathies. Rarer disorders include myasthenia gravis, Guillain-Barré syndrome, amyotrophic lateral sclerosis, polymyositis and muscular dystrophies.

Our staff includes board certified electromyographers and a staff of electromyography (EMG) technicians. Our state of the art technology can instantly and automatically upload test results to the electronic medical record. EMG services are available at the MetroHealth's main campus, as well as at five satellite locations in the community. Evening hours are now offered.

Cancer Rehabilitation

Our PM&R physicians and cancer rehabilitation specialists assess the diverse needs of our cancer patients to develop personalized rehabilitation programs. We have a PM&R physician embedded in the cancer center to maximize patient convenience and our collaboration with oncology staff. Newly

diagnosed patients with cancer are systematically screened for functional needs. Some of the many services we provide include physical therapy and interventional injections to manage pain and neurological changes caused by spinal tumors, speech and swallowing expertise for head and neck cancer patients, and a protocol in which all surgical breast cancer patients see a PM&R physician and a physical or occupational therapist. The MetroHealth Rehabilitation Institute is the home of the only PM&R-based Cancer Rehabilitation and Lymphedema Clinic in the region, and we currently have four physical therapists with lymphedema certification.

Industrial Medicine

MetroHealth's Industrial Medicine Program helps injured employees return to work quickly and safely with specialty outpatient care for work-related injuries.

The Injured Workers Walk-In Clinic is staffed by our industrial medicine-certified physicians, who assess, diagnose and provide initial treatment for the injury. Our team then develops a treatment plan aimed at eventual return to work. Our physicians continue to provide ongoing medical care. They also help patients access other specialists such as physical and occupational therapists, orthopedists or neurosurgeons in a timely manner as indicated.

Our goal is simple: Get people injured at work back to work as quickly and safely as possible.





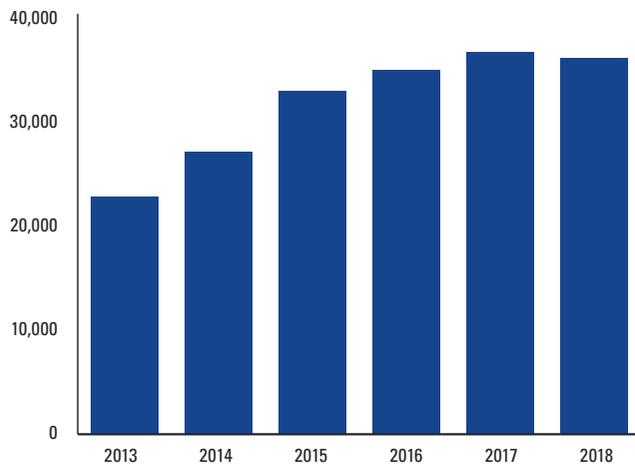
Amputee Rehabilitation

Our Amputee Rehabilitation Program serves patients who have undergone amputation of upper or lower limbs resulting from trauma or vascular disease, such as peripheral artery disease. Our program features a modern inpatient rehabilitation facility and several locations for outpatient services as patients progress with their recovery. In addition to PM&R specialists, our interdisciplinary team includes prosthetists, physical therapists specially trained for lower limb amputation, occupational and hand therapists specially trained for upper limb amputation, as well as rehabilitation psychologists to provide counseling. We coordinate with trauma, orthopaedic and vascular surgeons to anticipate and address postoperative complications and rehabilitation.

Ambulatory Practice

Physicians and Nurse Practitioners*

Annual Visits 2013-2018

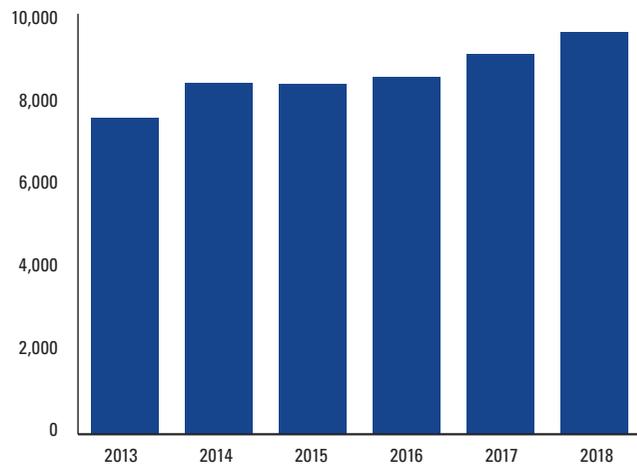


*Does not include procedures

Ambulatory Practice

Therapists (PT, OT, Speech)

Annual Visits 2013-2018



Community and Vocational Reintegration

Each year, specialists at MetroHealth's Benjamin S. Gerson Family Resource Center link more than 160 new patients with disabilities to educational information, support services and community agencies to enhance their quality of life. Examples of patients we serve include those contending with functional limitations from stroke, brain injury, SCI or major trauma.

HELPING PATIENTS REACH THEIR FULL POTENTIAL

Our specialists assist with the transition from rehabilitation to community reintegration for patients with disabilities, enabling them to reach their fullest potential. We are proud to be the region's only CARF-accredited Comprehensive Vocational Evaluation Program.

After our rehabilitation counselors conduct a needs assessment, we connect patients with resources to meet basic needs, such as medical equipment, housing, rent, food, utilities and transportation. We also help them apply for benefits such as Social Security and job and other entitlement benefits.

Vocational Rehabilitation Counselors work collaboratively with the rehabilitation teams and the Gerson Center to make referrals to financial counseling programs and help accessing other services to maximize independence. Additionally, we connect patients to mental health services, substance abuse programs, wellness services, childcare and legal assistance.

AGENCY COLLABORATION

We collaborate with a number of agencies, including Empowering and Strengthening Ohio's People, which offers housing and financial counseling, and Linking Employment, Abilities and Potential, which helps people with disabilities live independently, participate in the community and find and maintain jobs. We also work closely with Opportunities for Ohioans with Disabilities to assess patients for the proper level of vocational training needed to return them to the workforce.

VOCATIONAL REHABILITATION

As part of our vocational rehabilitation service, The MetroHealth Rehabilitation Institute offers comprehensive vocational evaluation, career counseling, job seeking skills training, job search assistance, job coaching and Work Matters Program. Housed at our main campus these services assess patients' transferable skills, barriers to work and assist individuals with determining feasible job goals. The Gerson Center also provides a work simulation program that helps patients acquire new skills and adapt to unfamiliar workplace settings.

DRIVING REHABILITATION

Another component of integrating patients back into the community and the workplace is driving rehabilitation. The Gerson Center refers patients to The MetroHealth Rehabilitation Institute Driver Rehabilitation Program, where they receive a thorough driving evaluation, training, necessary equipment such as wheel and hand controls and wheelchair adaptations, occupational therapy and physical therapy so they can better navigate operating a vehicle.

Education and Training

The MetroHealth Rehabilitation Institute is committed to improving the health, well-being and quality of life of persons with functional limitations. What better way to achieve this objective than to train the next generation of PM&R physicians and scientists?

Physical Medicine and Rehabilitation Residency

The MetroHealth System/Case Western Reserve University PM&R Residency Program is one of the oldest PM&R Residency Training Programs in the country (continuously accredited by the ACGME since 1957), and matches six residents per year from over 500 medical student applicants. We offer an outstanding training environment that features advanced clinical rehabilitative care and research in the context of three distinct health care systems: The MetroHealth System, The Cleveland Clinic Foundation and The Louis Stokes Cleveland Veterans Affairs Medical Center.

More than 60 faculty members from the three institutions participate in the training program. These include board-certified PM&R physicians, rehabilitation psychologists and PhD scientists. Neurologic rehabilitation training includes inpatient and outpatient rotations in stroke, brain injury, SCI and in a variety of

specialty clinics, including spasticity and concussion clinics. Musculoskeletal rehabilitation training includes rotations in electrodiagnostic medicine, neuromuscular diseases, lymphedema care, industrial rehabilitation, musculoskeletal medicine, spine care, interventional spine procedures, sports medicine, amputee rehabilitation and ultrasound guided procedures. All residents fulfill a research requirement, which includes an evidence-based medicine didactic series, journal clubs and research project completion and presentation.

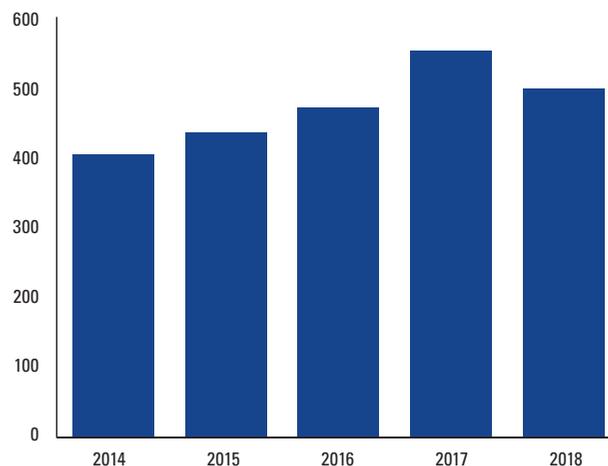
Fellowship Programs

SPINAL CORD INJURY MEDICINE FELLOWSHIP

Since its inception in 2006, The MetroHealth System/Case Western Reserve University ACGME-accredited SCI Medicine Fellowship Program has trained 13 fellows. Through funding from The Craig H. Nielsen Foundation, two fellows are accepted each year for highly specialized training and research in the prevention, diagnosis and treatment of both traumatic and non-traumatic SCI.

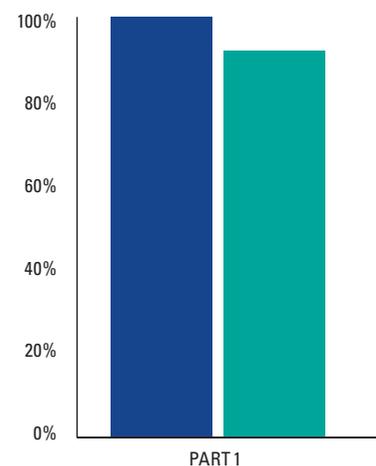
PM&R Residency: Six Positions Per Year

Number of Applicants



Board Pass Rates (5-yrs)

METROHEALTH NATION



As with the PM&R Residency Program, SCI fellows benefit from rotations in three distinct settings: The MetroHealth System, The Cleveland Clinic Foundation and The Louis Stokes Cleveland Veterans Affairs Medical Center. The fellows are trained by SCI Medicine-certified attending physicians and specialists in trauma, spine surgery, pulmonary care, critical care, pediatrics, plastic surgery, neurology and psychology.

Fellows benefit from exposure to all our SCI research programs, particularly our state-of-the-art Functional Electrical Stimulation (FES) technology for limb/trunk movement, respiratory/cough assistance and ventilator weaning through our close working relationship with the Cleveland FES Center.

BRAIN INJURY MEDICINE FELLOWSHIP

The MetroHealth System/Case Western Reserve University ACGME-accredited Brain Injury Medicine (BIM) Fellowship Program began in 2017, and welcomed its second fellow in 2018. The BIM fellowship includes clinical experiences in initial acute management, neurocritical care, acute rehabilitation and outpatient management with vocational and community reintegration of persons with brain injuries and concussions. The fellowship is largely based at the MetroHealthSystem, including its ACS verified Level 1 Acute Trauma Center, Acute Brain Injury Rehabilitation Unit, and comprehensive outpatient brain injury and concussion clinics with additional training at the Louis Stokes Cleveland Veterans Administration Medical Center (Regional Polytrauma Network) and The Cleveland Clinic Foundation. Fellows receive education from five BIM-certified attending physicians in addition to specialists in neurology, neuropsychology, sports medicine, neurocritical care, neurological surgery and trauma surgery. The fellowship allows for participation in neurotoxin injections and intrathecal

baclofen pump procedures, and exposure to research in FES technology including virtual reality and deep brain stimulation.

PAIN MEDICINE FELLOWSHIP

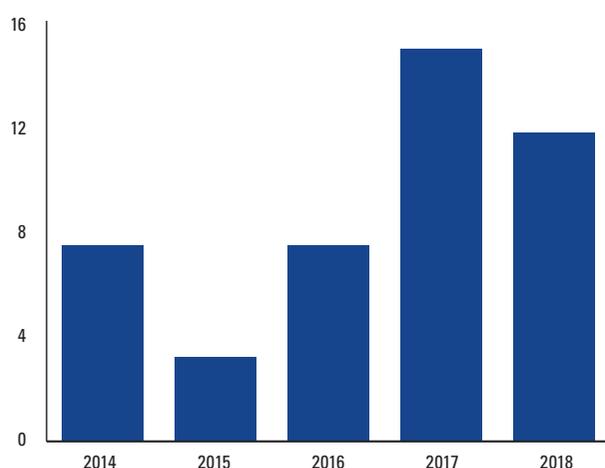
The MetroHealth System/Case Western Reserve University ACGME-accredited Pain Medicine Fellowship will welcome its first two fellows in 2019. The Fellowship includes clinical experiences in the assessment and management of acute and chronic pain within the combined framework of the biomedical and biopsychosocial models of pain with focus on pain mitigation, functional restoration, community and vocational reintegration, psychosocial well-being and quality of life. Fellows receive training from five Pain Medicine BC/BE faculty in the departments of PM&R and Anesthesiology with additional support from specialists in addiction medicine, neurology, neurosurgery, orthopaedics, palliative medicine, psychiatry, and pain psychology. The fellowship allows for clinical and investigational participation in all aspects of acute and chronic pain medicine, with focus on interventional approaches, including advanced neuromodulation and minimally-invasive techniques along with dedicated time and support for research and education.

POST-DOCTORAL FELLOWSHIP FOR SCIENTISTS

The MetroHealth Rehabilitation Institute accepts one to two candidates each year for a two-year fellowship that focuses on the development and testing of novel neuromodulation and neurostimulation approaches to functional restoration following central nervous system paralysis and pain. The objective of the Fellowship is to prepare each candidate to develop into an independent investigator with focus on clinically relevant translational basic or clinical research. To this end, each fellow is mentored by a physician scientist and a PhD scientist with a track record of independent extramural funding.

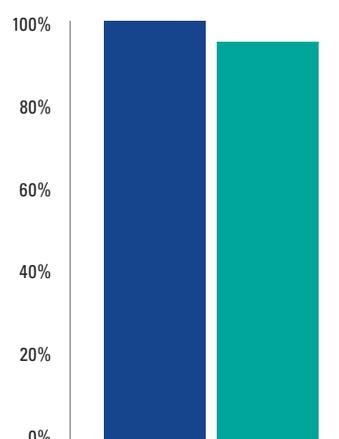
Spinal Cord Injury Fellowship: Two Positions Per Year

Number of Applicants



Board Pass Rates (5-yrs)

■ METROHEALTH ■ NATION

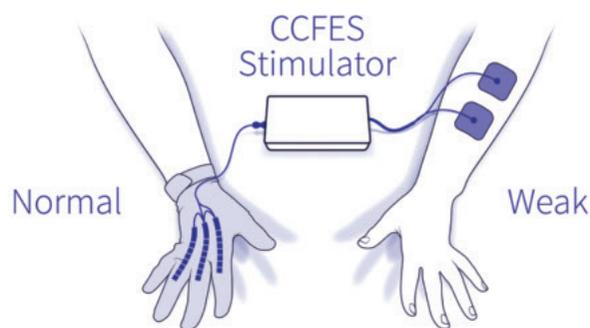


Research

KEY POINTS

- Research provides the fundamental foundation for all of our work with patients.
- Among medical school PM&R departments, we are the second-largest recipient of NIH funding (NIHRePORTER).
- We are the global leader in the development and implementation of functional electrical stimulation techniques for motor restoration for persons with central nervous system paralysis.

At the MetroHealth Rehabilitation Institute, we believe that research is a critical gateway to outstanding patient care. Each of our research divisions engages in multiple ongoing research projects led by our physicians and scientists. The MetroHealth Rehabilitation Institute continues to demonstrate impressive growth in the number of publications and grant funding. When we innovate, make discoveries and translate these discoveries to the standard of care, our patients benefit, not only regionally, but nationally and globally.



Stroke Rehabilitation Research

CONTRALATERALLY CONTROLLED FUNCTIONAL ELECTRICAL STIMULATION

Impaired arm and hand function is one of the most disabling consequences of stroke. With contralaterally controlled functional electrical stimulation (CCFES), when a stroke patient opens the unaffected hand, a corresponding amount of stimulation opens their weak, stroke-affected hand. This puts the patient back in control of their hand and enables them to participate in therapy with the assistance of electrical stimulation. The goal is improved motor function, even when the CCFES system is not being used. We are currently sending patients home with video games linked to the CCFES system to enable them to continue to train their impaired hands at home. We are also testing this treatment among children with cerebral palsy. The first multi-site CCFES study began in 2018 and includes sites at The MetroHealth System, The Kessler Foundation (New Jersey), and The Rusk Rehabilitation Institute (New York University).

NEUROPROSTHETICS

Many stroke patients have difficulty moving their leg for mobility, but clinically available devices usually only assist ankle movement. Our goal is to restore walking ability through a multi-joint implanted neuroprosthesis that generates movement by electrically activating muscles acting at the hip, knee and ankle in coordination with remaining volitional movement. We are enrolling patients who have suffered a stroke and have difficulty walking to receive this surgically implanted device. The long-term objective is a clinically available device that improves patients' daily function by increasing independence, safety and community engagement through enhanced walking ability.

PERIPHERAL NERVE STIMULATION FOR SHOULDER PAIN

We have developed a temporary, percutaneously implanted system that reduces shoulder pain in stroke patients by delivering electrical stimulation directly to the nerves supplying muscles surrounding the painful joint. We found that after three to six weeks of treatment, patients experienced significant pain reduction for at least one year. The system is now FDA-approved, and The MetroHealth Rehabilitation Institute is investigating the optimal dose of stimulation the combined effect of physical therapy, and the effect in the general patient population with shoulder pain.



Peripheral nerve stimulation for post-stroke shoulder pain



Spinal Cord Injury Rehabilitation Research

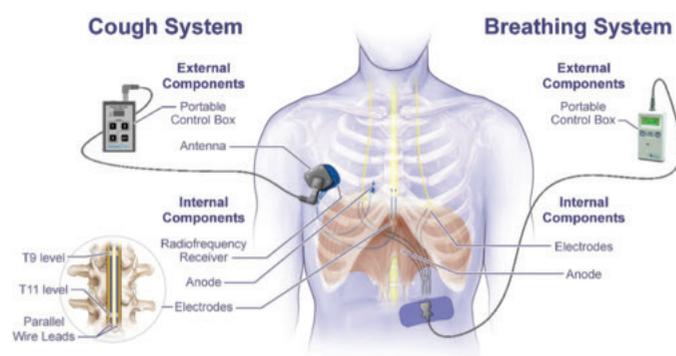
UPPER EXTREMITY AND TRUNK SPINAL CORD INJURY

We are providing the most advanced grasp, reaching and postural stability capabilities for individuals with chronic cervical SCI, via implanted neuroprosthetic devices. Our current system enables individuals to perform a variety of functional activities of daily living, including eating, office tasks, personal grooming, improved posture and improved wheelchair propulsion. We have now implanted three individuals with our new modular system, the networked neuroprosthesis. Results to date have shown that all subjects demonstrate improved independence in functional activities. We are now preparing to initiate a multi-center clinical trial of the hand system.

PULMONARY NEUROPROSTHESIS

Our scientists pioneered the development of a percutaneous diaphragmatic pacing system for the treatment of respiratory dysfunction following SCI. This system is presently available commercially. Ongoing work includes activation of inspiratory muscles via spinal cord stimulation and the development of a minimally invasive method to activate the expiratory muscles to restore cough. The cough system has been shown to reduce the incidence of pneumonia, which is common among SCI patients, and significantly reduces the overall costs of respiratory management in this patient population.

Complete Restoration of Respiratory Muscle Function





NETWORKED NEUROPROSTHESIS

The Networked Neuroprosthesis (NNP) is a modular, implantable neuroprosthesis capable of electrical stimulation and myoelectric signal recording. This system provides the platform for multiple clinical applications in SCI, stroke and other disabilities. The first version of the NNP is now being implanted clinically for hand and trunk function. During the past year, we began the development of version 2.0 of the NNP. The new version will include enhanced powering options and expanded sensor capabilities. The NNP has the capacity to incorporate multiple functions, including hand, trunk, respiratory, bowel and bladder and nerve blocking for treating spasticity.

SPINAL CORD INJURY MODEL SYSTEMS PROJECTS

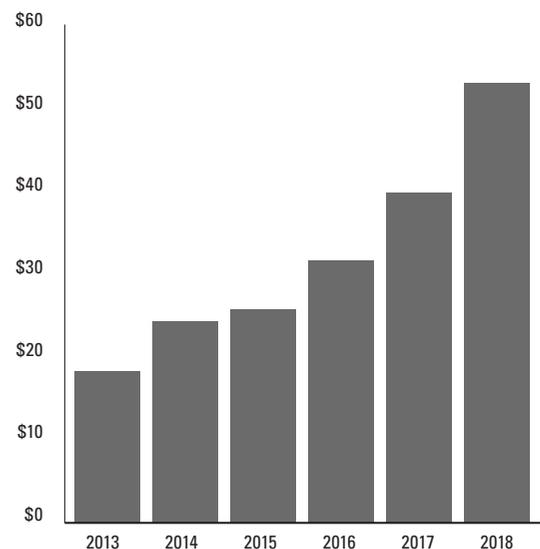
As a SCI Model System Center, we collect longitudinal data on persons with SCI regarding their neurological and functional recovery and submit them to the National SCI Database. These data will be used to formulate future research interventions. Our first site-specific project assesses upper extremity motor recovery patterns in persons with SCI to develop a preparatory guideline for treatment strategies for the restoration of function. In the second site-specific project, we are redesigning a spine board that will reduce the risk of pressure ulcer formation in persons transported from the injury scene. We are also collaborating on three additional module projects with other SCI Model System Centers, "Early Predictors of Rehabilitation Outcomes after Acute Traumatic SCI," "Equity and Quality in Assistive Technology" and "Residential Instability in Chronic SCI: An Investigation of Patterns and Consequences."

BLADDER AND BOWEL DYSFUNCTIONS

We have been testing approaches using electrical stimulation to inhibit unwanted bladder activity, inhibit unwanted urethral or anal sphincter activity or activate colon peristalsis. We are presently evaluating the feasibility of closed-loop control of electrical stimulation to relax the bladder and improve urinary continence. This approach uses the pressure signal from a urethral catheter in the human study participant to determine when inhibitory stimulation should be applied. We continue to develop wireless, implantable sensors that can provide continuous data from the bladder or the bowel.

Grant Funding*

Grants (Total \$ in Millions)



*Total value (direct and indirect) of all active grants for a given year

#2 in
NIH
Funding

PM&R
departments in
U.S. Medical Schools

Pain Research

PERIPHERAL NERVE STIMULATION

The previously described system for the treatment of post-stroke shoulder pain is now being investigated for the treatment of musculoskeletal pain in general. We have expanded this research to include shoulder pain in non-stroke patients, for SCI patients experiencing pain and for chronic lower back pain. The system is also being investigated for the treatment of post-amputation pain, pain following total knee arthroplasty and neuropathic pain.

ELECTRICAL BLOCK

Pain is mediated by electrical impulses in nerves. We have developed advanced implantable techniques that block these impulses in both animal models and in humans. The first human application was for the treatment of phantom and residual limb pain following lower limb amputation. We are now developing techniques that do not require implantation. Blocking electrical impulses may also be useful for treating other conditions such as spasticity following SCI, stroke or brain injury, asthma and heart failure.

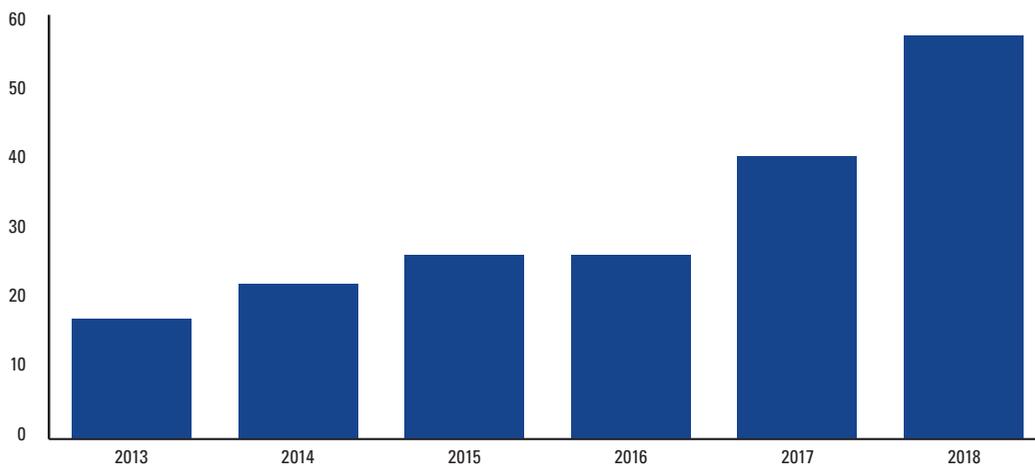
Cancer Research

Our center is part of a multi-center study evaluating metrics to assess improvements during outpatient rehabilitation in individuals with cancer. Researchers are trialing a self-assessment tool administered during rehabilitation to measure patient functional status and progress. Data accrual in categories of physical function, fatigue and social participation is currently ongoing, with plan to assess the item performance and scientific validity of the tool in the near future.

Concussion Research

In partnership with a local Cleveland middle school, feasibility of routine computerized cognitive screening in middle school-aged athletes is being assessed. Our concussion database also allows us to examine trends in concussion care, most recently exploring whether associations exist between socioeconomic factors and return-to-play for athletes with concussion.

Peer-reviewed Publications and Book Chapters*



*Does not include manuscripts *in-progress*

A PLACE TO HEAL

In 2017, MetroHealth opened the Zubizarreta House, a residence-like facility where patients who are participating in research can stay for up to two months, free of charge, during their treatment. The five modern, spacious, wheelchair-accessible suites help patients avoid the cost and inconvenience associated with extended stays in hotels and arranging transportation in accessible vans.



Meet Our Team

The MetroHealth Rehabilitation Institute takes a collaborative approach to care understanding the medical, physical and psychological needs of every patient. We view patients and their families as equal partners in the overall care plan. We focus on their goals, whether it's getting back to their job or school, or a certain hobby or milestone or attending a child's wedding. We want them to be able to do the things they want to do or enjoy — and we will work with them until they reach their goals.



“We are very much committed to changing the world,” says John Chae, MD, Vice President of Research and Chair of Physical Medicine and Rehabilitation. “We change the world by doing innovation that becomes the standard of practice.”

To hear more from Dr. Chae, and to get a glimpse of our dedicated doctors, therapists and patients who are at the heart of what we do, watch our video at metrohealth.org/rehab

Meet Our Experts



Shelly Amato PhD, RN

**Quality Officer, PM&R
Clinical Nurse Specialist,
Rehabilitation Nursing
Assistant Professor, PM&R***

EDUCATION AND TRAINING

BSN: University of Akron

MSN: Kent State

PhD: Kent State

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Rehabilitation Registered Nurse

Neuroscience Registered Nurse

CLINICAL AND ACADEMIC INTERESTS

- TBI and stroke rehabilitation
- Sleep and recovery



Kim Anderson, PhD

**Staff Scientist, PM&R
Professor, PM&R***

EDUCATION AND TRAINING

BS: Texas A&M

PhD: University of New Mexico

Fellowship: University of California, Irvine

CLINICAL AND ACADEMIC INTERESTS

- Spinal cord injury
- Clinical trials to restore function
- Outcomes assessment
- Consumer-oriented research



**James Begley,
MD, MS**

**Director, Stroke
Rehabilitation, PM&R
Program Director, Brain Injury
Medicine Fellowship, PM&R
Associate Director,
Clinical Informatics, NMSK
Service Line
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS, MS, MD: Creighton University

Residency: MetroHealth System –
Case Western Reserve University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

Brain Injury Medicine

CLINICAL AND ACADEMIC INTERESTS

- Brain Injury
- Stroke
- Spasticity
- Medical informatics



**Niloy Bhadra,
MBBS, PhD**

**Staff Scientist, PM&R
Associate Professor, PM&R**

EDUCATION AND TRAINING

MBBS: Calcutta University

MS, PhD: Case Western Reserve
University

Master of Surgery (Orthopaedics),
Calcutta University

Fellowship: Orthopaedics, Royal College of
Surgeons, Edinburgh, UK

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Fellow of the Royal College of Surgeons

CLINICAL AND ACADEMIC INTERESTS

- Electrical nerve block
- Neuroprostheses



Dennis Bourbeau, PhD

**Staff Scientist, PM&R
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: Worcester Polytechnic Institute

PhD: University of Pittsburgh

CLINICAL AND ACADEMIC INTERESTS

- Electrical stimulation for bladder and
bowel function



Andre Cassell, MD

**Associate Director, Clinical
Informatics, NMSK Service
Line
Associate Program Director,
Clinical Informatics
Fellowship
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: Massachusetts Institute of Technology

MD: University of Pittsburgh School of Medicine

Residency: PM&R, Johns Hopkins University
School of Medicine

Fellowship: Clinical Informatics, MetroHealth
System – Case Western Reserve University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Clinical informatics
- Concussions
- Electrodiagnostic medicine
- Musculoskeletal rehabilitation



John Chae, MD, ME

Vice President, Research and Sponsored Programs, MHS Chair, PM&R; Co-Director, MetroHealth Rehabilitation Institute
Professor and Chair, PM&R (primary)
Professor, Biomedical Engineering (secondary)

EDUCATION AND TRAINING

BSE: Duke University
ME: Dartmouth College
MD: Rutgers University – New Jersey Medical School
Residency: PM&R, Rutgers University – New Jersey Medical School

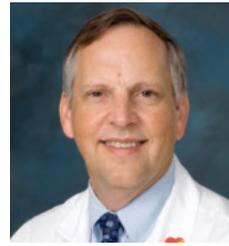
Fellowship: NIH-K12, Rehabilitation Medicine Scientist Training Program

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Stroke rehabilitation
- Electrical stimulation for motor relearning, neuroprosthesis and pain reduction



Gary S. Clark, MD, MMM, CPE

Vice Chair, PM&R
Associate Residency Program Director, PM&R
Director of Education, PM&R
Associate Designated Institutional Official, MHS
Assistant Dean for Student Activities at MetroHealth Campus, CWRU
Professor, PM&R

EDUCATION AND TRAINING

BS: Pennsylvania State University
MD: Jefferson Medical College
MMM: Carnegie Mellon University
Residency: PM&R, Thomas Jefferson University Hospital

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Amputee rehabilitation
- Geriatric rehabilitation
- Graduate medical education



Travis L. Cleland, DO

Associate Director, Division of Musculoskeletal Rehabilitation, PM&R
Director, Acute Musculoskeletal Medicine, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

BS: Kent State University
DO: Lake Erie College of Osteopathic Medicine
Residency: PM&R, MetroHealth System – Case Western Reserve University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Musculoskeletal medicine
- Electrodiagnostics medicine
- Ultrasound medicine



Patrick E. Crago, PhD

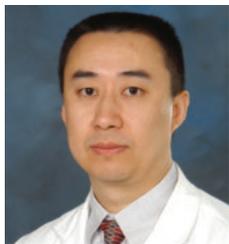
Staff Scientist, PM&R
Professor Emeritus, Biomedical Engineering

EDUCATION AND TRAINING

BSEE: Carnegie Mellon
MS, PhD: Case Western Reserve University
Fellowship: Neuromuscular physiology, Johns Hopkins

CLINICAL AND ACADEMIC INTERESTS

- Neuromuscular physiology
- Post-stroke motor control
- Neuroprostheses in hemiplegia



Lixin Cui, MD, PhD

Medical Staff, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

MD: Peking Union Medical College
PhD: University of Alabama at Birmingham
Residency: PM&R, MetroHealth System – Case Western Reserve University
Fellowship: Pharmacology, University of Alabama at Birmingham

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

Electrodiagnostic Medicine

Brain Injury Medicine

CLINICAL AND ACADEMIC INTERESTS

- Brain injury rehabilitation
- Electrodiagnostic medicine



Anthony DiMarco, MD

Staff Scientist, PM&R
Professor, PM&R, (primary)
Professor, Physiology and Biophysics, (secondary)

EDUCATION AND TRAINING

BA: Case Western Reserve University
MD: Tufts University
Residency: Medicine, Quigley Memorial Hospital
Fellowship: Research, Case Western Reserve University
Fellowship: Pulmonary Medicine, Case Western Reserve University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Critical care medicine

Pulmonary diseases

CLINICAL AND ACADEMIC INTERESTS

- Electrical stimulation for restoration of respiratory function and coughing in spinal cord injury



Elizabeth Dreben, PhD
Rehabilitation Psychologist, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

BA: Harvard College
 MA, PhD: Boston University

CLINICAL AND ACADEMIC INTERESTS

- Adjustment to disability for patients with a range of disabilities and medical conditions particularly stroke and amputation



Yevgeniya Dvorkin Winger, MD
Medical staff, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

BA, MD: Case Western Reserve University
 Residency: PM&R, University of Pittsburgh

Fellowship: Cancer Rehabilitation, Memorial Sloan Kettering Cancer Center

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Cancer rehabilitation



Felicia Fraser, PhD
Rehabilitation Psychologist, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

BA: SUNY – Stony Brook
 MA, PhD: Fordham University
 Residency: NYU-Rusk Institute of Rehabilitation Medicine;

Fellowship: Clinical Neuropsychology, Center for Cognitive Assessment, New York, NY

CLINICAL AND ACADEMIC INTERESTS

- Neuropsychology, TBI, SCI, adjustment to traumatic injuries and illnesses



Michael J. Fu, PhD
Staff Scientist, PM&R
Assistant Professor, Electrical Engineering and Computer Science (primary)
Assistant Professor, PM&R (secondary)

EDUCATION AND TRAINING

BS: University of California – Berkeley
 MS, PhD: Case Western Reserve University

Fellowship: NIH-KL2, Case Western Reserve University

CLINICAL AND ACADEMIC INTERESTS

- Electrical stimulation for motor relearning
- Virtual reality and video games for neurorehabilitation



Michael Harris, MD
Director, Industrial Medicine, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

BA: Emory University
 MD: State University of New York – Downstate
 Residency: PM&R, Rutgers University – New Jersey Medical School

Fellowship: Musculoskeletal Medicine, Louisiana State University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation
 Pain Medicine
 Independent Medical Examiner

CLINICAL AND ACADEMIC INTERESTS

- Pain medicine
- Musculoskeletal rehabilitation
- Workers Compensation



Harry A. Hoyer, III, MD
Director, Hand Surgery, Orthopaedics
Associate Professor, Orthopaedic Surgery

EDUCATION AND TRAINING

BS: University of Wisconsin
 MD: Medical College of Wisconsin
 Residency: Orthopaedic Surgery, Case Western Reserve University

Fellowship: Hand Surgery, Cleveland Clinic/University Hospitals of Cleveland/MetroHealth System

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Orthopaedic Surgery
 Hand Surgery

CLINICAL AND ACADEMIC INTERESTS

- Hand and shoulder surgery
- Functional electrical stimulation
- Neuroprostheses for spinal cord injury



Michael W. Keith, MD

**Medical Staff, Orthopaedics
Professor, Orthopaedics
(primary)
Biomedical Engineering
(secondary) and PM&R
(secondary)**

EDUCATION AND TRAINING

BA: Case Western Reserve University
MD: Ohio State University
Residency: Orthopaedics, Case Western Reserve University
Fellowship: Hand Surgery, Thomas Jefferson University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Orthopaedic Surgery
Hand Surgery

CLINICAL AND ACADEMIC INTERESTS

- Hand surgery
- Neuroprostheses for spinal cord injury



Michael L. Kelly, MD, MA

**Co-Director, Neurocritical Care and Acute Neurosurgery Fellowship
Assistant Professor, Neurological Surgery (primary) and PM&R (secondary)**

EDUCATION AND TRAINING

BA: University of Chicago
MA, MD: Loyola University
Residency: Neurological Surgery, Cleveland Clinic Foundation
Fellowship: Clinical Research, MetroHealth System – Case Western Reserve University
Fellowship: Surgical Ethics, University of Chicago

CLINICAL AND ACADEMIC INTERESTS

- Traumatic brain injury
- Spinal cord injury
- Trauma system of care



Frank M. Kenner, PhD

**Rehabilitation Psychologist, PM&R
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: John Carroll University
MA, PhD: Kent State
Fellowship: Chronic Pain Rehabilitation, Cleveland Clinic Foundation

CLINICAL AND ACADEMIC INTERESTS

- Pain
- Post traumatic stress disorder



Kevin L. Kilgore, PhD

**Staff Scientist, Orthopaedics and PM&R
Professor, Orthopaedics and PM&R (Joint) and Biomedical Engineering (Secondary)**

EDUCATION AND TRAINING

BS: University of Iowa
MS, PhD: Case Western Reserve University

CLINICAL AND ACADEMIC INTERESTS

- Neuroprostheses for upper extremity function in spinal cord injury
- Electrical nerve conduction block
- Neuroprosthetic system design



Chong H. Kim, MD

**Director, Division of Musculoskeletal Rehabilitation, PM&R
Program Director, Pain Medicine Fellowship, PM&R
Director, Pain and Healing Center, NMSK Service Line
Co-Director, Spine Center, NMSK Service Line
Professor, PM&R and Anesthesiology (joint)***

EDUCATION AND TRAINING

BS: Pennsylvania State University
MD: Temple University, School of Medicine
Residency: PM&R, University of Pittsburgh Medical Center/ Mercy
Fellowship: Pain Medicine, West Penn/ Temple University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation
Pain Medicine

CLINICAL AND ACADEMIC INTERESTS

- Pain management;
- Neuromodulation;
- Pain medicine graduate medical education



Jayme Knutson, PhD

**Director of Research, Staff Scientist, PM&R
Associate Professor, PM&R**

EDUCATION AND TRAINING

BS, MS, PhD: Case Western Reserve University
Fellowship: NIH-KL2, Case Western Reserve University

CLINICAL AND ACADEMIC INTERESTS

- Neuro-rehabilitation
- Electrical stimulation for motor relearning, neuroprosthesis



Krzysztof E. Kowalski, PhD

**Staff Scientist, PM&R
Associate Professor, PM&R***

EDUCATION AND TRAINING

MS, PhD: University of Poznan, Poland
Post-doctoral fellowship: Neurobiology, Academy of Physical Education, Poznan, Poland

CLINICAL AND ACADEMIC INTERESTS

- Restoration of respiratory muscle function to maintain full-time ventilatory support and to provide an effective cough mechanism in individuals with spinal cord injury



Nathaniel S. Makowski, PhD

**Staff Scientist, PM&R
Instructor, PM&R**

EDUCATION AND TRAINING

BSE: Hope College
PhD: Case Western Reserve University
Fellowship: NIH-KL2, Case Western Reserve University

CLINICAL AND ACADEMIC INTERESTS

- Stroke rehabilitation
- Functional electrical stimulation



Daniel Malkamaki, MD

**Medical Staff, PM&R
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: Ohio State University
MD: Wright State University School of Medicine
Residency: PM&R, University of Michigan
Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Musculoskeletal rehabilitation
- Spine care



Antwon Morton, DO

**Medical staff, PM&R
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: Eastern Michigan University
DO: Ohio University
Residency: PM&R, Eastern Virginia Medical School

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Musculoskeletal rehabilitation
- Ultrasound medicine



Greg Nemunaitis, MD

**Director, SCI Rehabilitation, PM&R
Program Director, SCI Medicine Fellowship, PM&R
Professor, PM&R**

EDUCATION AND TRAINING

BA, MD: Case Western Reserve University
Residency: PM&R, Thomas Jefferson University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation
Electrodiagnostic Medicine
Spinal Cord Injury Medicine

CLINICAL AND ACADEMIC INTERESTS

- SCI recovery, rehabilitation and prevention of complications
- Neuromuscular electrical stimulation
- SCI graduate medical education



King Ogbogu, MD

**Medical staff, PM&R
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: Cornell University
MD: Case Western Reserve University School of Medicine
Residency: PM&R, MetroHealth System – Case Western Reserve University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Electrodiagnostic medicine
- Musculoskeletal rehabilitation



Christina V. Oleson, MD

**Medical Staff, PM&R
Professor, PM&R**

EDUCATION AND TRAINING

BA: Harvard College
MD: University of Massachusetts
Residency: PM&R, Thomas Jefferson University
Fellowship: Spinal Cord Injury Medicine, Northwestern University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation
Spinal Cord Injury Medicine

CLINICAL AND ACADEMIC INTERESTS

- Traumatic and nontraumatic spinal cord injury
- Immobilization osteoporosis
- Multiple Sclerosis; spasticity



P. Hunter Peckham, PhD

**Co-Director, MetroHealth Rehabilitation Institute
Staff Scientist, Orthopaedics and PM&R
Professor, Biomedical Engineering (primary), Orthopaedic Surgery (secondary)**

EDUCATION AND TRAINING

BS: Clarkson College
MS, PhD: Case Western Reserve University

CLINICAL AND ACADEMIC INTERESTS

- Functional electrical stimulation
- Neuroprostheses for SCI



Jared Placeway, DO

**Program Director, PM&R Residency Program
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: Grace College
DO: Chicago College of Osteopathic Medicine
Residency: PM&R, Medical College of Wisconsin

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Graduate medical education
- Musculoskeletal rehabilitation
- Electrodiagnostic medicine



Heather Rainey, MD

**Director, Sports Medicine, PM&R
Assistant Professor, PM&R**

EDUCATION AND TRAINING

BS: John Carroll University
MD: Ohio State University
Residency: PM&R, Ohio State University
Fellowship: Sports Medicine, Wright State University/Kettering

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Physical Medicine and Rehabilitation
Sports Medicine

CLINICAL AND ACADEMIC INTERESTS

- Sports medicine
- Musculoskeletal rehabilitation
- Ultrasound medicine



Mary Joan Roach, PhD

**Staff Scientist, PM&R
Associate Professor, PM&R**

EDUCATION AND TRAINING

BA: Monmouth College
MA, PhD: University of Akron

CLINICAL AND ACADEMIC INTERESTS

- SCI rehabilitation
- Patient centered outcomes
- Healthcare disparities in the disability population



Eric M. Schearer, PhD, PE

**Staff Scientist, PM&R
Assistant Professor, Mechanical Engineering, Cleveland State University**

EDUCATION AND TRAINING

BSME, MBA: Notre Dame
MS: Carnegie Mellon
ME, PhD: Northwestern

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

Professional Engineer

CLINICAL AND ACADEMIC INTERESTS

- Robotics, functional electrical stimulation, human motion control



Kip Smith, PhD
Rehabilitation Psychologist, PM&R
Assistant Professor, PM&R

EDUCATION AND TRAINING

BA: University of Cincinnati
 MA, PhD: Ohio State
 Fellowship: Rehabilitation Psychology, Ohio State

CLINICAL AND ACADEMIC INTERESTS

- Traumatic brain injury, neuropsychology



Mary Vargo, MD
Director, Electromyography Cancer Rehabilitation and Lymphedema
Concussion Services, PM&R Professor, PM&R

EDUCATION AND TRAINING

BA: University of Pennsylvania
 MD: University of Rochester
 Residency: PM&R, University of Pittsburgh

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

- Physical Medicine and Rehabilitation
- Brain Injury Medicine
- Electrodiagnostic Medicine

CLINICAL AND ACADEMIC INTERESTS

- Cancer rehabilitation
- Brain injury rehabilitation
- Electrodiagnostic medicine



Tina L. Vrabec, PhD
Staff Scientist, PM&R
Assistant Professor, PM&R*

EDUCATION AND TRAINING

BS, MS, PhD: Case Western Reserve University

CLINICAL AND ACADEMIC INTERESTS

- Electrical nerve block for pain, spasticity and modulation of the autonomic nervous system



Victoria C. Whitehair, MD
Associate Director, Neurological Rehabilitation
Medical Director, Acute Inpatient Rehabilitation
Director, Brain Injury Rehabilitation
Assistant Professor, PM&R*

EDUCATION AND TRAINING

BA: Washington University in St. Louis
 MA: Boston University
 MD: Case Western Reserve University
 Residency: PM&R, MetroHealth System – Case Western Reserve University
 Fellowship: Brain Injury Medicine, MetroHealth System – Case Western Reserve University

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

- Physical Medicine and Rehabilitation
- Brain Injury Medicine

CLINICAL AND ACADEMIC INTERESTS

- Brain injury rehabilitation
- Stroke rehabilitation
- Spasticity management



Richard Wilson, MD, MS
Director, Division of Neurological Rehabilitation
Associate Professor, PM&R

EDUCATION AND TRAINING

BS: Ohio University
 MS: Case Western Reserve University
 MD: Medical College of Ohio
 Residency: PM&R, MetroHealth System – Case Western Reserve University
 Fellowship: NIH-K12, Rehabilitation Medicine Scientist Training Program

PRIMARY BOARD AND SUBSPECIALTY CERTIFICATIONS

- Physical Medicine and Rehabilitation

CLINICAL AND ACADEMIC INTERESTS

- Stroke rehabilitation
- Peripheral nerve stimulation
- Musculoskeletal medicine

MHS: MetroHealth System
 CWRU: Case Western Reserve University
 *Pending Case Western Reserve University Academic Promotion and Tenure Committee review NMSK: Neuromusculoskeletal Service Line

The MetroHealth Rehabilitation Institute
4229 Pearl Road, Cleveland, OH, 44109

For questions, or to refer a patient, call 216-778-3776
metrohealth.org/rehab

