



Neurological Institute

NorthShore Neurological Institute Annual Report

Neurological Care for What's Next



NorthShore University HealthSystem (NorthShore) Neurological Institute offers unparalleled access throughout the Chicago area, including at each of our four award-winning hospitals. Our expert team of neurospecialists offers comprehensive care for a range of neurological conditions.

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From Our Directors

NorthShore Neurological Institute is the region's pre-eminent provider of advanced care for brain and spine conditions. It is our mission to provide an extraordinary healthcare experience to every patient. We deliver this patient care through a collaborative, multidisciplinary approach and the coordination of services involving more than 70 neurospecialists to diagnose and treat complex conditions involving the brain, spine and peripheral nervous system.

During the past year, we have seen the launch of the Center for Brain Health where we will draw on the vast experience of our staff to use evidence-based interventions to prevent the onset of Alzheimer's disease and other neurodegenerative conditions.

Our surgeons are using the latest in minimally invasive brain and spine surgery technology such as the BrainPath[®] device, which provides unique surgical access to previously inoperable brain tumors and intracerebral hemorrhages without traumatically affecting normal brain tissue. We have added to this new imaging technology to provide advanced visualization for image-guided treatments and preoperative planning tools.

Our research includes the expansion of the Traumatic Brain Injury Laboratory, which has multiple translational projects under way studying varying aspects of the disease from basic science and preclinical science to neuroimaging biomarkers.

We are also conducting new clinical trials that allow patients access to cutting-edge diagnostics, the latest treatment options and novel therapies. Many of our programs are conducting the groundbreaking DodoNA research project to measure outcomes that will be tracked year-to-year and ultimately determine the DNA-related causes of debilitating neurological conditions.

Our ongoing commitment to neurological research also sees the launch of the Neurology Practice-Based Research Network (NPBRN). The goal of this federally funded network is to advance quality improvement and practice-based research in neurology using the Electronic Medical Record (EMR) system. The NPBRN will encompass multiple sites nationwide and share data from more than 180,000 office visits yearly for quality improvement. We will also perform comparative effectiveness research at NorthShore through pragmatic trials using the EMR for 10 common neurological disorders. Through these quality initiatives and pragmatic trials, we will improve knowledge and also create new technical capabilities to personalize medicine at the point of care.

From improving odds to improving lives, NorthShore Neurological Institute is providing healthcare for what's next. We hope you enjoy reading about our services and highlights over the last year, and we thank you for your continued support.

Sincerely,



Demetrius M. Maraganore, MD

Ruth Cain Ruggles Chairman of
the Department of Neurology
Medical Director, NorthShore
Neurological Institute



Julian E. Bailes, MD

Bennett-Tarkington Chairman of
the Department of Neurosurgery
Surgical Director, NorthShore
Neurological Institute



Joseph T. Alleva, MD

Chief, Division of Physical
Medicine and Rehabilitation



*From left: Dr. Joseph Alleva, Dr. Julian Bailes,
Dr. Demetrius Maraganore*

About Our Institute

Our Leadership

**U.S. News & World Report
“High Performing”
in Neurology and
Neurosurgery**

**13 NorthShore
Neurological Institute
Specialists Listed
as *Castle Connolly*
“Top Doctors”**

**Systemwide
Certification by
Joint Commission
as Primary Stroke
Center**

**Designated by
National Multiple
Sclerosis Society
as a Center for
Comprehensive and
Coordinated Multiple
Sclerosis Care**

**Sleep Disorders
Center certification
and A-STEP
Accreditation by
American Association
of Sleep Medicine**

Demetrius M. Maraganore, MD

Medical Director, NorthShore Neurological Institute

The Ruth Cain Ruggles Chairman, Department of Neurology

Demetrius (“Jim”) Maraganore, MD, is a nationally and internationally renowned expert on Parkinson’s disease and other movement disorders. He has been recognized as one of the world’s 20 most cited experts on Parkinson’s disease in the 21st century (Aaron A. Sorenson landmark study, published in the inaugural issue of the *Journal of Parkinson’s Disease*) with more than 150 peer-reviewed publications to date. At NorthShore he is the Chairman of the Department of Neurology and Co-Director of the NorthShore Neurological Institute. He is the principal investigator of the “DodoNA” project, which is leveraging NorthShore’s clinical excellence and expertise and its Electronic Medical Record (EMR) system to develop methods to predict, prevent and halt neurological diseases. Dr. Maraganore is also the principal investigator of the Neurology Practice-Based Research Network (NPBRN) whose goal is to advance quality improvement and practice-based research in neurology using the EMR system. He also founded and continues to lead the Genetic Epidemiology of Parkinson’s Disease (GEO-PD) Consortium. GEO-PD includes 60 sites from 30 countries and six continents, sharing DNA and data for 41,988 Parkinson’s disease (PD) cases and 41,505 controls.

Julian E. Bailes, MD

Surgical Director, NorthShore Neurological Institute

The Bennett-Tarkington Chairman, Department of Neurosurgery

Julian Bailes, MD, is a nationally recognized leader in neurosurgery, with special emphasis on brain tumors and the impact of brain injury on brain function. Dr. Bailes and the NorthShore Neurological Institute team are among the first in the country to use emerging technology to treat brain tumors, including Visualase® MRI-guided therapy. Dr. Bailes is also one of the first neurosurgeons in the Chicago area to use the minimally-invasive NICO BrainPath as part of the Six Pillars approach, offering promising outcomes for patients with otherwise inoperable brain tumors. Dr. Bailes joined NorthShore in 2011 as Chairman of the Department of Neurosurgery and Co-Director of the NorthShore Neurological Institute. He is conducting leading-edge basic and clinical research where his work has been instrumental in the understanding of the clinical evidence of chronic traumatic encephalopathy (CTE), a progressive degenerative disease found in individuals who have been subjected to multiple concussions and other forms of head injury. Dr. Bailes has written more than 200 scientific peer-reviewed publications or book chapters concerning various aspects of neurological surgery and brain injury, including five books on neurological disease.

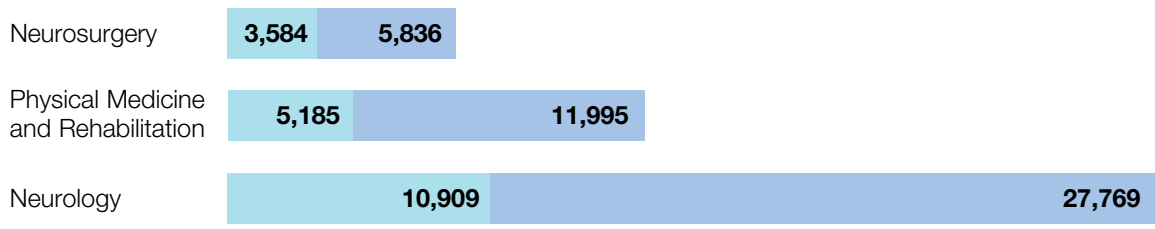
Joseph T. Alleva, MD

Division Head, Physical Medicine and Rehabilitation

Joseph Alleva, MD, has spent his entire career at NorthShore since completing his specialty training in 1994 at the prestigious Rehabilitation Institute of Chicago (RIC). As Chief of the Division of Physical Medicine and Rehabilitation (PM&R) and as a leader of the NorthShore Neurological Institute, he directs a team of physiatrists and therapists (physical, occupational, speech-language) experienced in treating patients with brain and spine disorders. His expertise in the field most recently landed him on the “America’s Best Doctors” list compiled by *U.S. News & World Report*, and for more than a decade, he has consistently been lauded in *Castle Connolly’s* guide *The Best Chicago Doctors*. In 2011, *Chicago* magazine featured Dr. Alleva on its “Best Sports Medicine Doctors” list. Dr. Alleva holds an MD degree from the Chicago Medical School and completed an internship in internal medicine and neurology at Northwestern University Medical School. He has numerous publications to his credit on nonsurgical spine care and pain management.

Volume Data

(2014 Fiscal Year)



■ New Patients
■ Established Patients

- More than **1,500** neurosurgical cases
- More than **3,500** EMU/EEG/autonomic tests performed
- More than **10,000** injections performed
- More than **2,900** stroke cases
- More than **3,500** sleep studies performed
- More than **750 patients** enrolled in clinical trials

A Comprehensive Team Approach to Advanced Neurologic Care

NorthShore Neurological Institute’s comprehensive programs offer patients and their families proven expertise, advanced technology and outstanding care coordination to treat a variety of neurological diseases and conditions.

The foundation of our excellence in neurological care is the multidisciplinary approach that is essential to achieving the best possible outcomes. Each program in the center circle has a team of medical, surgical and rehabilitative members with unique expertise that maintains open lines of communication. These members often collaborate face-to-face in real time, as well as through one of the most advanced Electronic Medical Record (EMR) systems in the country, to deliver care effectively for complex neurological diseases.

As one of the region’s pre-eminent providers of neurological care, we are actively engaged in clinical trials and basic research. We regularly launch new research studies to ensure that the latest technology, clinical treatments and techniques are available for our patients.



New Faculty

We are pleased to welcome new members of our faculty to NorthShore Neurological Institute. They join our multidisciplinary team of neurospecialists to bring patients the most comprehensive care of neurological disorders in the region.



Alexandru Barboi, MD, is the new Director of the Neuromuscular and Peripheral Neurophysiology Program and leads the new autonomics laboratory at NorthShore Glenbrook Hospital. Dr. Barboi is board-certified in neurology and clinical neurophysiology. He is a nationally recognized expert on autonomic disorders and member of the Clinical Affairs Committee of the American Autonomic Society. Dr. Barboi has numerous teaching awards and joins NorthShore Neurological Institute from the department of neurological sciences at Rush University.



Octavia Kincaid, MD, is a board-certified neurologist and fellowship trained in clinical neurophysiology and neuromuscular medicine. Dr. Kincaid has over 15 years of clinical neurology experience and joins us from the University of Illinois at Chicago College of Medicine where she was the Assistant Dean for Curriculum. Her clinical interests are in Amyotrophic Lateral Sclerosis (ALS).



Leslie Finkel, MD, a board-certified pediatric neurologist, has joined NorthShore Neurological Institute after completing her child neurology fellowship at the Ann & Robert H. Lurie Children's Hospital of Chicago. The addition of Dr. Finkel continues our commitment to provide comprehensive diagnostic and treatment services to children with neurological disorders or diseases.



Michael Musacchio, MD, is a highly skilled board-certified neurosurgeon specializing in minimally invasive spine surgery, degenerative spine disease, disorders of the cervical and lumbar regions, spine procedures, complex spine reconstruction and joint replacement of the spine. Dr. Musacchio received his Bachelor of Science degree from the University of Illinois and his Doctor of Medicine degree from Rush Medical College. His general surgery internship and neurosurgical residency were also completed at Rush University Medical Center. His research interests include follow-up studies of FDA-approved devices for minimally invasive spine surgery.



Marietta Hoogs, PhD, is a fellowship-trained clinical neuropsychologist from the Mayo Clinic. Dr. Hoogs obtained her doctorate at the Division of Cognitive and Behavioral Neurosciences at the University at Buffalo School of Medicine and Biomedical Sciences.



Nicole Reams, MD, is a board-certified neurologist and fellowship trained in sports neurology. Her educational background includes an undergraduate career at the University of Notre Dame and medical school at Saint Louis University. Prior to joining NorthShore Neurological Institute, Dr. Reams was a Clinical Lecturer at the University of Michigan. Dr. Reams continues her ongoing research projects at NorthShore, including assessing complex reaction time in concussed athletes, examining athletic performance following return to play in National Football League players, and proposing clinical diagnostic criteria for chronic traumatic encephalopathy (CTE).



Victoria Tuchscherer, PhD, is a fellowship-trained pediatric neuropsychologist. Dr. Tuchscherer obtained her doctorate in clinical psychology from Rosalind Franklin University of Medicine and Science and completed her training at the Alexian Brothers Behavioral Health Hospital. Dr. Tuchscherer's clinical expertise is in neuropsychological evaluations for children, adolescents and young adults with a diverse range of medical, neurological and neurodevelopmental disorders that impact thinking or behavior.



Mark Rubin, MD, joins NorthShore Neurological Institute from the Mayo Clinic where he completed a residency in adult neurology as well as fellowships in both vascular neurology and neurohospitalist care. This specialized training allows Dr. Rubin to provide acute stroke care and inpatient neurological care of the highest quality. Other clinical interests include teleneurological consultations and neurosonology.



Ricky Wong, MD, has joined the team of neurosurgeons at NorthShore Neurological Institute after having completed his fellowship in complex cranial surgery at the University of South Florida. His clinical expertise is in open and endoscopic skull base surgery, cerebrovascular surgery and deep brain stimulation. Dr. Wong is a graduate of Tufts University (Doctor of Medicine) and University of Chicago (neurosurgical residency). Dr. Wong also has received a Master of Business Administration from The University of Chicago Booth School of Business.



Tiffani Stroup, DO, is a graduate of Nova Southeastern University College of Osteopathic Medicine. Dr. Stroup completed her adult neurology residency at the University of Illinois at Chicago where she was chief resident. She then completed a multiple sclerosis (MS) fellowship at the University of Chicago. During her fellowship, Dr. Stroup received the National MS Society's award for training in specialized MS care.

Neuro-Oncology | Brain and Spine Tumors

PHYSICIAN TEAM

Neuro-Oncologists



Ryan Merrell, MD
*Program Director,
Neuro-Oncology*

Dennis Groothuis, MD

Nina Martinez, MD

Neurosurgeons

Brain and Spine Tumor



Julian Bailes, MD
*Chairman, Department
of Neurosurgery*

Shakeel Chowdhry, MD

Skull Base and Pituitary



Ricky Wong, MD

SCOPE OF SERVICES

The Neuro-Oncology program at NorthShore Neurological Institute is nationally recognized in providing the most advanced care available for brain tumor and spine tumor patients, as well as for patients with neurological complications secondary to other cancers.

The first step in developing an evidence-based long-term treatment plan for each patient is a complete diagnostic workup. This includes leveraging our advanced neuroimaging capabilities in combination with molecular neuropathology. Our multidisciplinary Neuro-Oncology care team reviews each patient's case in terms of history, radiologic studies and pathologic diagnosis at regular tumor conferences. The team, in consultation with the patient and family, determines the most effective treatments that are tailored to the individual. The treatment plan also includes a wide array of education, support and expressive arts programs to help soothe anxiety and manage pain while improving coping skills. In addition to the services of the NorthShore Neurological Institute, our patients have access to the programs and services offered by the NorthShore Kellogg Cancer Center whose social workers have experience and special training in the psychological, social, emotional and practical needs of tumor patients and their families.

Having one of the largest brain and spine tumor programs in the country, NorthShore Neurological Institute is also involved in multiple clinical trials, offering patients access to promising new methods of cancer detection and treatment. Our specialists have led and participated in numerous pivotal studies that are transforming the spine and brain tumor care of our patients—and of patients elsewhere in the world. See pages 35, 39 and 40 for more details.

Nonsurgical Treatments

Our highly skilled neuro-oncologists offer patients a full array of the latest medical therapies and treatments for brain and spine tumors. Our team directs the administration of chemotherapy and biologic therapies, including vaccines and monoclonal antibodies, which tap the body's immune system to help fight cancer. Molecular-targeted or directed medical therapies focus on cellular changes and target tumor cells to inhibit tumor growth.

Skull Base and Pituitary Surgery

The removal of tumors or vascular lesions that occur at the base of the skull is among the most technically challenging neurosurgical procedures. Our neurosurgeons' vast clinical experience allows us to tackle these challenging problems using the most advanced and least-invasive methods possible. These include minimally invasive and incision-free stereotactic radiosurgery; "SonoNav" and intraoperative ultrasound guidance technology that provide the surgeon information about the brain; and Visualase, an advanced laser thermal ablation technique. All surgeries incorporate image guidance and intraoperative monitoring.

HIGHLIGHTS AND ACCOMPLISHMENTS

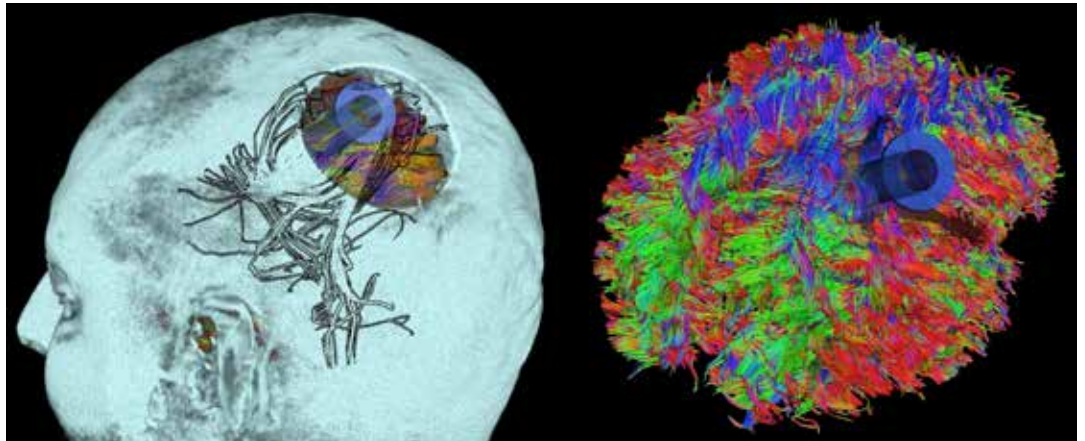
Education

American Brain Tumor Association (ABTA)—Julian Bailes, MD, discussed the latest innovations in surgically treating brain tumors in the ABTA webinar series. Dr. Bailes answered questions about Visualase, NICO BrainPath, stereotactic radiosurgery and the use of fluorescent dyes in neurosurgery.

Continuing Medical Education (CME) Series—NorthShore Neurological Institute organized the first Neuro-Oncology CME event, titled "Advancements in Brain Tumor Diagnosis and Treatments." The educational goal of this activity was to update the target audience about the latest treatment guidelines for brain tumor as well as the latest neuro-oncology clinical trials that are currently enrolling within their region. The audience also received an update on recent advances in the use of minimally invasive technologies in the treatment of brain tumors.

Innovation Technologies for Subcortical Surgery

Subcortical Surgery Group (SSG)—Julian Bailes, MD, was a founding member of the SSG last year with the mission to optimize minimally invasive surgical corridors to the subcortical space through clinical and scientific collaborative research. The vision is to continually improve safe and effective treatments for patients with subcortical brain pathology by bringing new imaging, mapping, navigation, optics and robotics technologies to bear. Dr. Bailes is the President of the newly formed group whose members are among the early adopters of these new technologies that provide access to hard-to-reach areas of the brain. More than 70 neurosurgeons from hospitals and academic centers across the country attended its first annual meeting to discuss this technology, called BrainPath, which uses the Six Pillar Approach to address glioblastoma multiforme, brain metastasis and intracerebral hematomas.



BrainPath and BrightMatter

BrainPath is an innovative technology that provides unique surgical access to brain tumors without traumatically affecting normal brain tissue. This allows surgeons to reach subcortical brain lesions that were considered inoperable or difficult to access. It is uniquely designed to minimize tissue damage by displacing fiber tracts of the brain during advancement to the abnormality—similar to the way a boat hull moves through water by displacing what is in front of it—all through an opening smaller than a dime. After reaching the lesion, an outer sheath remains in the brain to serve as a protective portal for surgeons to easily maintain access to the surgical site during tissue or fluid evacuation.

NorthShore Neurological Institute is one of the first places in the world to use the BrainPath device in conjunction with BrightMatter™ suite of robotics and advanced optics products. This imaging technology (shown above) provides advanced visualization for image-guided treatments and preoperative planning tools. Using automated data processing allows for brain segmentation and hands-free imaging registration to generate real-time 3D tractography. The images the BrightMatter workflow approach fuses tractography with the area of interest to plan a simple and intuitive trajectory for the BrainPath intervention technology.

Parkinson's Disease and Other Movement Disorders

PHYSICIAN TEAM

Neurologists



Katerina Markopoulou,
MD, PhD

*Program Director,
Parkinson's Disease and
Other Movement Disorders*

Demetrius ("Jim")
Maraganore, MD

Ashvini Premkumar, MD

Bernadette Schoneburg, MD

Neurosurgeon



Ricky Wong, MD

Physiatrist



Rachel Kermen, MD

SCOPE OF SERVICES

NorthShore Neurological Institute is a recognized leader in the treatment of Parkinson's disease (PD) and other types of Parkinsonism (multiple system atrophy, progressive supranuclear palsy, corticobasal degeneration), as well as other movement disorders such as ataxia, chorea, dystonia, hemifacial spasm, restless legs syndrome, tics, tremor and spasticity. Even though movement disorders can be stubbornly progressive and disabling, research has advanced our understanding of the mechanisms of these disorders. This has led to tremendous progress in treatment—both medical and surgical.

Medical Management—Pharmacological management (such as oral medications and botulinum toxin injections), patient education, rehabilitative services and family support are important aspects of the comprehensive treatment plan we provide for each of our patients. We use all of these components to optimize functional independence and improve quality of life. Our specialists are devoted to researching and thoroughly understanding the intricacies of Parkinson's disease and other movement disorders.

Surgical Treatment—Deep brain stimulation (DBS) is a surgical therapy used for the treatment of Parkinson's disease. Stereotactic guided neurosurgery is used to insert stimulating electrodes into specific nuclei deep within the brain. Once positioned, the electrodes are connected to a permanent neurostimulator implanted into the chest wall. The electrodes deliver electrical currents to the precise brain locations responsible for movement, regulating the abnormal brain cell activity that causes symptoms such as tremor and loss of fine skilled movements and gait problems. It is important to keep in mind that DBS can only help relieve the symptoms of Parkinson's; it does not cure or stop its progression.

HIGHLIGHTS AND ACCOMPLISHMENTS

LONG-PD—Demetrius Maraganore, MD, Medical Director of NorthShore Neurological Institute and Chairman, Department of Neurology, is the principal investigator of a newly launched research initiative called the LONG-PD study. This multinational and multicenter study will investigate the genetics of Parkinson's disease and its long-term outcomes. The study will collect data on more than 4,000 Parkinson's disease patients over a 15-year period.

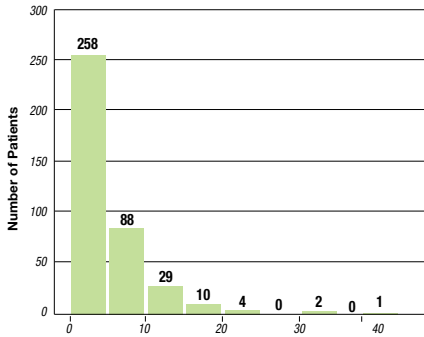
Community Outreach—Experts from NorthShore Neurological Institute participated in the Michael J. Fox Foundation Partners in Parkinson's event held in Rosemont. Neurologists, nurses, physical therapists and researchers were on hand to talk with the more than 800 attendees, who also took part in educational seminars and panel discussions designed for individuals and families affected by Parkinson's disease.

We have enrolled more than 450 patients to date in the Parkinson's disease DodoNA project. Data from the initial visit as well as longitudinal data over six years is shown on the facing page. DNA has been collected from these patients to identify DNA fingerprints that predict outcomes and therapeutic responses with the hope of developing new disease-modifying therapies. More than one million genetic tests have been performed per sample. See page 31 for more details.

Parkinson's Disease Description of 463 patients enrolled, at their initial visit

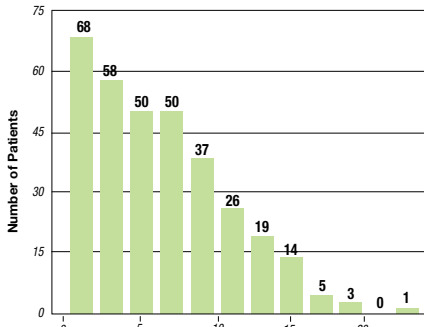
Disease Duration

Duration is measured in years, from the year of initial symptom to the year of initial visit.



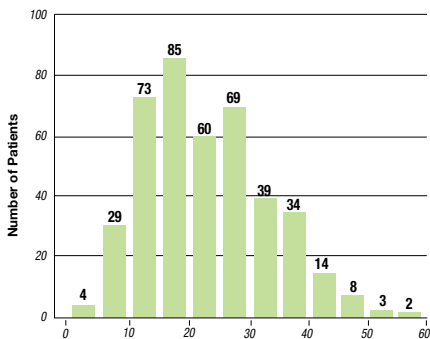
ESS Score

Using the Epworth Sleepiness Scale (ESS), scores greater than 10 indicate excessive daytime sleepiness.



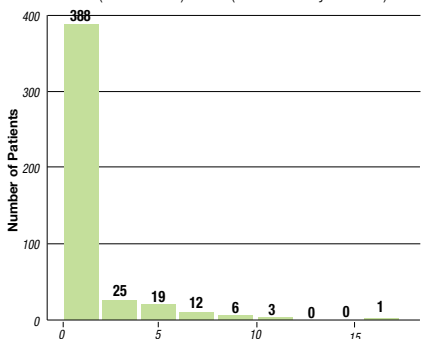
UPDRS Motor Score

The unified Parkinson's disease rating scale (UPDRS) examines motor examination where scores range from 0 (not affected) to 108 (most severely affected).



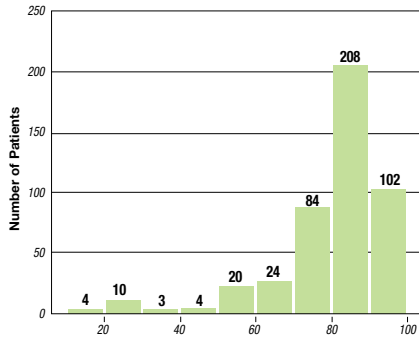
UPDRS Complications Score

The unified Parkinson's disease rating scale (UPDRS) examines complications of therapy where scores range from 0 (not affected) to 23 (most severely affected).



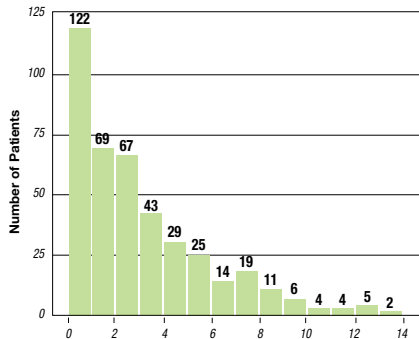
Schwab and England

This scale measures the patient's activities of daily living, where 100% is normal.



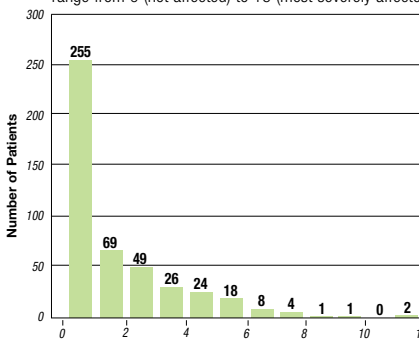
GDS Score

The Geriatric Depression Scale (GDS) assesses depressive symptoms in the elderly where scores of 0-4 indicate normal; 5-8 mild; 9-11 moderate; 12-15 severe.



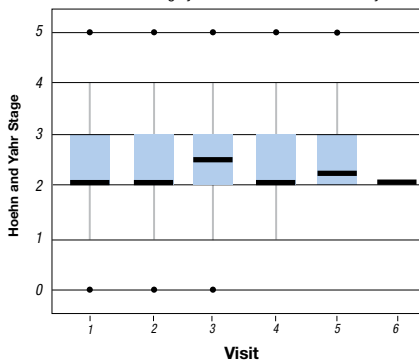
UPDRS Mentation, Behavior and Mood Score

The unified Parkinson's disease rating scale (UPDRS) examines mentation, behavior and mood where scores range from 0 (not affected) to 16 (most severely affected).



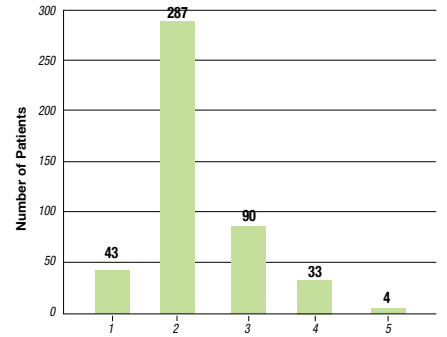
Longitudinal Changes in Hoehn and Yahr Stage

The Hoehn and Yahr stage is a measure of motor impairment; it is an objective measure of disability. As a group, our patients have remained largely stable over more than five years.



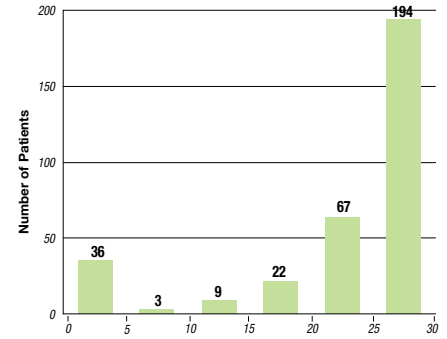
Hoehn and Yahr Score

Stage 1=one side of the body involved; Stage 2=both sides of the body involved; Stage 3=unsteady balance, at risk for falls; Stage 4=severely disabled, still able to walk or stand unassisted; Stage 5=wheelchair user or bedridden



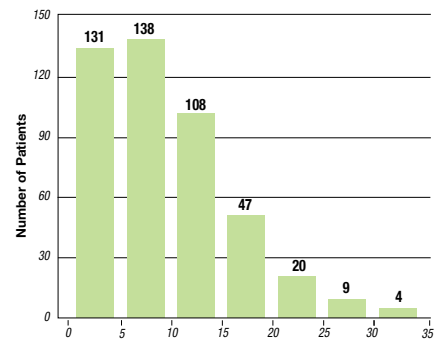
MoCA

The Montreal Cognitive Assessment (MoCA) test is a screening tool for the presence of cognitive dysfunction where a score of ≥ 26 is considered normal.



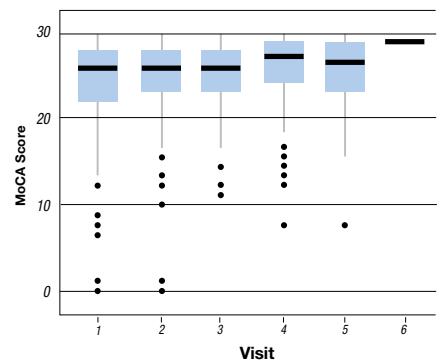
UPDRS ADL Score

The unified Parkinson's disease rating scale (UPDRS) examines activities of daily living (ADL) where scores range from 0 (not affected) to 52 (most severely affected).



Longitudinal Changes in Montreal Cognitive Assessment (MoCA) Score

The MoCA score is a measure of cognitive impairment; it is an objective measure of disability. As a group, our patients have remained largely stable over more than five years.



Center for Brain Health

PHYSICIAN TEAM

Neurologists



Demetrius ("Jim")
Maraganore, MD
*Chairman, Department
of Neurology*

Smita Patel, DO

Chad Yucus, MD

SCOPE OF SERVICES

The prevalence of Alzheimer's disease is growing rapidly due to successful aging. This is placing an unprecedented burden on individuals, families and the healthcare system. The mission of the newly launched NorthShore Center for Brain Health is to preserve and improve brain health by modifying risk factors associated with Alzheimer's disease and related disorders. The focus is primary prevention using risk assessments, interventions and surveillance.

Demetrius Maraganore, MD, Ruth Cain Ruggles Chairman of the Department of Neurology and Medical Director of NorthShore Neurological Institute, leads a multidisciplinary team of specialists who use leading-edge and comprehensive approaches to determine a patient's risk for developing brain disorders, and to mitigate the risks as much as possible in order to delay or altogether prevent neurodegenerative disease. The Center for Brain Health rapidly translates research into practice for the benefit of our patient population.

Our team of specialists includes: neurologists, neuropsychologists, brain imaging specialists, genetic counselors, laboratory physicians, physical and cognitive therapists, dietitians, integrative medicine specialists, lifestyle coaches and researchers.

Services include:

- Genetic and nongenetic risk assessments and counseling.
- Annual screening for Alzheimer's disease (AD), Parkinson's disease (PD) or chronic traumatic encephalopathy (CTE) in high-risk subjects using neurological and neuropsychological testing and brain imaging.
- Medical, physical, cognitive, dietary and integrative therapies to reduce risks.
- Lifestyle coaching and digital health (smartphone apps and tracking tools) to maximize compliance with therapies.
- Transition to neurological care when AD, PD or CTE is detected.

NorthShore's award-winning Electronic Medical Record (EMR) system enables our team of experts to provide seamless and collaborative care. Personal digital assistant devices, smartphone apps and tracking tools help patients stay compliant with the care plan and connected to our specialists. In addition, the DodoNA "Brain Health" Project will measure outcomes research to further refine treatment strategies.



Dr. Smita Patel of NorthShore's newly launched Center for Brain Health assesses a patient for signs of neurodegeneration.

HIGHLIGHTS AND ACCOMPLISHMENTS

The development of the Center for Brain Health was guided by five working groups, which were established under the leadership of Dr. Maraganore. These working groups are composed of expert members who are able to draw on the vast clinical, research, informatics and community engagement experience of NorthShore.

The Center for Brain Health is involved in the DodoNA Project: "DNA Predictions to Improve Neurological Health." DNA samples from 1,000 prospective patients will be evaluated to associate genotypes with brain performance and outcomes and to discover biological factors that contribute to brain health. See page 31 for more details.

Memory and Cognitive Disorders

PHYSICIAN TEAM

Neurologists



Chad Yucus, MD

James Castle, MD

Neuropsychologists



Jerry Sweet, PhD
*Vice Chair, Department of
Psychiatry and Behavioral
Sciences*

Leslie Guidotti Breting, PhD

Elizabeth Geary, PhD

Marietta Hoogs, PhD

Alona Ramati, PhD

SCOPE OF SERVICES

The NorthShore Neurological Institute Memory and Cognitive Disorders program is a comprehensive, compassionate and multidisciplinary care program that focuses on individuals coping with memory problems and other cognitive concerns. Our team is composed of neurologists, neuropsychologists, nurses and a medical social worker—all specializing in memory and cognitive disorders including mild cognitive impairment, Alzheimer's disease, vascular dementia, Lewy body dementia, frontal temporal lobe dementia and chronic complications of brain injuries. Our specialists also treat memory problems and cognitive issues related to head trauma, depression and sleep disorders.

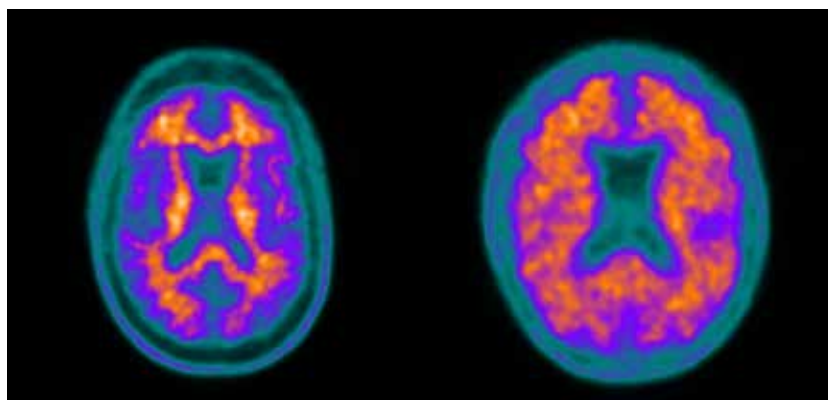
Depending on the type of memory disorder, both our neurologists and neuropsychologists provide assessments for the best diagnosis and treatment plan. We work closely with family members and other care providers to ensure that each patient is attended to with respect and compassion throughout the diagnosis and treatment process. Our doctors embrace the highest standard of care, continuously seeking and offering new and innovative treatments, cutting-edge imaging techniques and state-of-the-art neuropsychological evaluation tools.

We also offer a drop-in Memory Loss Caregiver Support Group that meets every month at the John and Carol Walter Ambulatory Care Center at Glenbrook Hospital.

HIGHLIGHTS AND ACCOMPLISHMENTS

Patients with cognitive impairment who are being evaluated for Alzheimer's disease and other causes of cognitive decline now have access to an FDA-approved diagnostic PET scan using a novel tracer, Amyvid, for imaging plaque in the brain, as may be seen in someone with Alzheimer's disease (see image below). While this test does not establish a diagnosis, it can help identify whether cognitive decline may be associated with Alzheimer's disease. Often used for younger patients, this scan serves as an additional tool to ensure a more conclusive diagnosis for Alzheimer's disease. This is a self-pay test, as most insurance companies do not currently cover the procedure.

Patients with memory or cognitive disorders now have an opportunity to enroll in the newly launched Memory and Cognitive Disorders DodoNA project. Research enrollment has already surpassed 120 patients in less than a year and will allow data to be collected to predict outcomes and therapeutic responses. We collect DNA from consenting subjects, and more than one million genetic tests have been performed per sample. See page 31 for more details.



PET brain imaging with Amyvid in a normal individual (left) and showing amyloid accumulation in a patient with Alzheimer's disease (right).

Spine Center

PHYSICIAN TEAM

Neurosurgeons



Noam Stadlan, MD
*Vice Chair, Department
of Neurosurgery*

Michael Musacchio, MD

Orthopaedic Surgeons



Srdjan Mirkovic, MD
*Division Head, Spine,
Department of
Orthopaedics*

Eldin Karakovic, MD, PhD

Mark Nolden, MD

Physiatrists



Joseph Alleva, MD
*Division Head,
Physical Medicine and
Rehabilitation*

Matthew Co, DO

Thomas Hudgins, MD

Daniel Hurley, MD

Rachel Kermen, MD

SCOPE OF SERVICES

At the NorthShore Spine Center, our goal is to provide a comprehensive, multidisciplinary and integrated team approach for the evaluation and management of disorders of the spine. The spine specialists offer patients a full range of treatment options for spinal conditions to create an individual care plan.

Nonsurgical Treatment Options—The patient's needs may be met with more conservative treatment options.

- Physical therapy—Physiatrists and therapists educate patients on proper body mechanics and establish individualized exercise programs they can follow at home.
- Interventional procedures—Image-guided pain-relieving injections of medicine straight to the source of the pain can make a huge difference for a patient's comfort.
- Medication management—Our experienced physicians and staff work closely with patients to regulate and monitor any oral medications they take to treat their back pain.
- Integrative medicine—NorthShore's Integrative Medicine program can complement a patient's holistic back pain treatment plan, in conjunction with any other therapies. Options include acupuncture, chiropractic care, yoga, biofeedback and more.

Surgical Treatment Options—When conditions require surgery, one of the most experienced surgical teams in the region is able to offer the most advanced minimally invasive and complex surgical techniques available. Minimally invasive procedures offered include: anterior lumbar interbody fusion, direct lateral interbody fusion, transforaminal lumbar interbody fusion, decompression, cervical interbody fusion, foraminotomy, total disc replacement, microdisectomy, kyphoplasty, lumbar disc replacement, cervical disc replacement, lumbar interbody fusion and cervical interbody fusion. Use of state-of-the-art minimally invasive techniques, instrumentation and imaging helps patients recover in a shorter period of time and allows for a quicker return home.

HIGHLIGHTS AND ACCOMPLISHMENTS

Michael Musacchio, MD, is the principal investigator of a post-market analysis study of the FDA-approved cervical fusion devices: the STALIF C[®] and STALIF C-Ti[™]. The purpose of this study is to collect information about how well different types of patients do after spinal fusion, based on their earlier conservative treatments.

Thanks to the development of high-definition scopes and improved depth of perception, we now have impeccably clear optics to view the spine. Collaborations between surgeons and industry continue to drive the field and continually introduce new techniques and equipment that enable minimally invasive surgeons to offer better, safer and smaller surgeries that offer maximal impact to patient outcomes and recovery. Most importantly, there is so much more to develop and perfect in the field as we are really only just beginning.

The Department of Neurosurgery is a participant of the National Neurosurgery Quality and Outcomes Database (N²QOD) initiative. This project allows us to track quality, efficiency and ultimately the value of care for the most common neurosurgical procedures. The initiative was set up by the NeuroPoint Alliance—the data collection arm of the American Association of Neurological Surgeons—with a broad coalition of other neurosurgical societies, including the Congress of Neurological Surgeons (CNS), Society of Neurological Surgeons (SNS) and American Board of Neurological Surgery (ABNS). The goal is to generate both quality and efficiency data to:

- Demonstrate comparative effectiveness of neurosurgical procedures;
- Determine which patients are most likely to benefit from specific surgical interventions; and
- Facilitate multicenter trials and other cooperative clinical studies.

NorthShore Neurological Institute was one of the very early sites that has contributed data to the N²QOD. The three-month and 12-month quality outcomes report of some common neurosurgical procedures are shown.

Pain Scale

- 0 No pain
- 1–3 Mild pain: nagging, annoying, interfering little with activities of daily living
- 4–6 Moderate pain: interferes significantly with activities of daily living
- 7–10 Severe pain: disabling, unable to perform activities of daily living

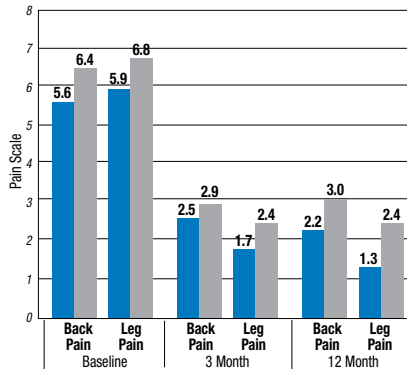
The Oswestry Disability Index (ODI) is an index derived from the Oswestry Low Back Pain Questionnaire used by clinicians and researchers to quantify disability for low back pain.

- 0–20 Minimal disability
- 21–40 Moderate disability
- 41–60 Severe disability
- 61–80 Crippling back pain
- 81–100 These patients are either bed-bound or have an exaggeration of their symptoms

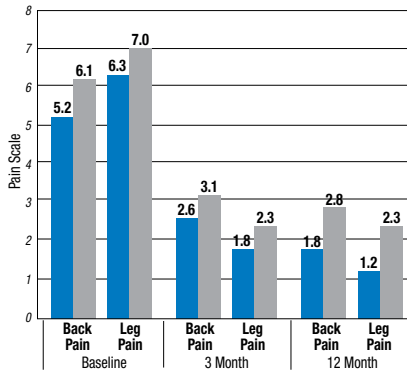
Pain Scale

NorthShore
N²QOD Total

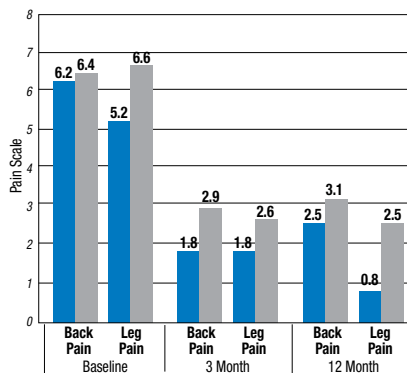
All Patients



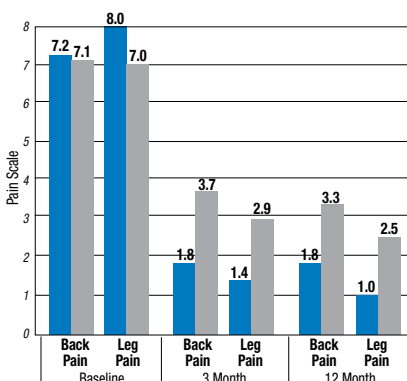
Disc Herniation



Stenosis

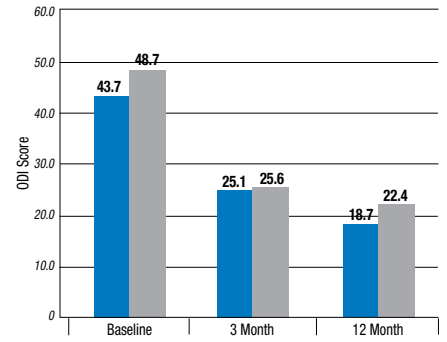


Fusion for Adjacent Segment Disease

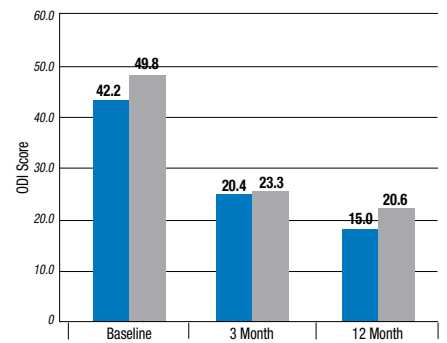


Oswestry Disability Index (ODI)

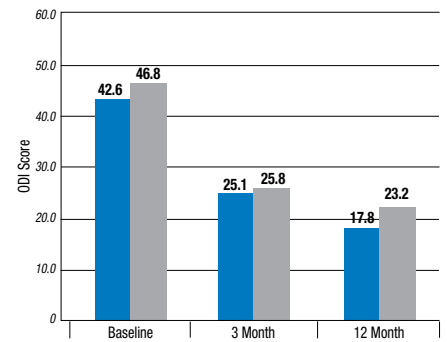
All Patients



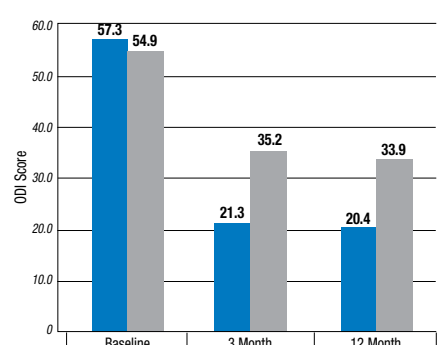
Disc Herniation



Stenosis



Fusion for Adjacent Segment Disease



Concussion/Brain Injury

PHYSICIAN TEAM

Neurologists



Nicole Reams, MD
Associate Director, Sports Concussion Program

James Castle, MD
Revital (“Tally”) Marcus, MD
David Randall, DO
Jesse Taber, MD
Charles Wang, MD

Neurosurgeon



Julian Bailes, MD
Chairman, Department of Neurosurgery

Neuropsychologist



Elizabeth Pieroth, PsyD
Associate Director, Sports Concussion Program

SCOPE OF SERVICES

A concussion is a type of mild traumatic brain injury (mTBI) caused by a bump or blow to the head that alters normal brain function and causes temporary cognitive and physical problems. Many activities of daily living from work to play can put people of all ages at risk for falls and collisions that could lead to concussions. However, concussions can also occur without a direct hit to the head, such as a strong whiplash action, literally resulting in the brain hitting the inside of the skull and causing injury.

Research shows that early intervention results in the best prognosis and rehabilitation. The NorthShore Neurological Institute’s multidisciplinary team of concussion and head injury specialists takes a multipronged approach to the diagnosis and treatment of concussions and other brain injuries. This team is led by one of the nation’s leading teams of concussion specialists:

Julian Bailes, MD, Co-Director of NorthShore Neurological Institute, is a nationally recognized mTBI expert and leads NorthShore’s Sports Concussion Program. Dr. Bailes has been a neurosurgical consultant to the National Football League (NFL) Players’ Association, which has supported research on the effects of head injuries on retired professional athletes. He is the Medical Director of the Center for the Study of Retired Athletes based at the University of North Carolina, Chapel Hill; Medical Director of Pop Warner Football, the oldest and largest national youth football organization with about 275,000 youth players nationwide; and an adviser to the National Collegiate Athletic Association.

Elizabeth Pieroth, PsyD, is a board-certified neuropsychologist and the Associate Director of NorthShore’s Sports Concussion Program. Dr. Pieroth is the concussion specialist for the Chicago Bears, Blackhawks, White Sox and Fire, as well as countless high schools across the state. She is also on the Board of Directors for the Brain Injury Association of Illinois and a member of the USA Football Heads Up Advisory Committee, Amateur Hockey Association of Illinois (AHA) Safety Committee and the U.S. Soccer Concussion Task Force.

Nicole Reams, MD, is a board-certified neurologist and completed her fellowship in sports neurology at the University of Michigan. She is the Associate Director of NorthShore’s Sports Concussion Program and has previously served as team physician for the Eastern Michigan University Eagles. Dr. Reams’ research interests include projects assessing complex reaction time in concussed athletes, examining athletic performance following return to play in National Football League players, and proposing clinical diagnostic criteria for chronic traumatic encephalopathy.

HIGHLIGHTS AND ACCOMPLISHMENTS

Concussion Education

Mom’s Football Safety Clinic—The Chicago Bears conducted a free safety clinic for about 100 mothers of Chicago-area youth football players in the Walter Payton Center at Halas Hall. Dr. Pieroth was a special guest speaker alongside Diane Long, wife of Hall of Famer Howie Long and mother of Bears guard Kyle Long and Rams defensive end Chris Long. The interactive and educational forum gave the moms a chance to learn about health and safety, including facts on concussion awareness, heat and hydration, and Heads Up Tackling techniques.

NFL Evolution—Dr. Pieroth is a regular contributing columnist in nflhealthplaybook.com, an NFL player health and safety website from the youth level to pro football. Articles included “How many concussions is too many?” “What does ‘rest’ after concussion mean?” and “Buyer beware with concussion cures.”

A Step aHead—This is the fifth year of Dr. Pieroth’s “A Step aHead” program. In association with the Chicago Blackhawks, AHA, Athletico and NorthShore, the “A Step aHead” program provides free baseline neurocognitive testing for youth hockey players and education on concussions and other safety issues for the entire youth hockey community.

Concussion Research

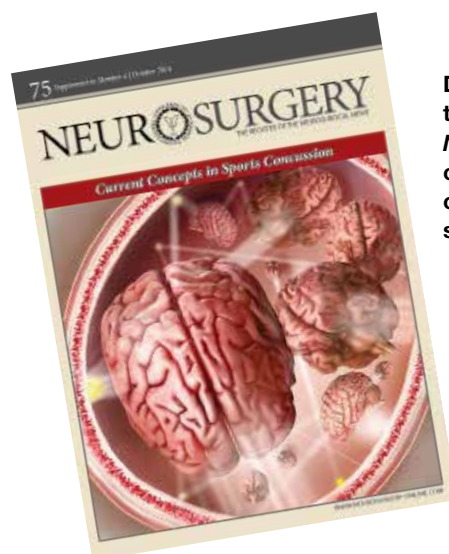
In a study published in the *Journal of Neurosurgery*, Dr. Bailes combined the data from all the recent studies that used helmet accelerometers and showed that athletes at the collegiate and high school levels sustain a surprisingly high number of head impacts ranging from several hundred to well over 1,000 during the course of a season. This cumulative “subconcussive” burden over the course of a career is equally important to concussion and a significant emerging concept requiring research of the potential role it plays in accumulating the brain injury and/or physiological damage in athletes and military personnel throughout life.

Dr. Pieroth published a report titled “Management of Concussion in the Professional Football Player” in the journal *Progress in Neurological Surgery*. Her co-author was Christopher Hanks, the head athletic trainer for the Chicago Bears football team. The focus of the report was detailing how medical professionals working with NFL players assess and manage concussions in their athletes. In the same issue, Dr. Bailes published an article titled “Cumulative Effects of Repetitive Mild Traumatic Brain Injury.” Dr. Pieroth also wrote a chapter titled “Concussion” in Dr. Bailes’ edited book, *Handbook of Neurological Sports Medicine*.

Dr. Bailes is a co-principal investigator of the newly established Concussion Neuroimaging Consortium. The mission of the consortium is the consolidation of leading brain science/brain imaging experts toward efforts aimed at identification of imaging “biomarkers” of concussion. It is hoped that this will allow the identification of athletes at risk for traumatic concussion and the development of advanced imaging techniques to measure physiological and neuropsychological alterations after concussion.

John Finan, PhD, joined the Traumatic Brain Injury Laboratory at NorthShore Neurological Institute. Dr. Finan is a biomedical engineer and joins us from the Neurotrauma and Repair Laboratory at Columbia University in New York. More information on our TBI research projects is shown on page 36 and 37.

The DodoNA Concussion Project was launched this past year and began enrolling patients. Currently, more than 50 patients have been enrolled with a target of 1,000. We are collecting DNA from consenting subjects and performing more than one million genetic tests per sample. See page 31 for more details.



Dr. Bailes was the co-editor of a special supplement titled “Current Concepts in Sports Concussion” in *Neurosurgery*, the official journal of the Congress of Neurological Surgeons. The special free online issue contains invited contributions from the leaders of sports concussion research, treatment and advocacy.

Epilepsy and Central Neurophysiology

PHYSICIAN TEAM

Neurologists



Jaishree Narayanan, MD
*Program Director,
Epilepsy and Central
Neurophysiology*

Janet Choi, MD

Sofia Dobrin, MD

Susan Rubin, MD

Neurosurgeons



Julian Bailes, MD
*Chairman, Department
of Neurosurgery*

Shakeel Chowdhry, MD

Ricky Wong, MD

Neuropsychologist

Leslie Guidotti Breting, PhD

Neurophysiologists

Emmanuel Nénonéné, PhD

Kevin Novak, PhD

SCOPE OF SERVICES

The Epilepsy and Central Neurophysiology program at NorthShore Neurological Institute provides advanced diagnosis and treatment options for seizure patients. We work to develop a tailored treatment plan for every patient and offer the latest approaches, including epilepsy clinical trials. Our Epilepsy Team includes board-certified neurologists/epileptologists, neuropsychologists, neurophysiologists, neurosurgeons and nurses who have an extensive background in neurology and epilepsy. Our team provides comprehensive diagnostic services to identify the likelihood and cause of seizures and assess the patients' candidacy for admission to our Epilepsy Monitoring Unit (EMU). We offer expert medication management for patients with epilepsy and assessment for surgical treatment to stop the effects of epilepsy such as Visualase, RNS[®] and Vagus Nerve Stimulation (VNS).

Visualase—Visualase is a laser ablation system that enables minimally invasive neurosurgical procedures. The technology uses laser interstitial thermal therapy (LITT) for precise thermal destruction of undesirable tissue in the brain, including epileptic foci or scar tissue deep in the temporal lobe. In combination with guided MRI, the Visualase laser technology allows the neurosurgeon more precision to destroy target-area lesions in hard-to-access parts of the brain via a small incision.

Vagus Nerve Stimulation—VNS is an adjunctive treatment for certain types of intractable epilepsy. VNS uses an implanted stimulator that sends electric impulses to the left vagus nerve in the neck via a lead wire implanted under the skin.

HIGHLIGHTS AND ACCOMPLISHMENTS

The Epilepsy Monitoring Unit (EMU) at NorthShore Evanston Hospital has been upgraded with new electroencephalogram (EEG) equipment to detect abnormalities in the brain waves or electrical activity of the brain. The EMU is a four-bed, inpatient facility where patients of all ages who have seizures that are difficult to diagnose and/or manage are admitted. Patients are monitored 24 hours a day, which allows the team to identify the type, frequency and source of their seizures. With this information, physicians can accurately analyze the cause of uncontrolled seizures and plan the most appropriate treatment plan. Patients considering seizure surgery also may be admitted to the EMU to identify whether they are suitable candidates.

Neuropace[®]—Responsive neurostimulation is a new innovative procedure that is now available as an adjunctive therapy in reducing the frequency of seizures in individuals 18 years of age or older with partial onset seizures. The Neuropace RNS System is suitable for patients who have undergone diagnostic testing that localized no more than two epileptogenic foci, do not respond to two or more antiepileptic medications, and currently have frequent and disabling seizures. The neurostimulator is a small, battery-powered device surgically implanted in the skull with lead wires that connect the neurostimulator directly to the area of the brain where seizures start. The neurostimulator uses the leads to sense brain activity and to deliver brief pulses of stimulation. The stimulation can help prevent the seizure before it happens. Our physicians, trained on the use of the RNS System, program the neurostimulator to continuously monitor brain electrical activity, and the neurostimulator delivers brief pulses of stimulation when it detects activity that could lead to a seizure.

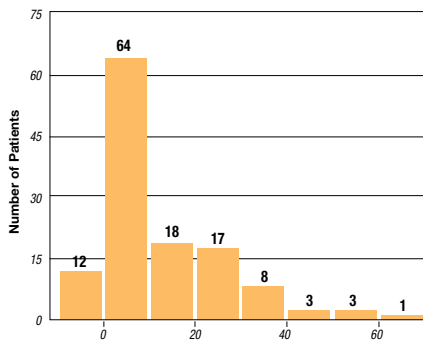
Enrollment of patients is nearly complete for a research study that is testing the ability of a hypertension drug called Verapamil to increase the effectiveness of the antiepileptic drugs in patients who have otherwise failed to respond to them. Jaishree Narayanan, MD, is the principal investigator of this study, which is funded by a NorthShore Research Institute/Medical Group Pilot Grant Program Award. Dr. Narayanan is also the principal investigator of a new study that is looking for signals in an EEG as a biomarker for cognitive impairment in patients with Parkinson's disease.

The DodoNA Epilepsy Project has enrolled more than 140 patients and collected discrete data that measure quality of life, depression, anxiety, sleepiness and cognitive dysfunction. Up to 1,000 patients will be enrolled and followed annually to assess outcomes and to individualize therapies and improve patients' neurological health. We are collecting DNA from consenting subjects and performing more than one million genetic tests per sample. See page 31 for more details.

Epilepsy Description of our first 136 patients enrolled, at their initial visit

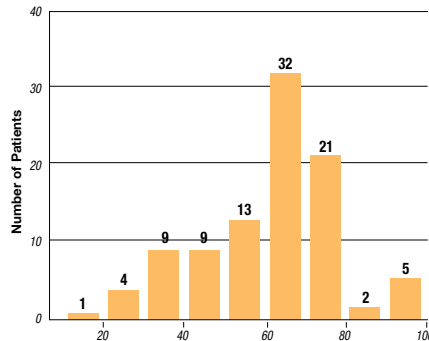
Disease Duration

Duration is measured in years, from the year of initial symptom to the year of initial visit.



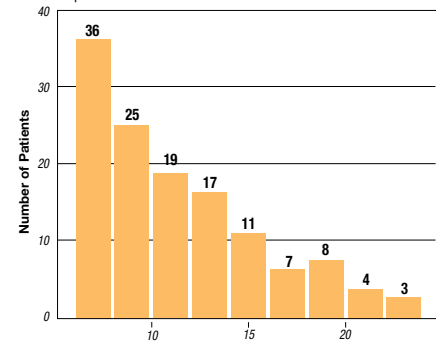
QOLIE Total Score

In the Quality of Life in Epilepsy (QOLIE-10-P) assessment, lower scores indicate a greater severity and burden of epilepsy on quality of life.



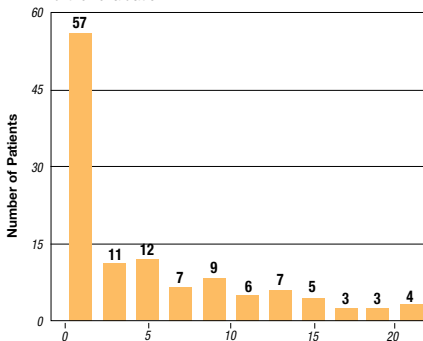
NDDI-E Total Score

The Neurological Disorders Depression Inventory for Epilepsy (NDDI-E) screens for depression in people with epilepsy where scores greater than 15 indicate depression.



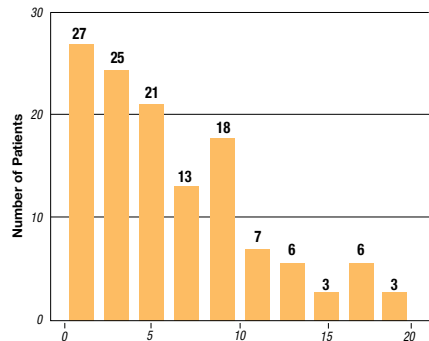
GAD-7

The generalized Anxiety Disorder 7 (GAD-7) score measures anxiety where a score of ≥ 10 indicates a probable diagnosis of GAD to be confirmed by further evaluation.



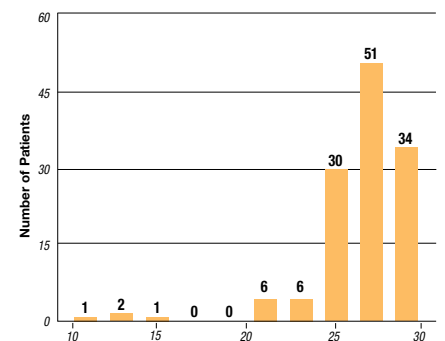
ESS Score

When using the Epworth Sleepiness Scale (ESS), scores greater than 10 indicate excessive daytime sleepiness.



MoCA

The Montreal Cognitive Assessment (MoCA) test is a screening tool for the presence of cognitive dysfunction where a score of ≥ 26 is considered normal.



Neuromuscular Disorders

PHYSICIAN TEAM

Neurologists



Alexandru Barboi, MD
*Program Director,
Neuromuscular
Disorders*

Octavia Kincaid, MD
David Randall, DO

Physiatrists

Kristina Drabkin, DO
Miledones Eliades, MD
Rachel Kermen, MD,
Danielle Schiff, MD
Naila Shaikh, MD

SCOPE OF SERVICES

Specialists at the Neuromuscular Disorders program offer comprehensive workups to achieve accurate diagnosis of nerve and muscle diseases and use state-of-the-art treatment modalities to optimize quality of life. Our team members are skilled in the diagnosis and medical management of amyotrophic lateral sclerosis (ALS or Lou Gehrig's disease), peripheral neuropathy, myasthenia gravis and myopathies. These disorders may be characterized by weakness, paralysis, respiratory distress and intractable pain and are often debilitating or progressive. They can dramatically alter quality of life for both patients and families, and in the case of ALS can be life-threatening. NorthShore Neurological Institute offers comprehensive workups to achieve an accurate diagnosis and rely upon state-of-the-art treatment modalities to develop a personalized plan to optimize quality of life. We have more than a dozen physicians with subspecialty board certification to perform an electromyography (EMG), a procedure used to diagnose muscle and nerve disorders.

HIGHLIGHTS AND ACCOMPLISHMENTS

NorthShore Neurological Institute opened a new autonomic laboratory under the direction of Alexandru Barboi, MD, an nationally recognized leader in this neurological specialty. The autonomic nervous system is part of the peripheral nervous system, which regulates subconscious activities such as heart rate, digestion, respiratory rate, salivation, perspiration, swallowing and more. Disorders of the autonomic nervous system are often complex and disabling conditions that are a challenge to diagnose. As one of the most comprehensive labs of its type in the region, NorthShore's autonomic lab includes the most advanced, state-of-the-art technology and equipment to diagnose these disorders. In addition to having sophisticated technology, the lab is staffed with specially trained technicians and a multidisciplinary team of experts who work together to diagnose and develop individualized treatment plans. The new lab will also increase the opportunities to perform autonomic disease research, an important component of advancing the treatment of autonomic disorders at NorthShore.



Dr. Alexandru Barboi (seated, right), Director of the Neuromuscular Disorders program, brings unique expertise in autonomic disorders to the NorthShore Neurological Institute.

Stroke

PHYSICIAN TEAM

Neurologists



Rima Dafer, MD
Program Director,
Stroke

Fan Caprio, MD

Daniel Homer, MD

Steven Meyers, MD

Richard Munson, MD

Archie Ong, MD

Mark Rubin, MD

Neurosurgeons



Shakeel Chowdhry, MD

Julian Bailes, MD

Ricky Wong, MD

SCOPE OF SERVICES

Our highly trained, multidisciplinary team of board-certified specialists and subspecialists collaborates to provide comprehensive care dedicated to preventing, diagnosing and treating strokes. Our team includes vascular neurologists, vascular neurosurgeons, neuroradiologists and physiatrists. The team focuses on the management of acute stroke, on the prevention of future strokes, and on the post-stroke rehabilitation process using a combination of medications; surgical interventions; physical, occupational and speech therapies; and lifestyle changes.

NorthShore Neurological Institute experts have immediate access to state-of-the-art neuroimaging technologies to make accurate diagnoses, to guide treatment, and to conduct rapid, thorough clinical evaluations. Neuroimaging studies such as a CT scan of the head, MRI of the brain and arterial vessel imaging are rapidly deployed to determine the cause of stroke and to determine the appropriate treatment modality.

Thrombolytic Therapy—NorthShore Neurological Institute's Acute Stroke Team is available 24 hours a day, seven days a week to administer tPA (tissue plasminogen activator) intravenously to patients with ischemic stroke—i.e., when a blood vessel in the brain is blocked by a clot. When this clot-dissolving drug (clot buster) is administered within the first three hours to four and a half hours after the stroke, the patient's chances of recovery are significantly improved.

Neurovascular Surgery—We offer patients mechanical thrombectomy treatment using the newest and safest FDA-approved minimally invasive intra-arterial clot-removal tools to open up blockages in large intracranial vessels. Our neurovascular surgeons also treat patients diagnosed with a hemorrhagic stroke to remove blood from the brain caused by ruptured blood vessels. If an aneurysm or vascular malformation is found, treatment is either surgery, endovascular intervention or a combination of both—all performed by our specialized team.

Carotid Artery Disease—Our specialists offer carotid artery blockage treatments ranging from carotid endarterectomy, to less-invasive techniques such as carotid angioplasty and stenting. Innovative minimally-invasive technologies allow our nationally renowned interventional neurosurgeons to safely open up blockages in carotid arteries for patients who may not be candidates for other treatment options. These advanced surgical techniques feature local instead of general anesthesia, smaller incisions, less pain and shorter recovery times.

HIGHLIGHTS AND ACCOMPLISHMENTS

All four NorthShore Hospitals—Evanston, Glenbrook, Highland Park and Skokie—are reaccredited with the Gold Seal of Approval™ from The Joint Commission for Primary Stroke Centers maintaining the systemwide designation. This designation demonstrates NorthShore's commitment to quality and the highest level of care for our stroke patients.

The Joint Commission's Primary Stroke Center Certification Program recognizes centers that follow the best practices for stroke care, including:

- Use of a standardized method of delivering care based on the Brain Attack Coalition's "Recommendations for Establishment of Primary Stroke Centers"
- Tailor treatment and intervention to individual needs
- Support patient self-management activities
- Promote the flow of patient information across settings and providers, while protecting patient rights, security and privacy
- Analyze and use standardized performance measure data to continually improve treatment plans
- Demonstrate their application of and compliance with clinical practice guidelines published by the AHA/ASA or equivalent evidence-based guidelines

We implemented the DodoNA Stroke Project. We are collecting discrete data using the Electronic Medical Record (EMR) system that measures stroke outcomes. Up to 1,000 patients will be enrolled and followed annually. We are collecting DNA from consenting subjects and performing more than one million genetic tests per sample. See page 31 for more details.

We also implemented teleneurology as a method of improving the accuracy of stroke diagnosis and accelerating the door-to-needle time for tPA administration. We are able to administer this life-saving treatment within seven minutes of the patient's arrival to the Emergency Department.

Migraine and Other Headache Disorders

PHYSICIAN TEAM

Neurologists



Steven Meyers, MD
Program Director,
General Neurology

Thomas Freedom, MD

Angela Mark, MD

Susan Rubin, MD

Irene Semenov, DO

Neuropsychologist

Leslie Guidotti Breting, PhD

Physiatrist



Daniel Hurley, MD

SCOPE OF SERVICES

NorthShore Neurological Institute takes a multidisciplinary approach to diagnosing and treating chronic headaches. Most headaches can be diagnosed by seeing one of our neurologists, sub-specialized in headache disorders, who perform a comprehensive history and physical exam. Rarely, there may be a secondary cause of headache such as a tumor or blood vessel problem. In the event a rarer cause of headache is suspected, blood work or imaging by CT or MRI may be needed.

Our neurology specialists treat most headache disorders by providing reassurance and with medications. Neurology specialists may consult experts in physiatry, psychology or neurosurgery to aid in the treatment of select headache disorders. For example, our physiatrists aid in the treatment of cervicogenic headaches with injections, while our psychologists aid in the treatment of tension headaches with relaxation techniques. Our neurosurgeons, on the other hand, often treat headache disorders due to raised intracranial pressure or mass lesions with surgery.

Our chronic headache specialists may also recommend BOTOX® therapy as well as integrative medicine programs such as acupuncture. Along with these treatment options, patient education is also an important component in chronic headache care. Our experts work with patients, helping them recognize triggers and modify habits that may be contributing to their chronic headaches.

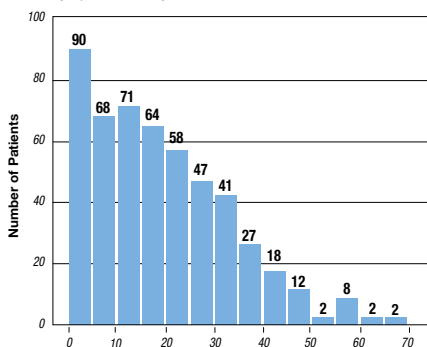
HIGHLIGHTS AND ACCOMPLISHMENTS

As part of the DodoNA project, we have customized our Electronic Medical Record (EMR) system to capture hundreds of discrete pieces of information from each headache office visit. We have enrolled more than 600 patients and are well on our way to our target of 1,000. Data from the initial visit are shown below and on the facing page. We also collect blood samples with informed consent to extract and store DNA. We are performing more than one million genetic tests on each sample. We aim to identify genetic and nongenetic factors that predict the severity, progression and outcomes of migraine in each patient and that guide personalized medicine treatment. See page 31 for more details.

Migraine Description of our first 582 patients enrolled, at their initial visit

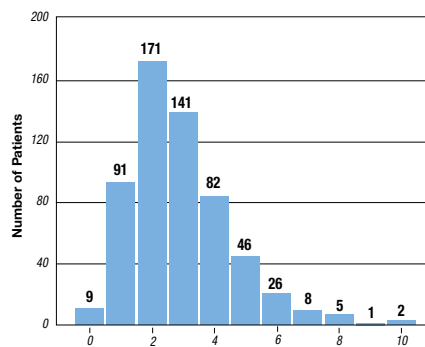
Disease Duration

Duration is measured in years, from the year of initial symptom to the year of initial visit.



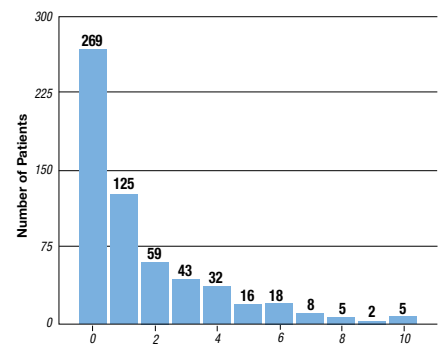
Number of Prior Abortive Medications

Abortive medications are taken at the start of a migraine attack to stop the symptoms.



Number of Prior Preventive Medications

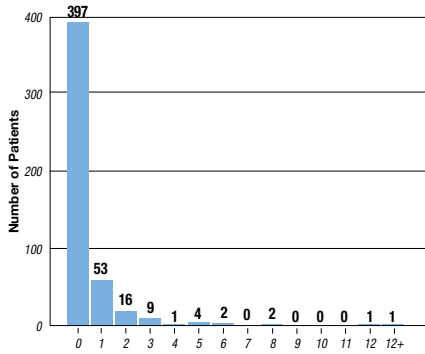
Preventive medications are taken daily to keep migraine attacks from occurring frequently.



Migraine (continued)

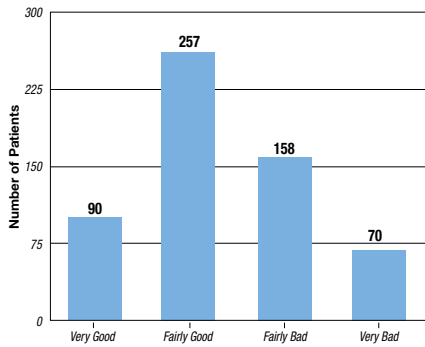
Number of Emergency Department Visits

This is the number of prior Emergency Department visits for headache reported at the patient's initial visit.



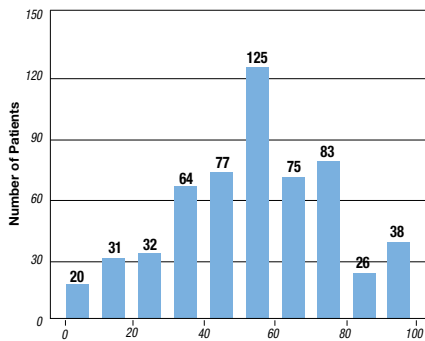
Sleep Quality

Quality of sleep is reported as ranging from very good to very bad.



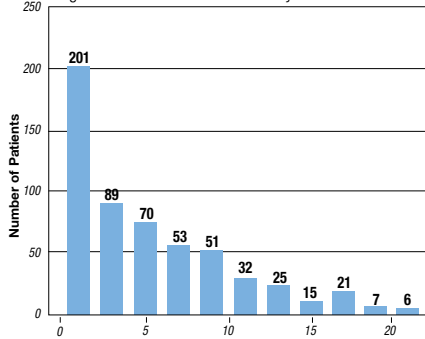
MSQ Restrictive

The Migraine-Specific Quality of Life (MSQ) restrictive score assesses how migraines limit one's daily social and work-related activities where higher scores indicate better health-related quality of life.



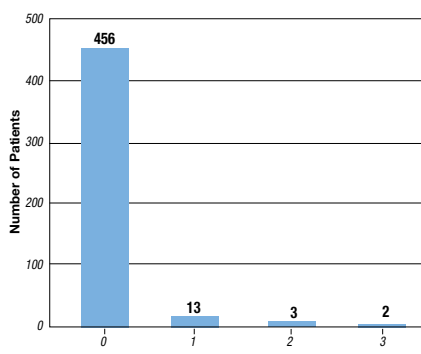
GAD-7

The Generalized Anxiety Disorder 7 (GAD-7) score measures anxiety where a score of ≥ 10 indicates a probable diagnosis of GAD to be confirmed by further evaluation.



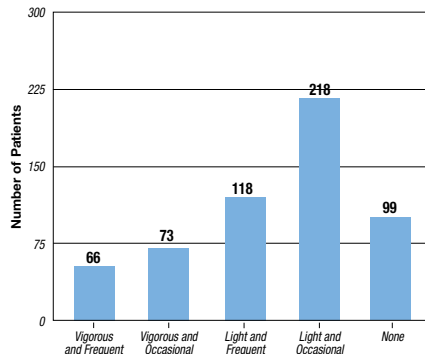
Number of Hospitalizations

This is the number of prior hospitalizations for headache reported at the patient's initial visit.



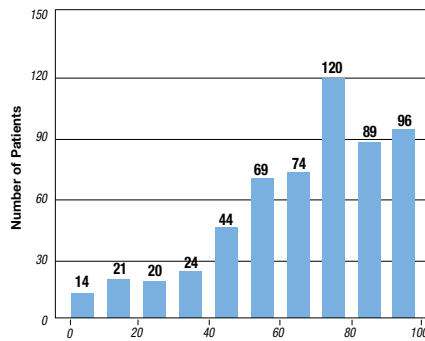
Exercise Score

Exercise is reported as ranging from vigorous and frequent to none.



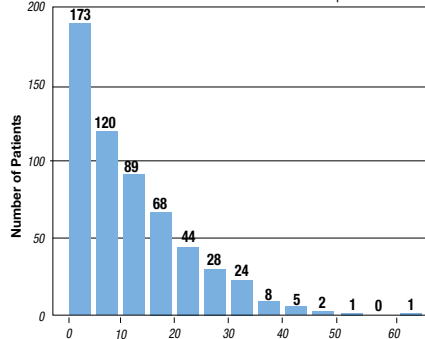
MSQ Preventive

The Migraine-Specific Quality of Life (MSQ) preventive score assesses how migraines prevent one's daily social and work-related activities where higher scores indicate better health-related quality of life.



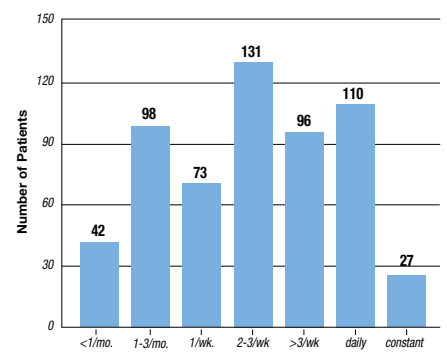
CESD

The Center for Epidemiologic Studies Depression Scale (CESD) is a screening test for depression where a score ≥ 15 indicates at least mild to moderate depression.



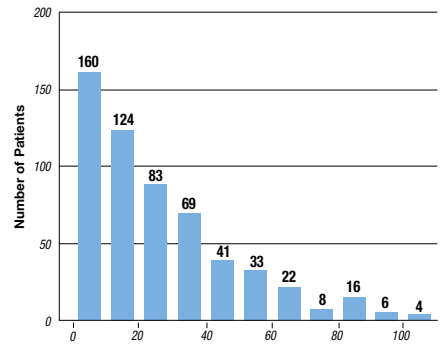
Headache Frequency Score

This shows the regularity of headaches ranging from less than once per month to constant.



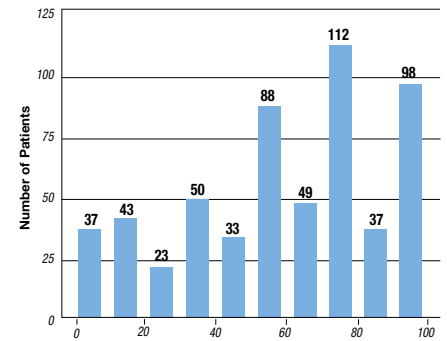
MIDAS Total Score

The Migraine Disability Assessment (MIDAS) test determines how severely migraines affect a patient's life where scores of 21+ indicated severe disability.



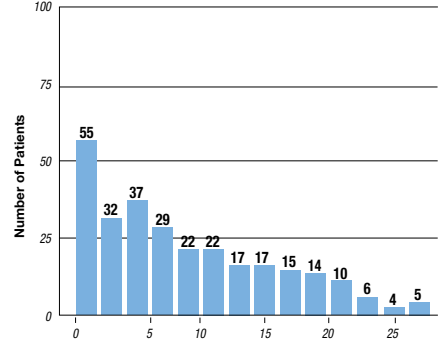
MSQ Emotional

The Migraine-Specific Quality of Life (MSQ) emotional score assesses the emotions associated with migraines where higher scores indicate better health-related quality of life.



ISI Score

In the Insomnia Severity Index (ISI), scores of 15 and over indicate at least moderate severity.



Multiple Sclerosis

PHYSICIAN TEAM

Neurologists



Afif Hentati, MD
*Program Director,
Multiple Sclerosis*

John Pula, MD
Susan Rubin, MD
Tiffani Stroup, DO

Neurosurgeons



Noam Stadlan, MD
*Vice Chair, Department
of Neurosurgery*

Shakeel Chowdhry, MD
Michael Musacchio, MD
Ricky Wong, MD

Physiatrists

Kristina Drabkin, DO
Miledones Eliades, MD
Rachel Kermen, MD
Danielle Schiff, MD
Naila Shaikh, MD

SCOPE OF SERVICES

NorthShore Neurological Institute's Multiple Sclerosis (MS) program is a designated Center for Comprehensive Multiple Sclerosis Care through the National Multiple Sclerosis Society's Partners in MS Care program. This recognition confirms our commitment to exceptional patient care; our provision of coordinated, comprehensive MS care; and our continuing partnership with the MS Society to address the challenges of people affected by MS. Our services begin with a diagnosis involving a comprehensive history, an in-depth physical evaluation, and the latest technology—including advanced magnetic resonance imaging (MRI), evoked potentials and lumbar punctures when indicated.

NorthShore offers the latest therapeutic MS treatment options, including the use of new “disease-modifying” oral medications. For the treatment of acute MS exacerbations, experienced healthcare staff at our infusion centers, provide intravenous corticosteroids or infusion of other therapies, such as immunoglobulins and monoclonal antibodies. We also perform plasma exchange in some cases. Severe spasticity may be managed by an intrathecal baclofen pump to help patients achieve maximum functionality and improve their comfort. The pump is implanted by a neurosurgeon, and medications are then titrated and managed long term. NorthShore Neurological Institute also hosts a support group for MS patients every month at Evanston Hospital.

HIGHLIGHTS AND ACCOMPLISHMENTS

We have enrolled more than 180 patients to date in the DodoNA project and have recorded 17 score test measures of disease severity (including for depression, anxiety and cognition), using toolkits custom built in our award-winning Electronic Medical Record (EMR) system. These patients will be evaluated annually in our MS program so that we can continue to perform multidimensional comparisons of all score tests. The data on the facing page are from the initial visit. Follow-up assessments will determine how score test patterns change over time. We have collected DNA from all consenting subjects and are performing more than one million genetic tests per sample (DNA predictions to improve neurological health).

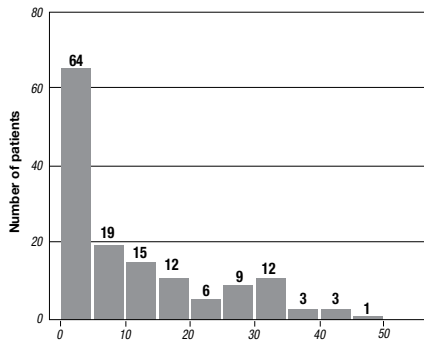
Afif Hentati, MD, published a Clinical Note titled “VZV encephalitis that developed in an immunized patient during fingolimod therapy” in the journal *Neurology*—the official journal of the American Academy of Neurology. The journal is the most widely read and highly cited peer-reviewed neurology journal.

Our specialists participated in several community and regional patient-focused activities for MS. In conjunction with the National Multiple Sclerosis Society, NorthShore Neurological Institute held its first-ever Multiple Sclerosis Symptom Fair featuring clinicians from a wide range of specialties to provide participants with a review of MS symptoms. The fair had an open house format featuring three 15-minute mini-lectures, with experts on hand to answer questions.

Susan Rubin, MD, contributed to a new MS educational program that seeks to improve care in women. Entitled “Strategies to Improve the Care of MS in Women,” the program provides clinicians with knowledge and expertise to successfully evaluate, treat and manage their female patients with MS. The program was launched by the Consortium of Multiple Sclerosis Centers in collaboration with The France Foundation, a provider of continuing medical education.

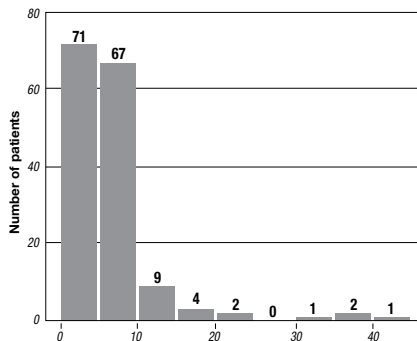
Disease Duration

Duration is measured in years, from the year of initial symptom to the year of initial visit.



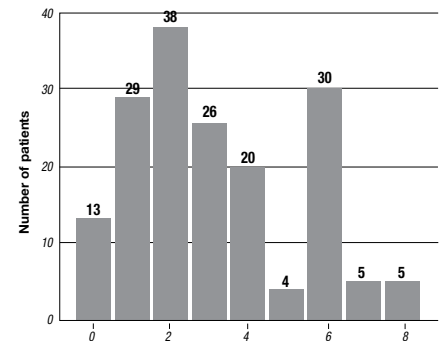
25 Ft. Walk

This shows the number of seconds required, on a second attempt, to walk 25 feet.



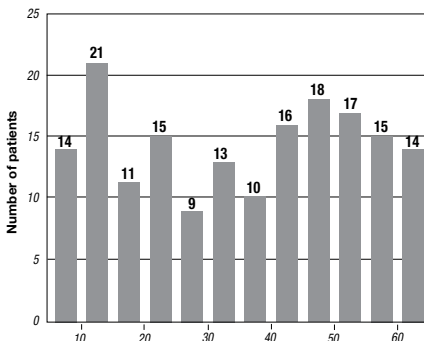
EDSS Step

With the Expanded Disability Status Scale (EDSS), higher scores are more severe (e.g., scores of 5 and above indicate increasing difficulty walking).



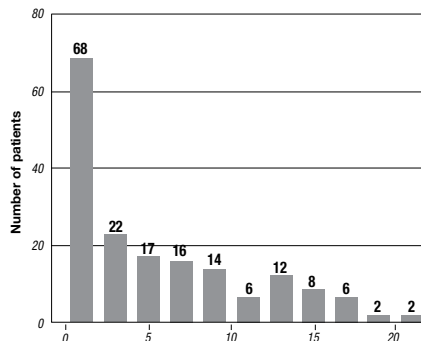
FSS

The Fatigue Severity Scale (FSS) is a method of evaluating fatigue where a score of >36 indicates the presence of significant fatigue.



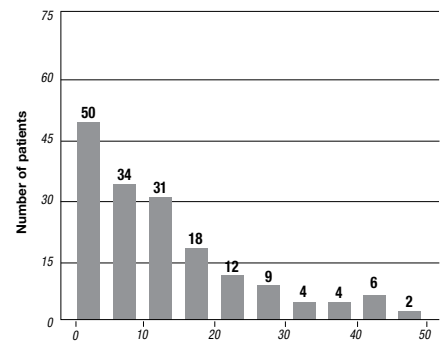
GAD-7

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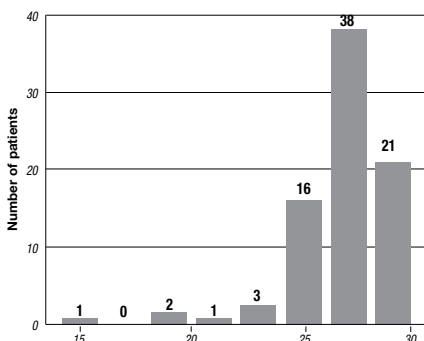
CESD

The Center for Epidemiologic Studies Depression Scale (CESD) is a screening test for depression where a score of ≥15 indicates at least mild to moderate depression.



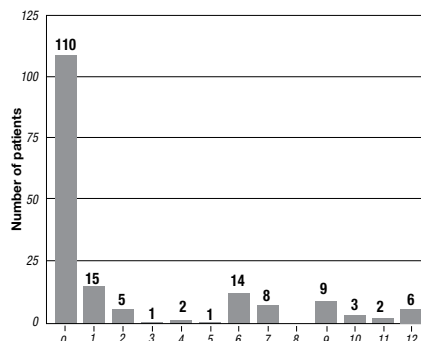
MoCA

The Montreal Cognitive Assessment (MoCA) test is a screening tool for the presence of cognitive dysfunction where a score of ≥26 is considered normal.



Ambulation Score

This measure assesses both the walking range and the type of assistance required. Scores range from 0 (fully active) to 12 (bedridden).



Sleep Disorders

PHYSICIAN TEAM

Neurologists



Thomas Freedom, MD
*Program Director,
Sleep Disorders*

Lori Lovitz, DO

Richard Munson, MD

Smita Patel, DO

Joya Paul, MD

Mari Viola-Saltzman, DO

Pulmonologists



Neil Freedman, MD
*Medical Director,
Bannockburn Sleep Lab*

Scott Field, MD

Tomasz Kuzniar, MD, PhD

Semil Mehta, MD

SCOPE OF SERVICES

NorthShore's multidisciplinary Sleep Centers offer state-of-the-art, comprehensive care for patients suffering from any of a variety of sleep disorders including sleep apnea, restless legs syndrome, night terrors, snoring, insomnia and narcolepsy. Our two Sleep Centers are accredited by the American Association of Sleep Medicine (AASM) and are staffed by one of the largest teams of board-certified sleep neurologists and nurse specialists in Chicagoland.

Dedicated to compassionate and successful treatment of sleep disorders, our certified sleep specialists offer the highest level of care, backed by the latest technology and advanced diagnostics. And to provide patients better access, the full range of care for sleep disorders is available at multiple outpatient sites. We also offer two conveniently located sleep center facilities.

Home sleep testing can be offered in some cases to diagnose obstructive sleep apnea (OSA) in the comfort of a patient's home, instead of a sleep laboratory, using a portable sleep monitor. Our multidisciplinary team includes pulmonologists, dentists, psychologists, and ear, nose and throat specialists for patients who require further management of their sleep disorders.

HIGHLIGHTS AND ACCOMPLISHMENTS

Educators at the Sleep Center have been offering the comprehensive Accredited Sleep Technologist Education Program (A-STEP) since 2008. Developed by the AASM, this program was designed to promote the standardization of sleep technologist education and training. This year, the program graduated five sleep technologists for a total of 61 since the program was started.

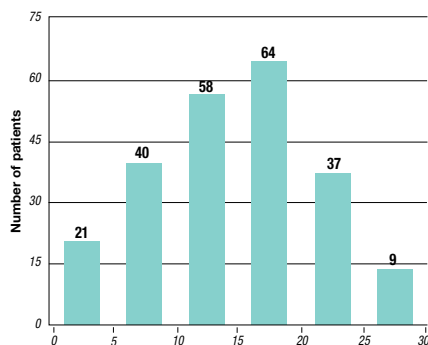
This year, our program has been accredited by the AASM as a Home Sleep Apnea Testing facility. In conjunction with this certification, the Sleep Center has increased the number of Apnea Risk Evaluation System home sleep test devices. For applicable patients, this system collects physiological data from the in-home environment to allow the physician team to integrate this data with a clinical history to diagnose the presence and severity of OSA.

We have enrolled more than 260 patients to date in the DodoNA project for Restless Legs Syndrome. The data below are recorded from the initial visit using toolkits in our award-winning Electronic Medical Record (EMR) system. Scores measure severity, depression, anxiety, sleepiness and sleep quality which can be followed annually. We also are collecting DNA from consenting subjects and performing more than one million genetic tests per sample. See page 31 for more details.

Restless Legs Syndrome *Description of our first 257 patients enrolled, at their initial visit*

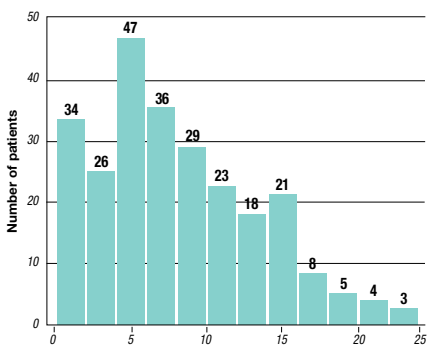
ISI Score

In the Insomnia Severity Index (ISI), scores of 15 and over indicate at least moderate severity.



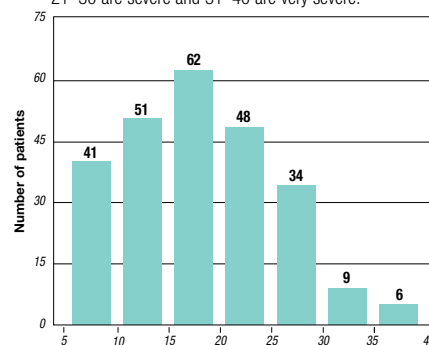
ESS Score

When using the Epworth Sleepiness Scale (ESS), scores greater than 10 indicate excessive daytime sleepiness.



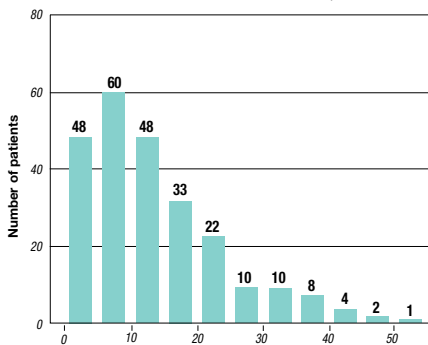
IRLS Score

In the International Restless Legs Society (IRLS) rating scale, scores of 0–10 are mild, 11–20 are moderate, 21–30 are severe and 31–40 are very severe.



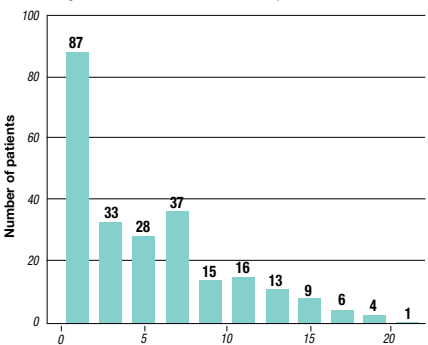
CES-D

The Center for Epidemiologic Studies Depression Scale (CES-D) is a screening test for depression where a score ≥ 15 indicates at least mild to moderate depression.



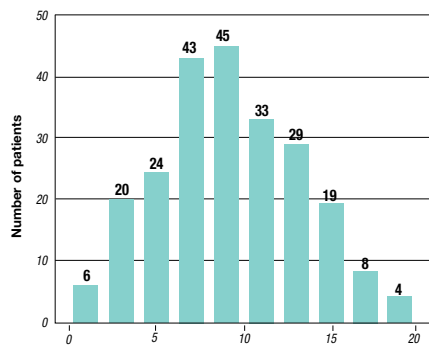
GAD-7

The Generalized Anxiety Disorder 7 (GAD-7) score measures anxiety where a score of ≥ 10 indicates a probable diagnosis of GAD to be confirmed by further evaluation.



PSQI

In the Pittsburgh Sleep Quality Index (PSQI), a score of ≥ 5 indicates poor sleep.



Physical Medicine and Rehabilitation

PHYSICIAN TEAM

Physiatrists



Joseph Alleva, MD
*Division Head,
Physical Medicine
and Rehabilitation*

Khalida Anwar, MD
Catherine Choi, MD
Matthew Co, DO
Kristina Drabkin, DO
Miledones Eliades, MD
Joseph Feldman, MD
Thomas Hudgins, MD
Daniel Hurley, MD
Rachel Kermen, MD
Danielle Schiff, MD
Nalia Shaikh, MD

SCOPE OF SERVICES

NorthShore Neurological Institute's Physical Medicine and Rehabilitation team develops personalized inpatient and outpatient rehabilitation plans that best help patients improve physical function and achieve their rehabilitation goals. Our physiatrists and rehabilitation experts treat a variety of neurologic problems. This includes maximizing the function of patients with disabilities secondary to a neurologic disease process such as stroke, Parkinson's disease, multiple sclerosis, and brain or spinal tumors or injuries.

The Neurorehabilitation Team designs individualized care plans that provide high-quality rehabilitative services in the hospital, in acute inpatient rehabilitation, in an outpatient setting or in the home environment. Cutting-edge treatments using fluoroscopic guided injection techniques are available for management of neurological symptoms such as spine pain and headaches.

Our multiple hospital and stand-alone clinics house state-of-the-art rehab technology and equipment. NorthShore's fitness center-based rehab services also feature warm water therapy pools and a leading-edge AlterG anti-gravity treadmill for "weightless" gait training.

HIGHLIGHTS AND ACCOMPLISHMENTS

The Physical Medicine and Rehabilitation program has enhanced access with weekend and evening hours available. New treatments offered in the Sports Medicine program—a joint endeavor with Family Practice and Orthopaedics—include ultrasound guided peripheral joint injections of corticosteroid and viscosupplementation (hyaluronate). For the spine, we also offer specialized procedures including radiofrequency ablation and spinal cord stimulators.

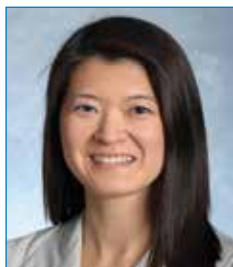


Physiatrists at NorthShore Neurological Institute strive to maximize movement and function, sometimes using innovative nonsurgical techniques such fluoroscopic guidance to ensure precise needle placement for epidural steroid injection as shown above.

Chronic Pain

PHYSICIAN TEAM

Physiatrists



Catherine Choi, MD
Medical Director,
Chronic Pain Services

Khalida Anwar, MD

Neurosurgeons



Noam Stadlan, MD
Vice Chair, Department
of Neurosurgery

Michael Musacchio, MD

SCOPE OF SERVICES

Our chronic pain management specialists treat patients at state-of-the-art facilities located at Evanston, Highland Park and Glenbrook Hospitals using the latest technology and techniques to treat pain from a variety of sources:

- Facet (arthritis)
- Arthritis
- Muscular (myofascial)
- Failed back surgery
- Neuropathy
- Pinched nerve
- Fibromyalgia (FMS)
- Herniated disc
- Postoperative
- Complex Regional Pain Syndrome (CRPS)
- Sciatica
- Shingles
- Spinal stenosis

Our physicians use their unique training to develop comprehensive treatment plans that include a variety of nonsurgical techniques and pain management services, ranging from medication to injections to address individual patient needs. Treatments include:

- Chronic opiate management for complex chronic pain patients.
- High-dose opiate therapy for non-cancer-related pain patients and high-risk patients.
- Spinal cord stimulator trials for chronic pain.
- Injections for spine-related pain disorders including cervical, thoracic, lumbar epidurals, facet injections and multi-joint injections.
- Injections for chronic pain disorders such as CRPS.

At NorthShore, we work with specialists such as pain psychology and chronic pain (physical and occupational) therapists closely for multidisciplinary services. In addition, our comprehensive Integrative Medicine Program offers therapies that are complementary to traditional Western medicine to achieve pain relief as well as promote healing and well-being. The program features a number of services, including:

- Acupuncture
- Integrative bodywork and massage
- Therapeutic yoga and meditation
- Herbal medicine counseling

HIGHLIGHTS AND ACCOMPLISHMENTS

Our pain management clinicians are working toward achieving 100 percent compliance with a standard trilateral opiate agreement. The use of a pain management agreement allows for the documentation of understanding between the pain management specialist, primary care doctor and patient. The purpose of this form is to educate the patient regarding the use of opioid medications for the treatment of pain and is integral to our goal to assist the patient in achieving the best possible quality of life given the reality of the clinical condition to be treated. Such documentation, when used as a means of facilitating care, also improves communication between doctors and patients.

Our Chronic Pain Care Team takes part in a series of continuing medical education/continuing nursing education activities designed to help safely and effectively manage patients with chronic pain, when appropriate, with opioid analgesics. The comprehensive educational curriculum of these activities covers all aspects of the FDA Blueprint for Prescriber Education for Extended Release and Long-Acting (ER/LA) opioid analgesics. This educational program addresses the need of care team that prescribe ER/LA opioid analgesics as to the benefits and risks of chronic opioid therapy.

NorthShore Neurological Institute Partners

Pediatric Neurology

PHYSICIAN TEAM

Pediatric Neurologists



Kent Kelley, MD
Division Head,
Pediatric Neurology,
Department of Pediatrics

Leslie Finkel, MD

Margaret Michelson, MD

Susan Fielkow, MD
Developmental Pediatrics

SCOPE OF SERVICES

The Pediatric Neurology program provides family-centered diagnosis and comprehensive care for children with disorders of the brain and nervous system. While closely collaborating with the child's pediatrician, as well as the Division of Behavioral and Developmental Pediatrics, our physicians and staff are committed to providing compassionate and coordinated care for children with neurological issues. Our team focuses on a range of neurological issues in infants, children and teenagers, including but not limited to headaches/migraine, cerebral palsy, developmental delays, epilepsy/seizures, genetic/metabolic disorders involving the nervous system, and movement disorders such as tic disorders and Tourette syndrome.

HIGHLIGHTS AND ACCOMPLISHMENTS

Kent Kelley, MD, is the principal site investigator of a long-term follow-up clinical trial of children with childhood absence epilepsy (CAE). Individuals with CAE have brief staring spell seizures that occur suddenly, unpredictably and frequently throughout the day. From the original trial, which studied optimal treatment to control seizures, 330 re-enrolled in this long-term follow-up study. The results were reported and showed, on average, the group of children with a history of childhood absence epilepsy—even if it resolved years ago—had significantly lower IQ, attention, memory, organizational ability, and academic achievement scores compared to the children in the healthy (did-not-have-epilepsy) group. Dr. Kelley, with colleagues from the University of Chicago, is the principal investigator in an ongoing retrospective review of databases in the Infant Special Care Unit and the Neonatal Intensive Care Unit. The purpose of the study is to identify risk factors for the development of autism, cerebral palsy, epilepsy and other neurodevelopmental disorders.

Neuroradiology

PHYSICIAN TEAM

Neuroradiologists



Matthew Walker, MD
Division Head,
Neuroradiology,
Department of Radiology

William Ankenbrandt, MD

Anne Doppenberg, MD

Kenneth Goldberg, MD

Michael Gorey, MD

Joel R. Meyer, MD

Kristina Olsen, MD

Bojan Petrovic, MD

Jordan Prager, MD

Doris Yip, MD

SCOPE OF SERVICES

The Neuroradiology program is fully subspecialized with fellowship-trained neuroradiologists certified by the American Board of Radiology with added qualification in Neuroradiology (CAQ). We provide subspecialty interpretation for the full range of brain, spine and head/neck imaging studies, including:

- Computed Tomography (CT)
- Computed Tomographic Angiography (CTA)
- Magnetic Resonance Imaging (MRI)
- MR Angiography (MRA)
- Time-Resolved MRA (TRMRA)
- MR Venography (MRV)
- MR Cerebrospinal Fluid Flow Analysis
- MR Diffusion Tensor Imaging (DTI)
- MR Perfusion Imaging (MRP)
- MR Spectroscopy (MRS)
- Functional MRI (fMRI)
- Positron Emission Tomography (PET)
- Single-Photon Emission Computed Tomography (SPECT)

HIGHLIGHTS AND ACCOMPLISHMENTS

At the Center for Advanced Imaging at NorthShore University HealthSystem, investigators are working on multiple projects studying how to bring the most advanced MR imaging techniques into everyday clinical practice. We have developed a method, based on magnetic resonance diffusion imaging, for very early detection of the region of stroke. This technique is currently being used to assist doctors in more accurate early diagnosis, and to monitor the effectiveness of various therapeutic interventions. Additionally, using high-resolution MR and CT images in conjunction with the Center's advanced image processing facility, 3D brain maps are being constructed that allow surgeons to plan neurosurgical procedures in a more effective way. Functional MRI is being applied to better understand the basis for various neurological and psychiatric disorders and the effects of therapy. Douglas Burman, PhD, is using fMRI and behavioral measures to identify the relationship between brain activity and cognitive (mental) functions, particularly changes in brain connectivity associated with cognition. The goal of this study is to identify normal patterns of brain activity and connectivity across a variety of cognitive tasks along with changes associated with injury and neurological disorders. These findings are essential for understanding the neurological basis of conscious behaviors.

Neuropathology

PHYSICIAN TEAM

Neuropathologist



John Lee, MD, PhD
*Director,
Residency Program,
Department of Pathology*

SCOPE OF SERVICES

John Lee, MD, PhD, at NorthShore Neurological Institute provides the full range of diagnostic services for neurosurgical specimens and autopsy brain diagnosis. Dr. Lee offers expertise in pathology of muscle and nerve biopsies and a comprehensive level of diagnostic expertise for tumors, traumatic lesions of the brain and spinal cord, forensic neuropathology, and neurodegenerative disorders.

HIGHLIGHTS AND ACCOMPLISHMENTS

Dr. Lee assists a large number of scientists in the analysis of tissue from models of neurologic diseases such as Alzheimer's disease (AD) and traumatic brain injury (TBI). Particular interests include using rat and mouse models of AD where he has previously been able to prevent behavioral and neuropathological deficits of AD using Neuroparin (C3), a low molecular weight glycosaminoglycan. A Phase 1 clinical trial investigating the pharmacokinetics and safety aspects of the compound has been completed. Since similar neuropathological findings found in AD such as up regulation of the Beta-amyloid precursor protein and phosphorylated tau are seen in TBI and chronic traumatic encephalopathy (CTE), respectively, these compounds may be of potential therapeutic use for these disorders as well. Dr. Lee has collected multiple specimens in the NorthShore Brain Bank from patients with neurodegenerative diseases including AD and Parkinson's disease as well as from individuals with TBI and suspected CTE. He processes the specimens for clinical and research purposes.

Neuropsychology

PHYSICIAN TEAM

Neuropsychologists



Jerry Sweet, PhD
*Vice Chair, Department of
Psychiatry and Behavioral
Sciences*

SCOPE OF SERVICES

The Neuropsychology team is composed of highly trained, dedicated practitioners who can provide treatment, consultation and comprehensive evaluation services to a broad range of inpatients and outpatients with a variety of neurological disorders. These include stroke, memory disorders (including mild cognitive impairment and dementias such as Alzheimer's disease), Parkinson's disease, concussion/traumatic brain injury, attention deficit hyperactivity disorder (ADHD), and psychiatric disorders such as depression and anxiety.

Evaluations of intellectual functioning, academic achievement, mental abilities such as thinking and memory, personality and mood are provided. When patients are identified as needing cognitive rehabilitation, a patient-specific treatment plan is coordinated with speech therapists, occupational therapists and learning disability specialists.

HIGHLIGHTS AND ACCOMPLISHMENTS

Education is a major focus of the adult neuropsychology service. We are accredited by the Association of Postdoctoral Programs in Clinical Neuropsychology (APPCN) to offer a Postdoctoral Residency in Clinical Neuropsychology. This is a two-year program that strives to maintain a balance of clinical service, research and education focusing primarily on assessment and consultation. The APPCN verifies that the postdoctoral training provided by our service adheres to the requirements put forth by the Houston Conference/INS-Division 40 requirements. Jerry Sweet, PhD, is the director of the residency program and also the Head of the Division of Psychology and Vice Chair of the Department of Psychiatry and Behavioral Sciences. The Neuropsychology service also accepts practicum students in adult neuropsychology and pediatric neuropsychology from a number of local universities. The practicum program, coordinated by Leslie Guidotti Breting, PhD, helps students develop and refine skills in the neuropsychological assessment of outpatients and inpatients.

- Elizabeth Geary, PhD
- Leslie Guidotti-Breting, PhD
- Elizabeth Heideman, PhD
- Marietta Hoogs, PhD
- Elizabeth Pieroth, PsyD
- Alona Ramati, PhD
- Victoria Tuchscherer, PhD

RESEARCH



NorthShore Neurological Institute is committed to conducting medical research with the goal of helping patients live longer, healthier lives. The multidisciplinary research staff of neurologists, neurosurgeons, neuroradiologists, neuropsychologists, neuro-pathologists and a large team of research personnel are engaged in a wide array of clinical and laboratory studies, often national and international in scope—all with one goal—to better understand how to diagnose, treat and prevent neurological diseases and conditions.

Under the leadership of Co-Directors Demetrius Maraganore, MD, and Julian Bailes, MD, and the administrative leadership of Roberta Frigerio, MD, NorthShore Neurological Institute has several major innovative neurological research initiatives.

DodoNA Project

At NorthShore, Dr. Maraganore leads the DodoNA project, a study that uses blood samples and our award-winning Electronic Medical Record (EMR) system to identify DNA variations that predict neurological outcomes and that will guide the development of disease-modifying treatments for 11 neurological disorders.

Neurology Practice-Based Research Network

Dr. Maraganore and the Department of Neurology at NorthShore Neurological Institute have launched a national practice-based network to improve healthcare quality by accelerating implementation of patient-centered outcomes research in neurology using the EMR. We will use the EMR to hardwire quality and outcomes research in neurology and individualize medicine at the point of care by conducting pragmatic trials using subgroup-based adaptive designs, comparing the effectiveness of available treatments for common neurological disorders. This initiative is federally funded by the Agency for Healthcare Research and Quality, and includes several other Departments of Neurology nationwide.

Genetic Epidemiology of Parkinson's Disease Consortium (GEO-PD)

Dr. Maraganore is the principal investigator of the GEO-PD, which is an international consortium of 60 centers from 30 countries and six continents that share DNA and data from more than 85,000 Parkinson's disease patients and control subjects, with the aim of identifying genetic predictors of the disease. Dr. Maraganore is launching within GEO-PD a longitudinal clinical

and genetic study of PD (LONG-PD study) that will follow, over 15 years, thousands of patients enrolled at dozens of sites worldwide to determine the genetic underpinnings of PD severity, progression and outcomes.

Neuro-Oncology Research

Our Neuro-Oncology program is a leading center of clinical trials featuring tailored therapeutic approaches spanning the entire neuro-oncology spectrum, including high-grade gliomas and brain metastases. Current actively enrolling studies feature promising new agents that target a wide range of tumor growth mechanisms and aim to improve upon results seen with current standard-of-care therapies.

Traumatic Brain Injury Research

NorthShore Neurological Institute is at the forefront of TBI research, led by Julian Bailes, MD, Surgical Director of NorthShore Neurological Institute, and a nationally recognized leader in research on the impact of brain injury on brain function. Dr. Bailes has performed both clinical and experimental studies on mild traumatic brain injury (mTBI) or concussion, particularly in athletes and military veterans. The Traumatic Brain Injury Laboratory at NorthShore Neurological Institute has multiple translational projects under way studying varying aspects of the disease.

Neuroimaging Research

There is a critical need for biomarkers that assist in diagnosis and also indicate whether a candidate's disease-modifying therapeutic agent is actually altering the underlying degenerative process. A number of in vivo neuroimaging techniques—which can reliably and noninvasively assess aspects of neuroanatomy, chemistry, physiology and pathology—hold promise as biomarkers. At NorthShore Neurological Institute, we have active neuroimaging studies testing biomarkers for chronic traumatic encephalopathy, Parkinson's disease and traumatic brain injury.

DodoNA Project

The DodoNA project is one of the major research initiatives of the NorthShore Neurological Institute. The purpose of the project is to predict, prevent and halt neurological disorders through the development of DNA-based prognostic tests and therapies.

“DodoNA” is a metaphor. Dodona was an oracle of ancient Greece, where priestesses interpreted the rustling leaves of a sacred oak tree to predict the future and to guide actions to improve fate. It is our hypothesis that just as the priestesses at Dodona interpreted rustling oak trees, we can interpret subtle variations in DNA, the “tree of life,” to predict outcomes and therapeutic responses and to individualize medicine and improve neurological health.

The specific goals of the DodoNA project are to identify:

- DNA fingerprints that predict outcomes in patients with neurological disorders.
- DNA fingerprints that predict therapeutic responses in patients with neurological disorders.
- DNA targets for the development of new disease modifying therapies.

To fulfill these goals, we are conducting 11 longitudinal studies that will enroll 1,000 patients each (11,000 patients in total). The conditions we are studying are progressive and have outcomes that are variable and difficult to predict.

We are studying brain tumors, epilepsy, memory disorders, migraine, mild traumatic brain injury, multiple sclerosis, neuropathy, Parkinson’s disease, restless legs syndrome and stroke. We are also studying healthy persons at increased risk for Alzheimer’s disease and related disorders.

The DodoNA researchers are building customized structured clinical documentation support “toolkits” within NorthShore’s Electronic Medical Record (EMR) system for each of the 11 disorders that capture and store data from routine office visits. The researchers also will collect blood and extract DNA and plasma to be stored in a “biobank.” Laboratory scientists will then perform automated DNA sequencing tests to define DNA fingerprints, which statisticians will then associate with disease outcomes and therapeutic responses. With this information, researchers will be in a better position to deliver methods to predict and modify disease.

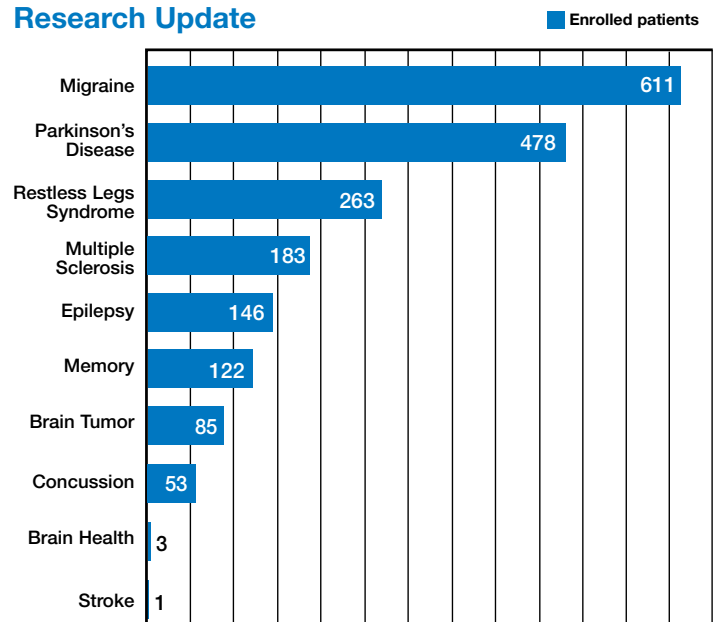
The DodoNA Project—Keys to Success:

- It engages all programs and faculty of a large neurological institute within a top-ranked health system.
- It targets a large and local patient population (Chicago and its surrounding suburbs).

- It leverages an award-winning EMR system.
- It creates informatics tools to improve the quality and efficacy of clinical practice.
- It has strong institutional and community support.

Upon reaching our targeted enrollment of 1,000 patients for each neurological disorder and capturing several years of follow-up data, we will be able to individualize therapies and improve patients’ neurological health

Research Update



As of July 1, 2015, we have enrolled more than 1,900 patients in the DodoNA project, and we are well on our way to reaching the 11,000 total. We have launched the Stroke and Brain Health Projects. Several hundred thousand discrete data points have been collected and analyzed by DodoNA researchers. We have also performed more than one million genetic tests on each DNA sample.

Data from the initial visits of the various DodoNA projects are featured in the respective program pages of this annual report. As we capture follow-up data in the years ahead, we will be able to individualize therapies and improve neurological health.

Neurology Practice-Based Research Network (NPBRN)

The mission of NorthShore Neurological Institute is to preserve and improve neurological health through clinical practice, education and research. In keeping with this mission, the Neurology Practice-Based Research Network (NPBRN) was launched earlier this year.

The goal of the network is to advance quality improvement and practice-based research in neurology using the Electronic Medical Record (EMR) system.

The principal investigator of the project is Demetrius Maraganore, MD, Ruth Cain Ruggles Chairman of the Department of Neurology and Medical Director of NorthShore Neurological Institute.

Currently, there is a lack of quality initiatives and comparative effectiveness research in neurology. To address this gap, the American Academy of Neurology (AAN) has published evidence-based guidelines, quality improvement measures and resources for treating neurological disorders. However, there are few tools available to standardize neurology office visits according to these guidelines.

“The creation of this network for quality improvement and practice-based, patient-centered outcomes research in neurology will make healthcare safer and will improve healthcare efficiency.”

—Dr. Demetrius Maraganore

NorthShore is a national leader in the implementation of innovative technologies, including the EMR. In 2003, NorthShore was among the first in the country to successfully launch a systemwide EMR, called “Epic,” with demonstrable benefits in quality, safety, efficiency and service to patients. NorthShore is recognized by multiple national organizations for this notable achievement. The Department of Neurology at NorthShore has invested heavily and built, into Epic, tools that meet AAN guidelines, standardize care, write progress notes and capture up to 1,000 discrete data points per office visit. These EMR toolkits have so far been applied to 10 common neurological disorders—brain tumor, epilepsy, migraine, mild cognitive impairment, mild traumatic brain injury, multiple sclerosis, neuropathy, Parkinson’s disease, restless legs syndrome and stroke.

To create the NPBRN, these proprietary EMR tools will be shared—free of charge—with other neurology practices nationwide that also use the Epic EMR system. Sharing in this way will not only foster collaboration, but increase the amount of data the project will be able to generate. In response to the initial call by Dr. Maraganore to participate in the NPBRN, seven institutions in addition to NorthShore agreed to join which, in 2013, had a total of more than 187,000 patient visits. See table above. Once fully implemented, the tools will capture and share de-identified data from each of these visits to support quality improvement efforts.

NPBRN Sites at Launch

Epic Site	2013 Outpatient Visits
Dartmouth-Hitchcock	38,410
Medical University of South Carolina	23,978
NorthShore University HealthSystem	35,487
Ochsner Health System	15,296
University of Nebraska	11,874
University of Arkansas	8,693
University of Pennsylvania	30,754
Wake Forest University	22,592
Total	187,084

Funding

Dr. Maraganore has been successful in obtaining federal support for the NPBRN in the form of a \$1.2 million multiyear award from the Agency for Healthcare Research and Quality (AHRQ). The proposed studies are aligned to the AHRQ mission, including improving healthcare quality by accelerating implementation of Patient Center Outcomes Research, making healthcare safer and improving healthcare efficiency.

The AHRQ award, titled “Quality Improvement and Practice, Based Research in Neurology Using the EMR, has two specific aims.

- To establish the NPBRN at the multiple sites by sharing Epic EMR toolkits for 10 common neurological disorders.
- To conduct comparative effectiveness research at NorthShore through pragmatic trials using the EMR for 10 common neurological disorders.

In discussing the network, Dr. Maraganore said, “The NPBRN has public health significance because we are studying several neurological disorders recognized as a leading cause of healthcare burden worldwide.” He continued, “The creation of this network for quality improvement and practice-based, patient-centered outcomes research in neurology will make healthcare safer and will improve healthcare efficiency.”

Comparative Effectiveness Research

The second aim—and an important component of the NPBRN—is that we will perform, for the first time, pragmatic clinical trials using the EMR in neurology to compare the effectiveness of several available therapies. These trials will be conducted using subgroup-based adaptive (SUBA) design, an innovative way to inform healthcare decisions and provide evidence on the effectiveness, benefits and drawbacks of different treatment options.

A SUBA clinical trial works by using data captured from the previously enrolled patients to identify subgroup effects and to assign newly enrolled patients to treatments that are expected to be more effective for them. SUBA will be built into the EMR toolkits to trigger alerts that prompt assignment of the enrolled patient to a specific compared treatment at the point of care. Our statistical team is led by Yuan Ji, PhD, Director of Clinical Research Informatics at NorthShore and an expert in SUBA. Dr. Ji cites the main statistical features of SUBA being the continuous learning of patient subgroups and the adaptive allocation of patients to the best treatment.

The plan is to perform 11 SUBA trials (see table to the right) with a total of 3,300 patients. For each trial, the first 100 patients encountered will be randomized to the compared treatments and then at least 200 patients will be adaptively assigned to the treatment expected to achieve better outcomes. To increase the “learning” of the system, we will capture outcomes data at initial, interval and annual visits over five years (whereas most clinical trials follow patients for up to a year).

Each trial will lead to new insights into 11 common neurological disorders:

- **Brain tumor (seizures)**—We will for the first time compare, side by side, the efficacy of levetiracetam, lamotrigine, and valproate for seizure control or survival in brain tumor patients.
- **Epilepsy**—We will for the first time perform a point-of-care trial of available treatments with head-to-head comparisons including not only seizure control, but also cognitive function, mood and quality of life.
- **Mild cognitive impairment (MCI)**—There are no FDA-approved treatments for MCI. We will test for the first time one cholinesterase inhibitor to another in MCI. We will also perform the first clinical trial assessing memantine (an NMDA antagonist) as monotherapy in patients with MCI.
- **Migraine (prophylaxis)**—Very few head-to-head studies comparing various preventive medications for migraines have been published, and all are limited in their size and length of follow-up. Our study will be enrolling 300 patients with follow-up over five years.
- **Migraine (abortive)**—While studies have shown that triptans are effective at aborting migraine compared to placebo, there is very limited data comparing them head-to-head. We will assign 100 patients to one of three commonly used first-line triptans, and at least 200 patients will be subsequently assigned to the triptan where it is expected to achieve better outcomes.
- **Mild traumatic brain injury (mTBI)**—There are no treatments proven effective in reducing postconcussion symptoms. Several animal studies of mTBI have found a benefit in the use of omega fatty acids, and we will test these compounds adequately in human subjects.
- **Multiple sclerosis (MS)**—Both adrenocorticotrophic hormone and intravenous methylprednisolone speed up symptoms recovery. Studies comparing the two are varied in the doses and durations of the treatments and in the outcomes measured. We will perform a practice-based study with subgroup-based adaptive design to individualize medicine at the point of care.

Pragmatic Trials Proposed

(NorthShore site; 3,300 subjects, 300 per trial)

SUBA Clinical Trial	Compared Treatments
Brain Tumors (seizures)	Lamotrigine Levetiracetam Valproic acid
Epilepsy (other seizures)	Lamotrigine Levetiracetam Valproic acid
Mild Cognitive Impairment	Donepezil (hs) Rivastigmine patch Namenda XR
Migraine (prophylaxis)	Amitriptyline (hs) Propranolol LA Topiramate (bid)
Migraine (abortive)	Sumatriptan 100 mg (po) Rizatriptan 10 mg (po) Zolmitriptan 5 mg (po)
Mild Traumatic Brain Injury	Omega-3 fatty acids (and education) Education only
Multiple Sclerosis	Acthar (SQ) Methylprednisolone (IV) Crossover (relapses)
Neuropathy (painful)	Duloxetine (am) Pregabalin (bid) Amitriptyline (hs)
Parkinson's disease	Pramipexole ER Ropinirole XL Rotigotine patch
Restless Leg Syndrome	Pramipexole (hs) Ropinirole (hs) Rotigotine patch
Stroke	Aspirin Clopidogrel Clopidogrel (CYP2C19)

- **Neuropathy**—Pain is a common neuropathy symptom. Numerous medications are used but are limited by side effects and lack of efficacy. We will perform a large-scale trial with five-year follow-up to determine superiority amongst common treatments.
- **Parkinson's disease**—Presently, there are three long-acting dopamine agonists available in the United States to treat Parkinson's disease. We will for the first time perform a comparative effectiveness trial of these three long-acting drugs.
- **Restless legs syndrome (RLS)**—Dopamine agonists have been the most successful therapy for RLS and are recommended as first-line therapy but head-to-head comparison studies are lacking. We will perform a practice-based study to test these therapies side by side involving at least 300 patients with RLS who would benefit from the dopamine agonist treatment, and we will use the EMR and a subgroup-based adaptive design to assign treatments.
- **Stroke**—We will compare aspirin and clopidogrel head to head in a clinical practice setting using the EMR to assign patients to either treatment and to capture outcomes data over several years. Additionally, the utility of genetic testing for clopidogrel resistance in guiding subgroup-based assignments will also be tested.

Through these quality initiatives and pragmatic trials, we will improve knowledge and also create new technical capabilities to individualize medicine at the point of care.

Genetic Epidemiology of Parkinson's Disease (GEO-PD)



The GEO-PD Consortium was launched in 2004 through the Edmond J. Safra Global Genetics Consortia initiative and with funding from the Michael J. Fox Foundation.

The goal was to form a collaborative team of investigators to tackle critical questions in the Parkinson's disease genetics field. The Consortium members collaborate and share findings to advance the understanding of the genetics and epidemiology of Parkinson's disease.

Demetrius Maraganore, MD, Chairman of the Department of Neurology at NorthShore, Medical Director of NorthShore Neurological Institute, and Clinical Professor of Neurology at the University of Chicago Pritzker School of Medicine, is the founder of GEO-PD and serves as its Medical Director.

The GEO-PD includes 60 sites from 30 countries and six continents. We share DNA and data for 41,988 Parkinson's disease cases and 41,505 control subjects. Many sites also conduct family studies, leading to the discovery of genes that cause familial Parkinson's disease.

The main goal of GEO-PD is to perform large-scale genetic association studies and serve as a replication engine to test the significance of discoveries in the Parkinson's disease genetics research field.

Research Update

In September 2014, Dr. Maraganore launched the Longitudinal Clinical and Genetic Study of Parkinson's Disease (LONG-PD) study during the annual meeting of the Genetic Epidemiology of Parkinson's Disease (GEO-PD) Consortium in Vancouver, Canada. This major new study will enroll and follow more than 4,000 Parkinson's disease patients worldwide over 15 years. Discussing the need for the LONG-PD study, Dr. Maraganore said, "The clinical and genetic factors that influence severity, progression and outcomes in Parkinson's disease are unknown... Identification of these factors may allow us to individualize the care of patients and to improve neurological health."

The LONG-PD team is using a Web-based tool for the capture and sharing of clinical severity, progression and outcomes data in Parkinson's disease patients at each study site. The tool was developed using the REDCap platform at NorthShore. A working group of clinical experts led by Dr. Maraganore defined the clinical data fields to be collected. The data will be maintained by NorthShore.

Twenty-five sites from 18 countries and five continents already have committed to the study (see table) with the agreement to enroll a minimum of 100 patients each. In addition to the clinical data, each site will collect DNA. We will perform more than one million genetic tests per sample. We will then associate genetic variations with the clinical severity, progression and

outcomes data captured from the yearly patient visits. Through the collection of DNA and standardized clinical data over the course of the study, the LONG-PD study of the GEO-PD Consortium will be uniquely positioned to identify genetic and other factors that predict progression and outcomes in Parkinson's disease.

Key Project Timeline:

- Oct. 1, 2015—Start date for enrollment of PD cases, biospecimens and data sharing.
- Sept. 30, 2016—Targeted enrollment of 100+ PD cases per site achieved.
- Oct. 1, 2016, through Sept. 30, 2031—Annual follow-up visits for enrolled patients up to 15 years.

Site PI	Country	Continent	Targeted Enrollment
Aasly	Norway	Europe	100
Berg	Germany	Europe	100
Brighina	Italy	Europe	100
Carr	South Africa	Africa	100
Chung	Korea	Asia	500
Cras	Belgium	Europe	100
Cresswell	Canada	North America	100
Destee	France	Europe	200
Hadjigeorgiou	Greece	Europe	100
Hassan	USA	North America	100
Hattori	Japan	Asia	200
Haq	USA	North America	100
Kasten	Germany	Europe	100
Kim	Korea	Asia	100
Koks	Estonia	Europe	100
Krueger	Luxembourg	Europe	200
Maraganore	USA	North America	1,000
Mellick	Australia	Australia	100
Sazci	Turkey	Europe	100
Tan	Singapore	Asia	100
Toft	Norway	Europe	100
Wider	Switzerland	Europe	100
Wirdefeldt	Sweden	Europe	100
Woitalla	Germany	Europe	100
Zesiewicz	USA	North America	200

Neuro-Oncology Research

NorthShore Neurological Institute has one of the most comprehensive lists of neuro-oncology clinical trials in the region, offering patients access to the latest investigational therapies.

These trials include rapidly expanding targeted therapies that are improving the standard of care for many patients with brain tumors. Many of our actively enrolling trials are testing treatments for glioblastoma, the most common primary brain tumor in adults. Principal investigators for these trials are neuro-oncologists Ryan Merrell, MD, Nina Martinez, MD, and neurosurgeon Julian Bailes, MD.

Glioblastoma Trials Update

Glioblastoma multiforme (GBM) is the most common and most aggressive type of malignant primary brain tumor. Prior to diagnosis, most patients experience symptoms such as a seizure, headaches and focal neurologic deficits. By definition, glioblastoma is an incurable tumor, but some patients have long survival. Standard treatment is surgical resection, radiotherapy with concomitant chemotherapy and adjuvant chemotherapy.

- NorthShore Neurological Institute was one of only six sites in the United States that was enrolling patients in a Phase I study evaluating the safety and pharmacokinetics of ABT-414 in combination with radiation plus temozolomide or temozolomide alone for subjects with newly diagnosed GBM. The study is currently enrolling patients with recurrent GBM. ABT-414 is an investigational antibody-drug conjugate composed of an antibody linked to the potent cytotoxic agent. This targeted therapy binds a unique epitope that is accessible in tumors that express a specific epidermal growth factor receptor (EGFR) variant, as well as in tumors with high levels of wild-type EGFR or excessive wild-type EGFR activation. NorthShore Neurological Institute has enrolled more patients than any other site into this clinical trial, and preliminary results were reported at numerous meetings during the year, including the American Society of Clinical Oncology in Chicago and the Society for Neuro-Oncology in Miami.
- A new Phase II/III randomized trial of temozolomide and veliparib in combination versus temozolomide alone in treating patients with newly diagnosed GBM after the completion of chemoradiation is currently recruiting patients. Drugs used in chemotherapy, such as temozolomide, disrupt the DNA of tumor cells, ultimately causing tumor cell death. Unfortunately, the tumor cells find ways to repair themselves. Veliparib may stop the growth of tumor cells by blocking some of the enzymes needed for tumor cell repair. It is not yet known whether temozolomide is more effective with or without veliparib in treating GBM.



Neuro-oncologists Dr. Ryan Merrell (left) and Dr. Nina Martinez, with Dr. Julian Bailes, Surgical Director of NorthShore Neurological Institute are principal investigators of an extensive list of clinical trials currently open to enrollment to brain tumor patients.

- NorthShore Neurological Institute is also a site for a Phase II GBM clinical trial that is testing HSPPC-96, a personalized cancer vaccine, in conjunction with bevacizumab. Heat shock protein-peptide complex-96 (HSPPC-96) consists of the heat shock protein glycoprotein 96 (HSP gp96) combined with a wide variety of proteins, including autologous antigenic peptides. In a stressful environment, such as a tumor, these conjugated proteins are upregulated and highly expressed on tumor cells where they are associated with tumor progression. However, due to the randomness of tumor-specific mutations, each cancer is specific to the individual. Therefore, a purified sample of HSPPC-96 can only effectively immunize against the tumor from which it originates. The HSPPC-96 vaccine is individualized to the patient's tumor and induces an immune response against the tumor. The process involves surgically removing as much tumor from the patient followed by extraction and purification of the HSPPC-96. This patient- and tumor-specific HSPPC-96 vaccine then is given back to the patient in combination with the commercial agent, bevacizumab.

Traumatic Brain Injury Research

Traumatic brain injury (TBI) affects approximately 3.5 million individuals annually in the United States of which approximately 75 percent are due to “mild” or concussive events.

TBI causes 275,000 hospitalizations, 52,000 deaths and an estimated \$76.5 billion in economic burden in the United States every year. In the U.S. military, it is estimated that approximately 20 percent of the deployed force experienced a head injury in the wars in Iraq and Afghanistan, of whom 83.3 percent endured a mild, uncomplicated TBI or concussion.

NorthShore Neurological Institute is at the forefront of TBI research, led by Julian Bailes, MD, Surgical Director of NorthShore Neurological Institute and a nationally recognized leader in research on the impact of brain injury on brain function. Dr. Bailes has performed both clinical and experimental studies on mild traumatic brain injury (mTBI) or concussion, particularly in athletes and military veterans. Many of these publications were instrumental in the understanding of chronic traumatic encephalopathy (CTE), a progressive degenerative disease found in individuals who have experienced multiple concussions and other forms of head injury.

The Traumatic Brain Injury Laboratory at NorthShore Neurological Institute has multiple translational projects under way studying varying aspects of the disease, from basic science to neuroimaging biomarkers. Last year, the Traumatic Brain

Injury Laboratory welcomed a new member to its multidisciplinary team. John Finan, PhD, is a neuroscientist with a doctorate in biomechanical engineering from Duke University and joins us from the Neurotrauma and Repair Laboratory at Columbia University in New York.

“The mission of the lab is to reduce the burden of traumatic brain injury on patients and society in general,” said Dr. Finan.

Developing New Potential Solutions to Concussions

Efforts aimed at preventing TBI in at-risk populations such as military personnel and athletes have continued to focus on improved helmet technology. However, although helmets are effective in preventing the more severe TBI such as fracture of the skull, they have little ability to limit the high-speed acceleration and deceleration of the head that leads to concussive or mild TBI. This is because the brain floats inside the skull within fluid that does not completely fill the skull cavity. As such when the brain undergoes a sudden acceleration and deceleration, it can continue the momentum, hitting against the inside of the skull possibly rotating

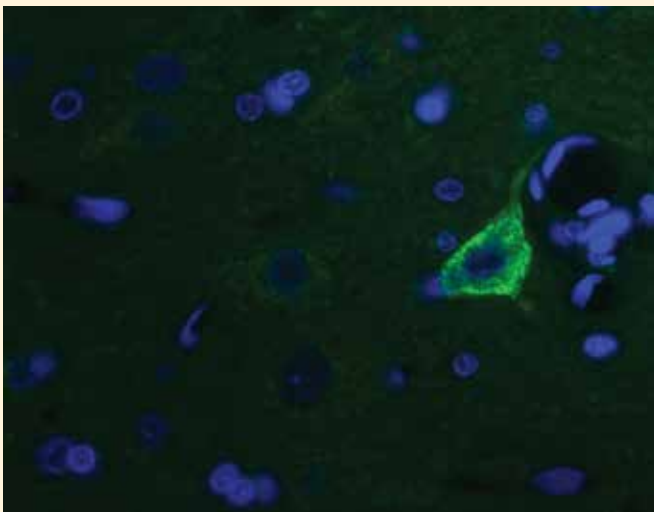


Image of brain tissue taken from the Traumatic Brain Injury Laboratory showing the nuclei of brain cells (blue) and the bright fluorescent (green) staining of a damaged neuron after TBI. Researchers use staining like this to test strategies that can reduce brain damage after TBI.

Testing Nutraceuticals to Mitigate TBI

Ongoing research in the Traumatic Brain Injury Laboratory is using an in-vivo model to test the efficacy of compounds in reducing the level of brain injury following TBI. One of these compounds is the omega-3 fatty acid, DHA. Promising research now indicates that working through several mechanisms, omega-3 fatty acids may provide advantages for brain health, including its use as a prophylactic against cerebral concussion. Having established the rat model of TBI here at NorthShore, researchers can test various treatments that may mitigate the damage to brain cells before translating the preliminary findings to humans. The Traumatic Brain Injury Laboratory at NorthShore Neurological Institute is one of the few places in the region that is doing this type of basic science research for TBI.

and tearing brain fibers. Dr. Bailes and research colleagues refer to this phenomenon as “brain slosh.” Learning from nature, Dr. Bailes and co-researchers noted that the brains of both woodpeckers and bighorn sheep are naturally protected against brain slosh by advantageous anatomical traits. Woodpeckers use specialized muscles wrapped around the brain, and bighorn sheep use their hollow pneumatic horn cores attached to their respiratory system that allow them to re-breathe their air and thus increase carbon dioxide in their bloodstream. These processes work to slow the return of blood from the head to the heart thereby increasing volume that fills their brain’s blood vessels and create a bubble-wrap effect.

Dr. Bailes and co-researchers are currently testing an innovative strategy designed to mitigate brain slosh effect—and subsequent concussion—using a collar. In describing the device, Dr. Bailes said, “The blood goes from your heart up two main systems of arteries to your brain, circulates around and returns to your heart via the jugular veins. The collar mildly applies pressure on the jugular veins to produce a small increase of blood volume in the brain and thus reduce its movement.”

Previously published pre-clinical studies found the collar produced an 83 percent reduction in the number of torn brain fibers in a standard laboratory concussion model. This pre-clinical research is continuing in the Traumatic Brain Injury Laboratory at NorthShore Neurological Institute where an active study is testing the safety of the collar in a larger model. Jugular vein compression is the first attempt to prevent brain injury by an internal protection mechanism, and the Traumatic Brain Injury Laboratory at NorthShore Neurological Institute is the only place in the country with the resources and expertise to do these types of research studies that advance new solutions to the TBI problem. So far, the research and their findings are preliminary. Further work needs to be conducted to determine the effectiveness of this method in humans—particularly in those at risk of the long-term effects of concussions such as athletes and active-duty soldiers who sometimes return with multiple blast-induced TBI.



Biomedical Engineer Dr. John Finan, PhD (left) and research assistant Sydney Sherman are members of the Traumatic Brain Injury Laboratory at NorthShore Neurological Institute.

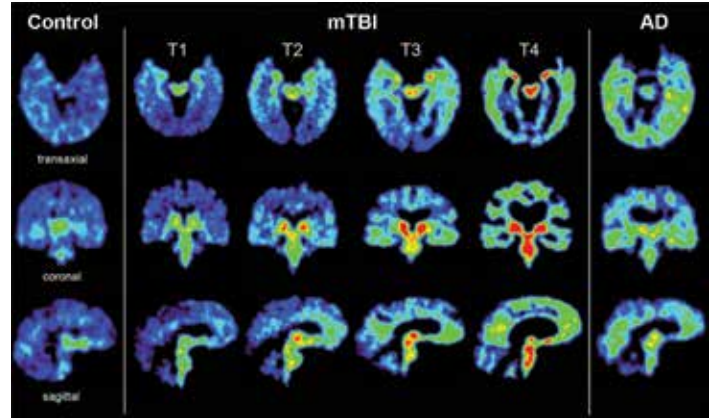
Sports Concussion Research

In a recent study by Dr. Bailes published in the journal *Clinical Neurology and Neurosurgery*, researchers used data from sensors placed in helmets of a Pop Warner football team for an entire season. Supported by this research and previously published data, Dr. Bailes, Chairman of the Pop Warner Medical Advisory Board, already has instituted changes to the rules of play that limit contact during practice in Pop Warner football leagues. Pop Warner is the first youth football organization to implement these critical protective guidelines. Pop Warner, based in Langhorne, Pa., is the oldest and largest national youth football organization with about 275,000 youth players nationwide.

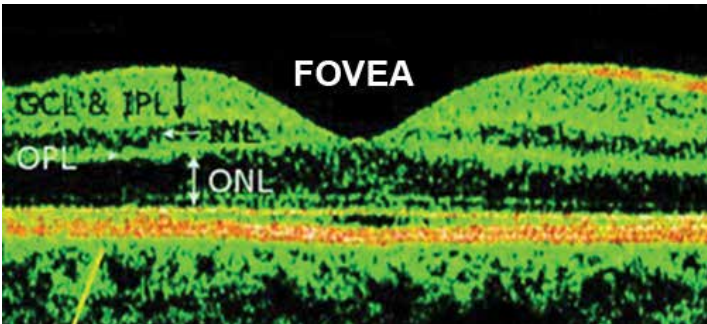
Neuroimaging Research

Diagnosis of Chronic Traumatic Encephalopathy (CTE) in Living Patients

CTE is a disorder that is believed to be caused by repeated mild traumatic brain injuries (mTBI or concussions) and is still in the discovery and research phases. At NorthShore Neurological Institute, Julian Bailes, MD, is a co-investigator of a collaborative study with scientists at UCLA who are using positron emission tomography (PET) scans combined with a newly developed chemical biomarker called FDDNP to perform brain imaging tests to assess early diagnosis of CTE. The biomarker binds to a protein in the brain called tau, which has been shown to be associated with repetitive head trauma, as well as the onset of Alzheimer's disease (AD). The location and concentration of tau deposits are then imaged using PET scanning that ultimately reveals the patterns of the abnormal tau protein that is distinctive in CTE compared to AD. The group recently published an article in the *Proceedings of the National Academy of Sciences* that further characterized these distinctive patterns (see image).



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Optical Biomarker of Parkinson's Disease

Apart from neuroimaging of the brain (as describe above), the search for biomarkers of neurological disease has seen increasing efforts focused on imaging of the eye. Since Parkinson's disease is associated with changes in the retina (back of the eye), researchers are testing whether regular retina assessment could be an alternative method to monitor the course of the disease. This was not achievable until the introduction of optical coherence tomography (OCT), a high-resolution optical imaging method that has been used to detect glaucoma and diabetic retinopathy. At NorthShore Neurological Institute, Aikaterina Markopoulou, MD, is using this state-of-the-art technology in a clinical trial designed to detect the changes in the center portion of the retina (fovea, see image above) in Parkinson's disease patients. The hope of the trial, sponsored by the Michael J. Fox Foundation, is that by following the changes we get an index by which we can compare the effects of different treatments and neuroprotective agents in Parkinson's disease.

Biomarkers of Traumatic Brain Injury

The purpose of this study is to provide more information about a possible association between mild to moderate traumatic brain injury (mTBI) and Parkinson's disease. There were approximately 10,000 mTBI patients seen at the Emergency Departments of NorthShore University HealthSystem during the years 2006–2013. The study is enrolling 100 of these patients and 100 "controls" who had no known mTBI to undergo neurological imaging with DaTscan to see if researchers can detect subtle changes in the brain similar to those seen in early Parkinson's disease in the mTBI group. DaTscan is an imaging technology that uses small amounts of a radioactive drug to provide visual evidence of the density of dopamine transporters (DATs) in a person's brain. The drug is detected using single photon emission computed tomography (SPECT), which

measures the amount and location of the "biomarker" drug in the brain. Demetrius Maraganore, MD, is the principal investigator of this study, which may provide preliminary data that might be used to help design future long-term studies.



Clinical Trials

The DodoNA Project

The DodoNA Project: DNA Predictions to Improve Neurological Health

Aims: “DodoNA” is a metaphor. Dodona was an oracle of ancient Greece, where priestesses interpreted the rustling leaves of a sacred oak tree to predict the future and to guide actions to improve fate. Just as at DodoNA, we can interpret subtle variations in DNA, the “tree of life,” to improve neurological health. Specifically, we are developing medical informatics tools to capture standardized data via routine office visits that measure the progression and outcomes of patients with several neurological disorders: brain tumors, epilepsy, memory disorders, migraine, mild traumatic brain injury, multiple sclerosis, neuropathy, Parkinson’s disease, restless legs syndrome and stroke. We are also studying persons who are neurologically healthy but at increased risk for Alzheimer’s disease and related brain disorders.

DodoNA is a clinical practice initiative (note-writing and workflow efficiencies) and a quality initiative (best practices). It is also a research initiative. To obtain data, we will invite up to 1,000 subjects for each of the 11 projects (11,000 subjects in total) to provide, via informed consent, a blood sample for DNA extraction and storage. We then will ask permission to associate information in their blood with information in their medical record (for the purposes of developing molecular prognostics and therapeutics).

Principal Investigator: Demetrius Maraganore, MD

Practice-Based Research

Quality Improvement and Practice-Based Research in Neurology Using the EMR

Aims: The purpose of the study is to advance quality improvement and practice-based research in Neurology using the Electronic Medical Record (EMR) system. The Department of Neurology at NorthShore has built into its commercial EMR, called “Epic,” structured clinical documentation support (SCDS) and clinical decision support (CDS) tools that standardize care, write progress notes, and capture ~1,000 discrete and cascading fields of neurological data per office visit. The specific aims of this project are to firstly create a Neurology Practice-Based Research Network (NPBRN) by sharing SCDS and CDS tools for 10 common neurological disorders (brain tumors, epilepsy, migraine, mild cognitive impairment, mild traumatic brain injury, multiple sclerosis, neuropathy, Parkinson’s disease, restless legs syndrome and stroke) with seven other Neurology Departments nationwide that also use the Epic EMR platform (eight sites total). Secondly, we will individualize medicine at the point of care by conducting pragmatic trials using subgroup-based adaptive designs, comparing the effectiveness of available treatments for common neurological disorders.

Principal Investigator: Demetrius Maraganore, MD

Brain Aneurysm Clinical Trials

Humanitarian Use Device: Neuroform Microdelivery Stent System

Aims: The Neuroform Microdelivery Stent System is used with coils for treating wide-neck aneurysms in the brain that cannot be treated with open brain surgery.

Principal Investigator: Shakeel Chowdhry, MD

Humanitarian Use Device: CODMAN ENTERPRISE Vascular Reconstructive Device and Delivery System

Aims: This device is used for treatment of wide-neck aneurysms. A stent is placed across the opening or neck of the aneurysm to secure the placement of coils and to maintain blood flow through the artery in which the stent is placed.

Principal Investigator: Shakeel Chowdhry, MD

CARE: A Prospective Multicenter Case Study to Assess Radiation Exposure in Patients Treated with the Penumbra Coil 400™

Aims: This is a multicenter case review study of patients presenting with intracranial aneurysms who are treated with coil embolization therapy using the Penumbra Coil 400 system (PC 400) or conventional coils. The primary objective of this study is to gather data on the radiation exposure in patients treated with the PC 400 or conventional coils per their respective indications for use. This study does not involve randomization. The devices evaluated in this study are FDA-approved.

Principal Investigator: Shakeel Chowdhry, MD

Humanitarian Use Device: Wingspan Stent System with Gateway PTA Balloon Catheter

Aims: This device is used to increase cerebral artery blood flow in patients with intracranial atherosclerotic disease. A stent is placed in the affected area and is deployed by inflation of a very small balloon, which widens the occluded vessel.

Principal Investigator: Shakeel Chowdhry, MD

Brain and Spine Tumor Clinical Trials

Randomized, Double-Blind, Placebo-Controlled Trial of Lacosamide for Seizure Prophylaxis in Patients with High-Grade Gliomas

Aims: The purpose of this study is to find out whether treating with lacosamide reduces the risk of seizures in patients with malignant glioma.

Principal Investigator: Ryan Merrell, MD

continued >>

Brain and Spine Tumor Clinical Trials (cont.)

A Phase III Randomized, Double-Blind, Placebo-Controlled Study of Armodafinil (Nuvigil) to Reduce Cancer-Related Fatigue in Patients with High-Grade Glioma

Aims: The purpose of this study is to determine whether taking the drug armodafinil will improve problems with fatigue in patients with glioblastoma and to evaluate the effects of taking armodafinil as compared to a placebo on cancer-related fatigue and on cognitive function.

Principal Investigator: Ryan Merrell, MD

N107C: A Phase III Trial of Postsurgical Stereotactic Radiosurgery (SRS) Compared with Whole-Brain Radiotherapy (WBRT) for Resected Metastatic Brain Disease

Aims: The purpose of this study is to compare overall survival and the effects of stereotactic radiosurgery to whole-brain radiation therapy in patients with brain metastases.

Principal Investigator: Ryan Merrell, MD

A Phase II Randomized Trial Comparing the Efficacy of Heat Shock Protein-Peptide Complex-96 (HSPPC-96) (NSC #725085, Alliance IND #15380) Vaccine Given with Bevacizumab versus Bevacizumab Alone in the Treatment of Surgically Resectable Recurrent Glioblastoma Multiforme (GBM)

Aims: The purpose of this study is to evaluate whether the addition of HSPPC-96 to bevacizumab can improve the overall survival in patients with resectable recurrent glioblastoma.

Principal Investigator: Ryan Merrell, MD

YELLOW 560 Microscope for Intraoperative Visualization of Fluorescein-Stained High-Grade Gliomas

Aims: The purpose of this study is to assess the use of a yellow, fluorescent dye in combination with a specialized microscope during brain surgery for the removal of a specific type of tumor called a high-grade glioma. Objectives include measuring patient outcomes and measuring the extent of tumor removal.

Principal Investigator: Julian Bailes, MD

A Phase I Study Evaluating the Safety and Pharmacokinetics of ABT-414 in Combination with Radiation Plus Temozolomide or Temozolomide Alone for Subjects with Glioblastoma Multiforme

Aims: The purpose of this study is to determine how the drug ABT-414 works in the body and evaluate its safety in patients with newly diagnosed or recurrent glioblastoma.

Principal Investigator: Ryan Merrell, MD

BTTC12-01: A Phase II Trial of Oral Pazopanib Plus Oral Topotecan Metronomic Antiangiogenic Therapy for Recurrent Glioblastoma Multiforme (A) without Prior Bevacizumab Exposure and (B) after Failing Prior Bevacizumab

Aims: The purpose of this study is to learn whether pazopanib, when given in combination with topotecan, can help control glioblastoma. The safety of this drug combination also will be studied.

Principal Investigator: Nina Martinez, MD

A071102: A Phase II/III Randomized Trial of Veliparib or Placebo in Combination with Adjuvant Temozolomide in Newly Diagnosed Glioblastoma with MGMT Promoter Hypermethylation

Aims: The purpose of this study is to compare the effects—good or bad—of the usual treatment (temozolomide) with or without the addition of the investigational drug veliparib for patients whose brain tumors show a change in a small region of DNA (gene) called O6-methylguanine methyltransferase (MGMT).

Principal Investigator: Ryan Merrell, MD

Concussion Clinical Trials

Imaging Biomarkers of Delayed Sequelae in Mild to Moderate Traumatic Brain Injury

Aims: This study is being conducted to determine whether a new brain-imaging technology called DaTscan can detect subtle changes in the brain (“biomarkers”) that are similar to those seen in early Parkinson’s disease (PD). The results of this study may provide more information about a potential link between mild traumatic brain injury (mTBI) and PD. We will compare findings from those who experienced mTBI with those without a history of brain injury (mTBI-negative or “control group”). This study may provide preliminary data that could be used to help design future long-term studies.

Principal Investigator: Demetrius Maraganore, MD

Changes in Brain Function and Connectivity Following a Concussion

Aims: Identify and quantify normal patterns of brain activity and connectivity across a variety functional systems, then determine whether a concussion produces abnormal values in functional systems related to patient symptomology. The ultimate goal is to provide an objective means to diagnose a concussion, identify the functional systems affected, and evaluate recovery.

Principal Investigator: Doug Burman, PhD

Epilepsy Clinical Trial

Verapamil as an Adjunct Therapy for Medically Refractory Epilepsy

Aims: The purpose of this study is to determine whether the use of the medication verapamil can reduce seizures in patients with epilepsy that is not controlled by standard seizure medications.

Principal Investigator: Jaishree Narayanan, MD

Multiple Sclerosis Clinical Trial

ASSESS: A 12-Month, Randomized, Rater- and Dose-Blinded Study to Compare the Efficacy and Safety of Fingolimod 0.25 mg and 0.5 mg Doses Administered Orally Once Daily versus Glatiramer Acetate Administered Subcutaneously Once Daily in Patients with Relapsing-Remitting Multiple Sclerosis

Aims: The purpose of this study is to compare two doses of fingolimod to glatiramer acetate (COPAXONE) and to evaluate the efficacy and safety of fingolimod 0.25 mg and 0.5 mg.

Principal Investigator: Afif Hentati, MD

Neuromuscular Disorder Clinical Trial

Compassionate Use of 3,4-Diaminopyridine in Lambert-Eaton Myasthenic Syndrome

Aims: The purpose of this study is to assess the use of 3,4-diaminopyridine in patients with Lambert-Eaton myasthenic syndrome.

Principal Investigator: David Randall, DO

Parkinson's Disease and Movement Disorder Clinical Trials

Imaging Biomarkers of Delayed Sequelae in Mild to Moderate Traumatic Brain Injury

Aims: This study is being conducted to determine whether a new brain-imaging technology called DaTscan can detect subtle changes in the brain ("biomarkers") that are similar to those seen in early Parkinson's disease (PD). The results of this study may provide more information about a potential link between mild traumatic brain injury (mTBI) and PD. We will compare findings from those who experienced mTBI to those without a history of brain injury (mTBI-negative or "control group"). This study may provide preliminary data that could be used to help design future long-term studies.

Principal Investigator: Demetrius Maraganore, MD

Intrinsic Remodeling of the Fovea in Parkinson's Disease

Aims: The purpose of this study is to compare changes in the back of the retina of the eye (the fovea) of Parkinson's disease patients to healthy control subjects.

Principal Investigator: Katerina Markopoulou, MD, PhD

The Longitudinal Clinical and Genetic Study of Parkinson's Disease (LONG-PD Study)

Aims: The clinical and genetic factors that influence motor and nonmotor severity, progression and outcomes in Parkinson's disease are unknown. Identification of these factors may allow us to individualize the care of patients and to improve neurological health. The Genetic Epidemiology of Parkinson's Disease (GEO-PD) consortium sites treat thousands of patients each year in its clinics. The purpose of this study is to develop a Web-based platform for the capture and sharing of standardized data that measure motor and nonmotor severity, progression and outcomes in Parkinson's disease across 25 global sites—from 18 countries, five continents, 4,200 cases. These patients will be followed for 15 years for collaborative research studies. Additionally, DNA will be shared in a central repository to conduct genomic studies of severity, progression and outcomes in Parkinson's disease.

Principal Investigator: Demetrius Maraganore, MD

Spine Surgery Clinical Trial

A Prospective Clinical Evaluation of the Centinel Spine™ STALIF C® No Profile® Integrated Interbody Fusion™ Device

Aims: This is a postmarket analysis study of FDA-approved cervical fusion devices: the STALIF C and STALIF C-Ti. The purpose of this study is to collect information about how well different types of patients do after spinal fusion, based on their earlier treatments (conservative therapy). This study is designed to better understand the links between conservative care, spinal fusion and patient outcomes.

Principal Investigator: Michael Musacchio, MD

Stroke Program Clinical Trials

MISTIE III: A Phase III, Randomized, Open-Label, 500-Subject Clinical Trial of Minimally Invasive Surgery Plus rt-PA in the Treatment of Intracerebral Hemorrhage

Aims: The purpose of this study is to determine the safety and effectiveness of an emergency treatment for intracerebral hemorrhage (spontaneous bleeding in the brain) compared to the current standard of care. The investigational treatment involves a procedure to remove the blood clot in the brain through a small tube, and the use of a drug called rt-PA to break up the clot and further aid in its removal. Study participants will be randomly assigned to either the investigational treatment or current standard of care, which does not include removal of the clot.

Principal Investigator: Shakeel Chowdhry, MD

SOCRATES—Acute Stroke or Transient Ischemic Attack (TIA) Treated with Aspirin or Ticagrelor and Patient Outcomes Trial: A Randomized, Double-Blind, Multinational Study to Prevent Major Vascular Events with Ticagrelor Compared to Aspirin (Acetylsalicylic Acid) in Patients with Acute Ischemic Stroke, or TIA

Aims: The purpose of this study is to compare the effect of 90-day treatment with ticagrelor (180 mg loading dose on Day 1 followed by 90 mg twice daily for the remainder of the study) versus aspirin (300 mg loading dose on Day 1 followed by 100 mg once daily for the remainder of the study) for the prevention of major vascular events (composite of stroke, myocardial infarction and death) in patients with acute ischemic stroke or TIA when initiated within 24 hours.

Principal Investigator: Rima Dafer, MD

Platelet-Oriented Inhibition in New TIA and Minor Ischemic Stroke (POINT) Trial

Aims: The purpose of this study is to determine whether clopidogrel 75 mg/day by mouth after a loading dose of 600 mg of clopidogrel is effective in preventing major ischemic vascular events (ischemic stroke, myocardial infarction and ischemic vascular death) at 90 days when initiated within 12 hours of transient ischemic attack (TIA) or minor ischemic stroke onset in patients receiving aspirin 50–325 mg/day (with a dose of 162 mg daily for 5 days followed by 81 mg daily strongly recommended).

Principal Investigator: Rima Dafer, MD

Door-to-Needle Improvement Initiative: Thrombolysis Use in Acute Stroke Consent and Delay

Aims: The purpose of our proposed study is to determine reasons behind delay in administration of intravenous thrombolytic (IV) therapy to patients presenting to one of the four NorthShore Emergency Departments with symptoms and signs of stroke, and to implement measures to improve early diagnosis and treatment. Our study will attempt to gauge the frequency by which various forms of consent are obtained in the emergent setting with reference to stroke patients. It will also attempt to gauge whether consent delays administration of IV tissue plasminogen activator (tPA) to eligible patients.

Principal Investigator: Fan Caprio, MD

Peer-Reviewed Publications

Bailes J, Bravo S, Breiter H, Kaufman D, Lu Z, Molfese D, Perrish T, Slobounov S, Talavage T, Zhu D. A call to arms: the need to create an inter-institutional concussion neuroimaging consortium to discover clinically relevant diagnostic biomarkers and develop evidence-based interventions to facilitate recovery. *Dev Neuropsychol*. 2015 Feb-Mar;40(2):59-62. PubMed PMID: 25961586.

Post A, Karton C, Hoshizaki TB, Gilchrist MD, **Bailes J**. Evaluation of the protective capacity of baseball helmets for concussive impacts. *Comput Methods Biomech Biomed Engin*. 2015 Apr 9:1-10. [Epub ahead of print] PubMed PMID: 25855861.

Barrio JR, Small GW, Wong KP, Huang SC, Liu J, Merrill DA, Giza CC, Fitzsimmons RP, Omalu B, **Bailes J**, Kepe V. In vivo characterization of chronic traumatic encephalopathy using [¹⁸F]-FDDNP PET brain imaging. *Proc Natl Acad Sci U S A*. 2015 Apr 21;112(16):E2039-47. PubMed PMID: 25848027.

Petraglia AL, Walker CT, **Bailes JE**, Callerame KJ, Thompson KE, Burnham JM. Concussion in the absence of head impact: A case in a collegiate hammer thrower. *Curr Sports Med Rep*. 2015 Jan;14(1):11-5. PubMed PMID: 25574875.

Bailes JE, Patel V. The potential for DHA to mitigate mild traumatic brain injury. *Mil Med*. 2014 Nov;179(11 Suppl):112-6. PubMed PMID: 25373094.

Petraglia AL, Dashnaw ML, Turner RC, **Bailes JE**. Models of mild traumatic brain injury: Translation of physiological and anatomic injury. *Neurosurgery*. 2014 Oct;75 Suppl 4:S34-49. PubMed PMID: 25232883.

Stone JL, Patel V, Bailes JE. The history of neurosurgical treatment of sports concussion. *Neurosurgery*. 2014 Oct;75 Suppl 4:S3-S23. PubMed PMID: 25232882.

Ciric I, **Bailes J**. The quiddity of frontobasal meningiomas. *World Neurosurg*. 2015 Apr;83(4):477-8. PubMed PMID: 25195108.

Bailes JE, Dashnaw ML, Petraglia AL, Turner RC. Cumulative effects of repetitive mild traumatic brain injury. *Prog Neurol Surg*. 2014;28:50-62. PubMed PMID: 24923392.

Bailes JE. Response. *J Neurosurg*. 2014 Mar;120(3):789-90. PubMed PMID: 24724179.

Stone JL, Bailes JE. In the absence of diagnosed concussion in collegiate contact sport athletes, a relationship is suggested between the effects of head impact exposure, white matter diffusivity measures and cognition. *Evid Based Med*. 2014 Aug;19(4):157. PubMed PMID: 24688090.

Wong RH, Wong AK, **Bailes JE**. Frequency, magnitude and distribution of head impacts in Pop Warner football: The cumulative burden. *Clin Neurol Neurosurg*. 2014 Mar;118:1-4. PubMed PMID: 24529219.

Lucke-Wold BP, Turner RC, Logsdon AF, **Bailes JE**, Huber JD, Rosen CL. Linking traumatic brain injury to chronic traumatic encephalopathy: Identification of potential mechanisms leading to neurofibrillary tangle development. *J Neurotrauma*. 2014 Jul 1;31(13):1129-38. PubMed PMID: 24499307.

Turner RC, VanGilder RL, Naser ZJ, Lucke-Wold BP, **Bailes JE**, Matsumoto RR, Huber JD, Rosen CL. Elucidating the severity of preclinical traumatic brain injury models: A role for functional assessment? *Neurosurgery*. 2014 Apr;74(4):382-94; discussion 394. PubMed PMID: 24448183.

Gibbons C, Cheshire W, **Barboi A**, Levine B, Olshansky B, Kinsella L, Claydon VE, Crandall C, Fink G, Joyner M, Macefield V, Norcliffe-Kaufmann L, Freeman R, Raj S, Stewart J, Sandroni P, Kaufmann H, Chelimsky T. Endovascular procedures for the treatment of autonomic dysfunction. *Clin Auton Res*. 2014 Feb;24(1):1-2. PubMed PMID: 24178965.

Caprio FZ, Bernstein RA, Alberts MJ, Curran Y, Bergman D, Korutz AW, Syed F, Ansari SA, Prabhakaran S. Efficacy and safety of novel oral anticoagulants in patients with cervical artery dissections. *Cerebrovasc Dis*. 2014;38(4):247-53. PubMed PMID: 25401389.

Lieberman AL, Nagel MA, Hurley MC, **Caprio FZ**, Bernstein RA, Gilden D. Rapid development of 9 cerebral aneurysms in varicella-zoster virus vasculopathy. *Neurology*. 2014 Jun 10;82(23):2139-41. PubMed PMID: 24827494.

Zaidi HA, Awad AW, **Chowdhry SA**, Fusco D, Nakaji P, Spetzler RF. Microvascular decompression for hemifacial spasm secondary to vertebrobasilar dolichoectasia: Surgical strategies, technical nuances and clinical outcomes. *J Clin Neurosci*. 2015 Jan;22(1):62-8. PubMed PMID: 25510536.

Zaidi HA, **Chowdhry SA**, Nakaji P, Aba AA, Spetzler RF. Contralateral interhemispheric approach to deep-seated cavernous malformations: Surgical considerations and clinical outcomes in 31 consecutive cases. *Neurosurgery*. 2014 Jul;75(1):80-6. PubMed PMID: 24618803.

Zaidi HA, Albuquerque FC, **Chowdhry SA**, Zabramski JM, Ducruet AF, Spetzler RF. Diagnosis and management of bow hunter's syndrome: 15-year experience at Barrow Neurological Institute. *World Neurosurg*. 2014 Nov;82(5):733-8. PubMed PMID: 24549025.

Zaidi HA, Abba AA, Nakaji P, **Chowdhry SA**, Albuquerque FC, Spetzler RF. Indocyanine green angiography in the surgical management of cerebral arteriovenous malformations: Lessons learned in 130 consecutive cases. *Neurosurgery*. 2014 Jun;10 Suppl 2:246-51; discussion 251. PubMed PMID: 24535264.

Chowdhry SA, Spetzler RF. Genealogy of training in vascular neurosurgery. *Neurosurgery*. 2014 Feb;74 Suppl 1:S198-203. PubMed PMID: 24402488.

Oppenlander ME, **Chowdhry SA**, Merkl B, Hattendorf GM, Nakaji P, Spetzler RF. Robotic autopoisoning of the operating microscope. *Neurosurgery*. 2014 Jun;10 Suppl 2:214-9; discussion 219. PubMed PMID: 24335818.

Manjila S, **Chowdhry SA**, Bambakidis NC, Hart DJ. Traumatic, high-cervical, coronal-plane spondyloptosis with unilateral vertebral artery occlusion: Treatment using a prophylactic arterial bypass graft, open reduction and instrumented segmental fusion. *J Neurosurg Spine*. 2014 Feb;20(2):183-90. PubMed PMID: 24286529.

Zaidi HA, **Chowdhry SA**, Wilson DA, Spetzler RF. The dilemma of early postoperative magnetic resonance imaging: When efficiency compromises accuracy: Case report. *Neurosurgery*. 2014 Mar;74(3):E335-40. PubMed PMID: 24077584.

Dafer RM. Migraine and the risk of stroke. *Dis Mon*. 2015 Jun;61(6):223-228. PubMed PMID: 25937391.

Dafer RM, Paleologos N, Lynch D. Intravenous thrombolysis for ischemic stroke in recurrent oligodendroglioma: A case report. *J Stroke Cerebrovasc Dis*. 2014 May-Jun;23(5):1235-8. PubMed PMID: 24103669.

Freedom T. Headaches and sleep disorders. *Dis Mon*. 2015 Jun;61(6):240-248. PubMed PMID: 25951784.

Freedom T. Classification of headache. *Dis Mon*. 2015 Jun;61(6):214-217. PubMed PMID: 25913497.

Freedom T. Headache and sleep: Also assess circadian rhythm sleep disorders: A response. *Headache*. 2014 Jan;54(1):178. PubMed PMID: 24400765.

McMahon JP, **Groothuis DR**, Homer D, **Maraganore DM**, Nicholas A, Vick, MD (1939–2014). *Neurology*. 2015 Feb 10;84(6):558-9. PubMed PMID: 25811061.

Issa NP, **Hentati A**. VZV encephalitis that developed in an immunized patient during fingolimod therapy. *Neurology*. 2015 Jan 6;84(1):99-100. PubMed PMID: 25416038.

Kastner K, Rust L, **Kelley K**, Msall M, Hageman JR. A 9-month-old boy with right-hand preference. *Pediatr Ann*. 2015 Mar;44(3):e53-7. PubMed PMID: 25806730.

Taylor C, Piantino J, Hageman J, Lyons E, Janies K, Leonard D, **Kelley K**, Fuchs S. Emergency Department Management of Pediatric Unprovoked Seizures and Status Epilepticus in the State of Illinois. *J Child Neurol*. 2015 Feb 16. [Epub ahead of print] PubMed PMID: 25688070.

Carapetian S, Hageman J, Lyons E, Leonard D, Janies K, **Kelley K**, Fuchs S. Emergency Department Evaluation and Management of Children With Simple Febrile Seizures. *Clin Pediatr (Phila)*. 2015 Feb 8. pii: 0009922815570623. [Epub ahead of print] PubMed PMID: 25667312.

Puschmann A, Brighina L, **Markopoulou K**, Aasly J, Chung SJ, **Frigerio R**, Hadjigeorgiou G, Köks S, Krüger R, Siuda J, Wider C, Zesiewicz TA, **Maraganore DM**. Clinically meaningful parameters of progression and long-term outcome of Parkinson's disease: An international consensus statement. *Parkinsonism Relat Disord*. 2015 May 1. pii: S1353-8020(15)00195-9. PubMed PMID: 25952959.

Ahmed I, Lee PC, Lill CM, Searles Nielsen S, Artaud F, Gallagher LG, Lorient MA, Mulot C, Nacfer M, Liu T, Biernacka JM, Armasu S, Anderson K, Farin FM, Lassen CF, Hansen J, Olsen JH, Bertram L, **Maraganore DM**, Checkoway H, Ritz B, Elbaz A. Lack of replication of the GRIN2A-by-coffee interaction in Parkinson's disease. *PLoS Genet*. 2014 Nov 20;10(11):e1004788. PubMed PMID: 25412286.

Theuns J, Verstraeten A, Slegers K, Wauters E, Gijssels I, Smolders S, Crosiers D, Corsmit E, Elinck E, Sharma M, Krüger R, Lesage S, Brice A, Chung SJ, Kim MJ, Kim YJ, Ross OA, Wszolek ZK, Rogava E, Xi Z, Lang AE, Klein C, Weissbach A, Mellick GD, Silburn PA, Hadjigeorgiou GM, Dardiotis E, Hattori N, Ogaki K, Tan EK, Zhao Y, Aasly J, Valente EM, Petrucci S, Annesi G, Quattrone A, Ferrarese C, Brighina L, Deuschländer A, Puschmann A, Nilsson C, Garraux G, LeDoux MS, Pfeiffer RF, Boczaraska-Jedynak M, Opala G, **Maraganore DM**, Engelborghs S, De Deyn PP, Cras P, Cruts M, Van Broeckhoven C; GEO-PD Consortium. Global investigation and meta-analysis of the C9orf72 (G4C2)n repeat in Parkinson disease. *Neurology*. 2014 Nov 18;83(21):1906-13. PubMed PMID: 25326098.

Markopoulou K, Biernacka JM, Armasu SM, Anderson KJ, Ahlskog JE, Chase BA, Chung SJ, Cunningham JM, Farrer M, **Frigerio R**, **Maraganore DM**. Does α -synuclein have a dual and opposing effect in preclinical versus clinical Parkinson's disease? *Parkinsonism Relat Disord*. 2014 Jun;20(6):584-9; discussion 584. PubMed PMID: 24656894.

continued >>

Chung SJ, Biernacka JM, Armasu SM, Anderson K, Frigerio R, Aasly JO, Annesi G, Bentivoglio AR, Brighina L, Chartier-Harlin MC, Goldwurm S, Hadjigeorgiou G, Jasinska-Myga B, Jeon BS, Kim YJ, Krüger R, Lesage S, **Markopoulou K**, Mellick G, Morrison KE, Puschmann A, Tan EK, Crosiers D, Theuns J, Van Broeckhoven C, Wirdefeldt K, Wszolek ZK, Elbaz A, **Maraganore DM**; Genetic Epidemiology of Parkinson's Disease Consortium. Alpha-synuclein repeat variants and survival in Parkinson's disease. *Mov Disord*. 2014 Jul;29(8):1053-7. PubMed PMID: 24578302.

Heckman MG, Elbaz A, Soto-Ortolaza AI, Serie DJ, Aasly JO, Annesi G, Auburger G, Bacon JA, Boczarska-Jedynak M, Bozi M, Brighina L, Chartier-Harlin MC, Dardiotis E, Destée A, Ferrarese C, Ferraris A, Fiske B, Gispert S, Hadjigeorgiou GM, Hattori N, Ioannidis JP, Jasinska-Myga B, Jeon BS, Kim YJ, Klein C, Kruger R, Kyrtzi E, Lin CH, Lohmann K, Liorot MA, Lynch T, Mellick GD, Mutez E, Opala G, Park SS, Petrucci S, Quattrone A, Sharma M, Silburn PA, Sohn YH, Stefanis L, Tadic V, Tomiyama H, Uitti RJ, Valente EM, Vassilatis DK, Vilariño-Güell C, White LR, Wirdefeldt K, Wszolek ZK, Wu RM, Xiromerisiou G, **Maraganore DM**, Farrer MJ, Ross OA; Genetic Epidemiology of Parkinson's Disease (GEO-PD) Consortium. Protective effect of LRRK2 p.R1398H on risk of Parkinson's disease is independent of MAPT and SNCA variants. *Neurobiol Aging*. 2014 Jan;35(1):266.e5-14. PubMed PMID: 23962496.

Prager AJ, **Martinez N**, Beal K, Omuro A, Zhang Z, Young RJ. Diffusion and perfusion MRI to differentiate treatment-related changes including pseudoprogression from recurrent tumors in high-grade gliomas with histopathologic evidence. *AJNR Am J Neuroradiol*. 2015 May;36(5):877-85. PubMed PMID: 25593202.

Jalali A, Amirian ES, Bainbridge MN, Armstrong GN, Liu Y, Tsavachidis S, Jhangiani SN, Plon SE, Lau CC, Claus EB, Barnholtz-Sloan JS, Il'yasova D, Schildkraut J, Ali-Osman F, Sadetzki S, Johansen C, Houlston RS, Jenkins RB, Lachance D, Olson SH, Bernstein JL, **Merrell RT**, Wrensch MR, Davis FG, Lai R, Shete S, Aldape K, Amos CI, Muzny DM, Gibbs RA, Melin BS, Bondy ML. Targeted sequencing in chromosome 17q linkage region identifies familial glioma candidates in the Gliogene Consortium. *Sci Rep*. 2015 Feb 5;5:8278. PubMed PMID: 25652157.

Bainbridge MN, Armstrong GN, Gramatges MM, Bertuch AA, Jhangiani SN, Doddapaneni H, Lewis L, Tombrello J, Tsavachidis S, Liu Y, Jalali A, Plon SE, Lau CC, Parsons DW, Claus EB, Barnholtz-Sloan J, Il'yasova D, Schildkraut J, Ali-Osman F, Sadetzki S, Johansen C, Houlston RS, Jenkins RB, Lachance D, Olson SH, Bernstein JL, **Merrell RT**, Wrensch MR, Walsh KM, Davis FG, Lai R, Shete S, Aldape K, Amos CI, Thompson PA, Muzny DM, Gibbs RA, Melin BS, Bondy ML. Gliogene Consortium. Germline mutations in shelterin complex genes are associated with familial glioma. *J Natl Cancer Inst*. 2014 Dec 7;107(1):384. PubMed PMID: 25482530.

Andersson U, Wibom C, Cederquist K, Aradottir S, Borg A, Armstrong GN, Shete S, Lau CC, Bainbridge MN, Claus EB, Barnholtz-Sloan J, Lai R, Il'yasova D, Houlston RS, Schildkraut J, Bernstein JL, Olson SH, Jenkins RB, Lachance DH, Wrensch M, Davis FG, **Merrell R**, Johansen C, Sadetzki S; Gliogene Consortium, Bondy ML, Melin BS. Germline rearrangements in families with strong family history of glioma and malignant melanoma, colon, and breast cancer. *Neuro Oncol*. 2014 Oct;16(10):1333-40. PubMed PMID: 24723567.

Wong RH, Thakral B, Watkin WG, **Merrell R**, Wong AK, Farhat HI. Intracranial, intra-axial metastatic giant cell tumor of bone: Case report and review of literature. *Clin Neurol Neurosurg*. 2014 Feb;117:40-3. PubMed PMID: 24438802.

Koktzoğlu I, **Meyer JR**, **Ankenbrandt WJ**, Giri S, Piccini D, Zenge MO, Flanagan O, Desai T, Gupta N, Edelman RR. Nonenhanced arterial spin labeled carotid MR angiography using three-dimensional radial balanced steady-state free precession imaging. *J Magn Reson Imaging*. 2015 Apr;41(4):1150-6. PubMed PMID: 24737420.

Meyers SL. Cluster headache and trigeminal autonomic cephalgias. *Dis Mon*. 2015 Jun;61(6):236-9. PubMed PMID: 25841267.

Tan LA, **Musacchio MJ**, Mitchell BA, Kapadia SK, Patel NH, Byrne RW. Simultaneously occurring meningioma and contralateral glioblastoma multiforme. *Br J Neurosurg*. 2014 Dec;28(6):815-6. PubMed PMID: 24953874.

Prager JM, Thomas C, **Ankenbrandt WJ**, **Meyer JR**, Gao Y, Ragin A, Sidharthan S, Hutten R, Wu YG. Association of white matter hyperintensities with low serum 25-hydroxyvitamin D levels. *AJNR Am J Neuroradiol*. 2014 Jun;35(6):1145-9. PubMed PMID: 24436348.

Pula JH, Glisson CC. Should plasma exchange be offered to patients with multiple sclerosis-associated optic neuritis? *J Neuroophthalmol*. 2015 Mar;35(1):86-9. PubMed PMID: 25534476.

Sandroff BM, Motl RW, Sosnoff JJ, **Pula JH**. Further validation of the Six-Spot Step Test as a measure of ambulation in multiple sclerosis. *Gait Posture*. 2015 Jan;41(1):222-7. PubMed PMID: 25455207.

Pula JH, Mehta M. Silent sinus syndrome. *Curr Opin Ophthalmol*. 2014 Nov;25(6):480-4. PubMed PMID: 25237931.

Pula JH, Kattah JC. Ocular pulsations due to posttraumatic compromise of the orbital roof. *Neurology*. 2014 Aug 19;83(8):771. PubMed PMID: 25135911.

Pula JH, Kattah JC, Keung B, Wang H, Daily J. Longitudinally extensive optic neuritis in neuromyelitis optica spectrum disorder. *J Neurol Sci*. 2014 Oct 15;345(1-2):209-12. PubMed PMID: 25125046.

Balantrapu S, Sosnoff JJ, **Pula JH**, Sandroff BM, Motl RW. Leg spasticity and ambulation in multiple sclerosis. *Mult Scler Int*. 2014;2014:649390. PubMed PMID: 24999434.

Sandroff BM, Pilutti LA, Dlugonski D, Learmonth YC, **Pula JH**, Motl RW. Comparing two conditions of administering the six-minute walk test in people with multiple sclerosis. *Int J MS Care*. 2014 Spring;16(1):48-54. PubMed PMID: 24688354.

Pula JH, Fischer M, Kattah JC. Hemifield slide from traumatic optic chiasmopathy. *J Clin Neurosci*. 2014 Aug;21(8):1446-7. PubMed PMID: 24613428.

Sandroff BM, Dlugonski D, Pilutti LA, **Pula JH**, Benedict RH, Motl RW. Physical activity is associated with cognitive processing speed in persons with multiple sclerosis. *Mult Scler Relat Disord*. 2014 Jan;3(1):123-8. PubMed PMID: 25877983.

Parker SE, Gujrati M, **Pula JH**, Zallek SN, Kattah JC. The Heidenhain variant of Creutzfeldt-Jakob disease—A case series. *J Neuroophthalmol*. 2014 Mar;34(1):4-9. PubMed PMID: 23896811.

Sosnoff JJ, Socie MJ, Sandroff BM, Balantrapu S, Suh Y, **Pula JH**, Motl RW. Mobility and cognitive correlates of dual task cost of walking in persons with multiple sclerosis. *Disabil Rehabil*. 2014;36(3):205-9. PubMed PMID: 23597000.

Rubin SM. Migraines in women. *Dis Mon*. 2015 Jun;61(6):229-232. PubMed PMID: 25890621.

Baston C, Mancini M, **Schoneburg B**, Horak F, Rocchi L. Postural strategies assessed with inertial sensors in healthy and parkinsonian subjects. *Gait Posture*. 2014;40(1):70-5. PubMed PMID: 24656713.

Semenov IA. Migraine headaches. *Dis Mon*. 2015 Jun;61(6):218-222. PubMed PMID: 25911064.

Semenov IA. Headache in the elderly. *Dis Mon*. 2015 Jun;61(6):249-250. PubMed PMID: 25911063.

Semenov IA. Tension-type headaches. *Dis Mon*. 2015 Jun;61(6):233-235. PubMed PMID: 25882693.

Stadlan NY. Practice variability in brain death determination: A call to action. *Neurology*. 2014 May 27;82(21):1936-7. PubMed PMID: 24862897.

Stadlan N. Considerations on “a pilot study of transcranial Doppler-guided initial resuscitation of traumatic and non-traumatic comatose patients.” *Minerva Anesthesiol*. 2014 Sep;80(9):983. PubMed PMID: 24622161.

Rozenky RH, Tovian SM, **Sweet JJ**. Twenty years of the *Journal of Clinical Psychology in Medical Settings*: We hope you will enjoy the show. *J Clin Psychol Med Settings*. 2014 Mar;21(1):1-9. PubMed PMID: 24492915.

Sweet JJ. Editorial. EQUATOR—Reporting guidelines for “Enhancing the Quality and Transparency of Health Research.” *Clin Neuropsychol*. 2014;28(4):547-8. PubMed PMID: 24983313.

Pape TL, Rosenow JM, Steiner M, Parrish T, Guernon A, Harton B, Patil V, Bhaumik DK, McNamee S, **Walker M**, Froehlich K, Burrell C, Odle C, Wang X, Herrold AA, Zhao W, Reda D, Mallinson T, Conneely M, Nemeth AJ. Placebo controlled trial of familiar auditory sensory training for acute severe traumatic brain injury: A preliminary report. *Neurorehabil Neural Repair*. 2015 Jul;29(6):537-47. PubMed PMID: 25613986.

Rozenfeld MN, Nemeth AJ, **Walker MT**, Mohan P, Wang X, Parrish TB, Opal P. An investigation of diffusion imaging techniques in the evaluation of spinocerebellar ataxia and multisystem atrophy. *J Clin Neurosci*. 2015 Jan;22(1):166-72. PubMed PMID: 25439745.

Education

NorthShore is the primary teaching affiliate of the University of Chicago Pritzker School of Medicine. The two institutions unite one of the premier medical schools in the country with one of the nation's leading teaching hospitals to share a commitment to medical education, clinical investigation and excellent patient care. All physicians who are involved with teaching hold an academic appointment or title at the University of Chicago Pritzker School of Medicine.

Susan Rubin, MD, Vice Chair of Education, oversees the academic activities of the Department of Neurology. PGY2 neurology residents rotate on the inpatient consultation service and PGY3 neurology residents rotate through our clinics, observing and treating patients as assigned. PGY4 neurology residents are offered an elective rotation based on particular subspecialty interests. John Pula, MD, is the Neurology Residency Program Director, and Octavia Kincaid, MD, directs the medical student education program when they rotate through the neurology program. Neurosurgery residents from the University of Chicago rotate through our teaching hospitals. Our neurology and neurosurgical residents actively publish articles in collaboration with the staff.

NorthShore Neurological Institute is committed to offering quality education to physicians and healthcare professionals. In conjunction with The Office of Continuing Medical Education (CME) at the University of Chicago, we held our first ever Neuro-Oncology CME event to provide up-to-date information to community physicians about advancements in brain tumor diagnosis and treatments. Our speakers included Nina Martinez, MD, who discussed current treatment strategies and clinical trials for gliomas and brain metastases and Julian Bailes, MD, who discussed the latest surgical technologies regarding tumor resection, including BrainPath and the Six Pillar Approach.

NorthShore Neurological Institute also offers regularly scheduled instructional series focused on clinical topics, research, case presentations, patient-physician communication and other topics that advance the educational goals of our staff. These include our weekly CME Neuroscience Conference held at Evanston Hospital and teleconferenced to all the other NorthShore Hospitals, as well as a monthly Neurosurgery Academic Day for residents and staff where there are brain cuttings and laboratory sessions. We regularly invite nationally and internationally recognized experts from outside institutions to give lectures at these activities.

Guest speakers and topics:

- Terrence Cascino, MD, Professor, Department of Neurology, Mayo Clinic, and President, American Academy of Neurology, "Overview of the Priorities of the American Academy of Neurology and Its Impact on NorthShore."
- Daniel Lachance, MD, Associate Professor of Neurology, Department of Neurology, Mayo Clinic, "Defining a Molecular Classification for Gliomas."
- Sotirios Parashos, MD, PhD, Professor, University of Minnesota, "Big Data in Parkinson Disease: The National Parkinson Foundation Parkinson's Outcomes Project."
- Sara Hocker, MD, Department of Neurology, Mayo Clinic, "Insights in Refractory and Super Refractory Status Epilepticus."
- Shabbar Danish, MD, Director, Stereotactic and Functional Neurosurgery Director, Rutgers Medical School, "MRI-Guided Laser Therapy for Intracranial Pathologies: Initial Experience."
- Neilank Jha, MD, Neurosurgeon, Editor-In-Chief, Current Research-Concussion, "Future of Concussion Management."
- Ernesto Coscarella, MD, Neurosurgeon, President of Second Opinion America-Italia, "3-D Lecture: Microsurgical anatomy of the supratentorial ventricular cavities" and "3-D Lecture: The brain stem microsurgical anatomy of surface landmarks, entry points, intraparenchymal corridors, surgical approaches and a 4.7 tesla MRI study of the intraparenchymal anatomy, limbic system and mesial temporal lobe."

Community Outreach

Experts from NorthShore Neurological Institute participated in multiple community events over the course of the year designed to raise funds, educate and bring awareness about neurological diseases.

Highlights included the first-ever series of NorthShore Neurological Institute Multiple Sclerosis Symptoms Fairs, which featured lectures by clinical experts providing a review of MS symptoms with a multidisciplinary team of specialists available to answer questions.

These events were some of the multiple outreach programs sponsored or hosted by NorthShore Neurological Institute:

Brain Tumor

- American Brain Tumor Association (ABTA) Breakthrough for Brain Tumors (April 2014, Soldier Field)
- ABTA Patient and Family Conference (July 2014, Chicago)
- ABTA Breakthrough for Brain Tumors (April 2015, Soldier Field)

Parkinson's Disease

- American Parkinson's Disease Association (APDA) Parkinson's Patient Conference (April 2014, Rolling Meadows)
- NorthShore Neurological Institute Understanding Parkinson's Event (April 2014, Arlington Heights)
- APDA Optimism Walk (September 2014, Naperville)
- MJFF Parkinson's Research Symposium (November 2014, Rosemont)
- APDA Parkinson's Patient Conference (April 2015, Rolling Meadows)
- Golf4PD Tournament (June 2015, Barrington)
- NorthShore Neurological Institute Understanding Parkinson's Event (June 2015, Libertyville)

Epilepsy

- NorthShore Neurological Institute Visualase Community Event (April 2014, Evanston Hospital)
- Epilepsy Foundation of Greater Chicago 5K (May 2014, Chicago and Libertyville)
- Epilepsy Patient Conference (November 2014, Chicago)
- Epilepsy Foundation of Greater Chicago 5K (May 2015, Chicago)



At the Michael J. Fox Foundation Partners in Parkinson's event held in Rosemont, neurologists, nurses, physical therapists and researchers were on hand to talk with the more than 800 attendees. Participants also took part in educational seminars and panel discussions designed for individuals and families affected by Parkinson's disease.

Multiple Sclerosis (MS)

- MS Society 5K Walk for MS (May 2014, Glenview)
- NorthShore Neurological Institute Multiple Sclerosis Symptoms Fair (October 2014, Glenbrook Hospital)
- MS Society Research Symposium (October 2014, Rosemont)
- NorthShore Neurological Institute MS Symptoms Fair (November 2014, Glenbrook Hospital)
- NorthShore Neurological Institute MS Symptoms Fair (April 2015, NorthShore Highland Park Hospital)
- MS Society 5K Walk for MS (May 2015, Glenview)

Concussion

- A Step aHead Moms' Night (October 2014, United Center)

Spine Center

- Spine Center Community Event (June 2014, Highland Park, Libertyville and Vernon Hills)

Mayo Clinic Care Network



Two teams of experts working together. Working for you.

NorthShore is the only Chicago-based health system within the Mayo Clinic Care Network. Consistent with our commitment to bring excellence to our patients, this relationship was formed to improve the delivery of healthcare close to home. NorthShore physicians have direct access to Mayo Clinic physicians to collaborate on the best treatment plan for the individual patient. This means most patients can benefit from enhanced care locally, reducing the need to travel outside the region.

Hundreds of patients already have benefited from the interactions between NorthShore and Mayo Clinic physicians, including expedited referrals to Mayo, electronic chart consults, graduated patient referrals to NorthShore and overflow patient referrals to NorthShore.

NorthShore is the first Mayo Clinic Care Network member in the country to implement a dedicated telemedicine room, further demonstrating our commitment to providing the best care for patients. Located in the John and Carol Walter Ambulatory Care Center at Glenbrook Hospital, it provides an exceptional opportunity for NorthShore Neurological Institute patients to have high-tech video consults with their NorthShore physician and a Mayo specialist.

The room is equipped with sophisticated, high-definition audio and video equipment, as well as a suite of clinical instruments. The Mayo physician also can listen to the patient's heart and take vitals in real time through the superior telemedicine design. Video consults have been very well received by patients who are happy to have the benefit of a Mayo consult without traveling to Minnesota.

Additional benefits of this relationship are local community forums on the latest neurological treatments co-sponsored by NorthShore and Mayo neurologists and neurosurgeons. Thousands of Chicago residents have attended these events, including two held in 2015:

- NorthShore Neurologists James Castle, MD, and Archie Ong, MD, and Neurosurgeon Shakeel Chowdhry, MD, joined Mayo Clinic Neurosurgeon Giuseppe Lanzino, MD, to discuss the latest innovations in advanced diagnosis and treatment options for stroke.
- NorthShore Neurologists Alexandru Barboi, MD, David Randall, DO, and Octavia Kincaid, MD, appeared with Mayo Clinic Neurologists James Dyck, MD, and Christopher Klein, MD, to discuss the latest innovations in advanced diagnosis and treatment options for neuropathy.



In the telemedicine room, NorthShore physicians collaborate in real time with Mayo Clinic counterparts to coordinate care management and treatment of a variety of complex neurological conditions.

Locations

Chicago Lake Shore Medical Office (CH)
680 North Lake Shore Drive
Suite 924
Chicago, IL 60611

NorthShore Medical Group (DF)
49 South Waukegan Road
Suite 200
Deerfield, IL 60015

Des Plaines Medical Office (DP)
9301 West Golf Road
Suite 302
Des Plaines, IL 60016

NorthShore Medical Group (DS)
909 Davis Street
Suite 160
Evanston, IL 60201

Evanston Hospital (EH)
2650 Ridge Avenue
Evanston, IL 60201

Evanston Neurological Institute (EV)
1000 Central Street
Suite 880
Evanston, IL 60201

Evanston Kellogg Cancer Center (EVK)
2650 Ridge Avenue
Evanston, IL 60201

Glenbrook Ambulatory Care Center (GB)
2180 Pfingsten Road
Suite 2000
Glenview, IL 60026

Glenbrook Eye and Vision Center (GBE)
2050 Pfingsten Road
Suite 280
Glenview, IL 60026

Gurnee Ambulatory Care Center (GR)
7900 Rollins Road
Gurnee, IL 60031

NorthShore Medical Group (GV)
2300 Lehigh Avenue
Suite 215
Glenview, IL 60026

Glenview Park Center (GVP)
2400 Chestnut Avenue
Glenview, IL 60026

Highland Park Specialty Care Center (HP)
757 Park Avenue West
Suite 2850
Highland Park, IL 60035

Highland Park Hospital (HPH)
777 Park Avenue West
Room 1260
Highland Park, IL 60035

Highland Park Kellogg Cancer Center (HPK)
777 Park Avenue West
Highland Park, IL 60035

Mount Prospect Medical Building (MP)
1329 Wolf Road
Mount Prospect, IL 60056

NorthShore Medical Group (OB)
700 Commerce Drive
Suite 500
Oak Brook, IL 60523

Skokie Ambulatory Care Center (SK)
9650 Gross Point Road
Suite 3000
Skokie, IL 60076

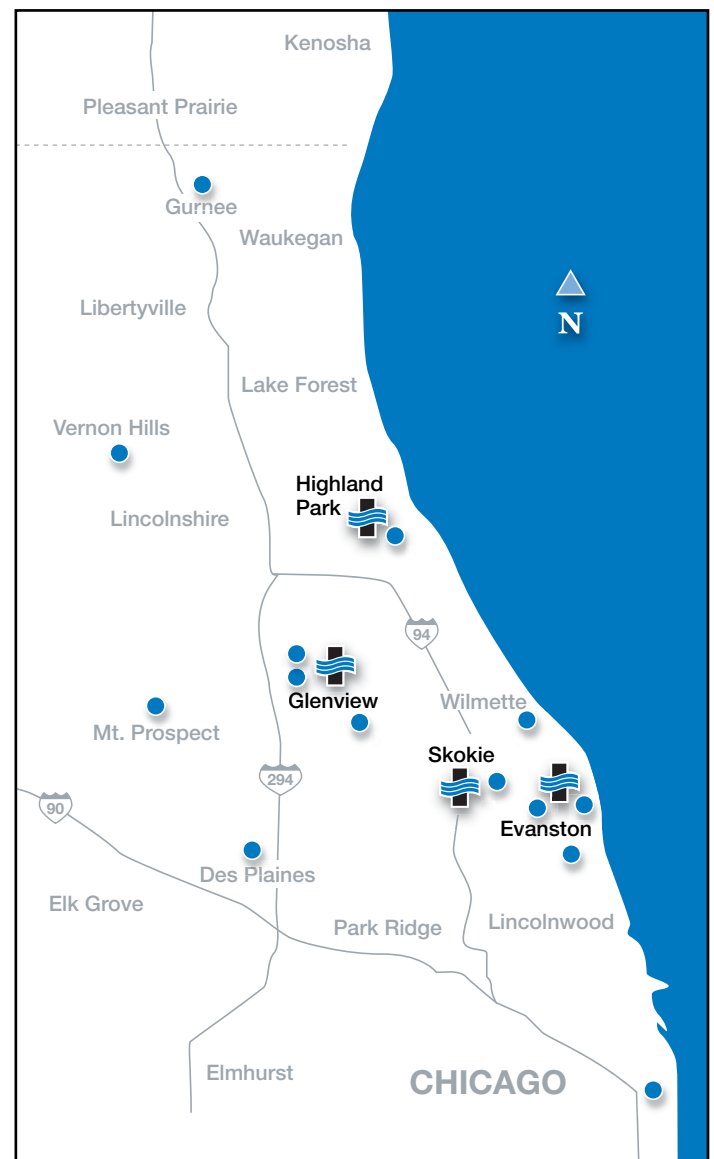
Skokie Eye and Vision Center (SKE)
9650 Gross Point Road
Suite 1900
Skokie, IL 60076

Skokie Ambulatory Care Center Spine Center (SKS)
9650 Gross Point Road
Suite 2000
Skokie, IL 60076

Skokie PM&R Pediatric Services (SKP)
9811 Woods Drive
Suite H-190
Skokie, IL 60077

Vernon Hills Specialty Suites (VH)
225 North Milwaukee Avenue
Vernon Hills, IL 60061

NorthShore Medical Group (WM)
1515 Sheridan Road
Suite 31A
Wilmette, IL 60091



Physician Directory

Neurologists

**Demetrius Maraganore, MD**

*Chairman,
Department of Neurology
Co-Director, NorthShore
Neurological Institute*

Expertise: Movement Disorders,
Brain Health

Location: GB

**Alexandru Barboi, MD**

*Director, Neuromuscular
Disorders Program*

Expertise: Autonomic Disorders;
Muscle and Nerve Disorders;
EMG/NCV Testing

Location: GB

**Fan Caprio, MD**

Expertise: Stroke
Locations: GB, HP

**James Castle, MD**

Expertise: Memory Disorders;
Concussion

Locations: HP, SK

**Janet Choi, MD**

Expertise: Epilepsy/Seizure;
EEG Testing

Locations: GB, GR, HP

**Rima Dafer, MD**

Director, Stroke Program

Expertise: Stroke
Locations: EV, GB

**Lloyd Davis, MD**

Expertise: General Neurology
Locations: DP, GB, VH

**Sofia Dobrin, MD**

Expertise: Epilepsy/Seizures;
EEG Testing

Location: HP

**Thomas Freedom, MD**

Director, Sleep Program
Expertise: Sleep Medicine;
Headaches; Migraines

Location: GB

**Dennis Groothuis, MD**

Expertise: General Neurology

Locations: EV, SKA

**Afif Hentati, MD**

Director, Multiple Sclerosis Program

Expertise: Multiple Sclerosis

Locations: EV, GB, SK

**Daniel Homer, MD**

Expertise: Stroke

Locations: EV, GB, HP, SK

**Octavia Kincaid, MD**

Expertise: Muscle and Nerve
Disorders; EMG/NCV Testing

Location: EV

**Lori Lovitz, DO**

Expertise: Sleep Medicine;
Neurophysiology

Locations: EV, SK

**Revital (Tally) Marcus, MD**

Expertise: General Neurology;
Neurophysiology; EMG/NCV Testing

Locations: GR, HP, SK

**Angela Mark, MD**

Expertise: General Neurology;
Neurophysiology; Headaches/
Migraines; EMG/NCV Testing

Location: EV

**Katerina Markopoulou,
MD, PhD**

*Director, Neurodegenerative
Disorders Program (Movement
and Memory)*

Expertise: Movement Disorders;
Deep Brain Stimulation

Locations: EV, GB, HP

**Nina Martinez, MD**

Expertise: Neuro-Oncology

Locations: EVK, EV, HP, HPK

**Ryan Merrell, MD**

Director, Neuro-Oncology Program

Expertise: Neuro-Oncology

Locations: EVK, EV, GB, GBK

**Steven Meyers, MD**

Vice Chair, Quality and Informatics

Director, General Neurology Program

Expertise: General Neurology; EMG/
NCV Testing; Headaches/Migraines

Locations: HP, SK

**Richard Munson, MD**

Expertise: Stroke; Sleep Medicine

Locations: EV, GB

**Jaishree Narayanan, MD**

*Director, Epilepsy and Central
Neurophysiology Program*

Expertise: Epilepsy/Seizure; EEG
Testing; Vagus Nerve Stimulation

Location: EV

**Archie Ong, MD**

Expertise: Stroke

Locations: GB, SK

**Smita Patel, DO**

Expertise: Sleep Medicine; Brain
Health; Integrative Medicine

Locations: GB, GVP

**Joya Paul, MD**

Expertise: Sleep Medicine

Locations: HP, SK

**Ashvini Premkumar, MD**

Vice Chair, Loyalty

Expertise: Movement Disorders

Location: GB

**John Pula, MD**

Expertise: Neuro-Ophthalmology;
Multiple Sclerosis

Locations: GB, GBE, SK, SKE

**David Randall, DO**

Vice Chair, Growth

Expertise: Muscle and Nerve
Disorders; EMG/NCV Testing

Locations: GB, HP

**Nicole Reams, MD**

Expertise: Sports Neurology;
Concussion; EMG/NCV Testing

Locations: EV, GB, GVP

Neurologists *(continued)*



Mark Rubin, MD

Expertise: Stroke;
Neurohospitalist
Locations: GB, HP, SK



Susan Rubin, MD

Vice Chair, Education
Expertise: Multiple Sclerosis;
Women's Neurology;
Headaches; Epilepsy/Seizures
Locations: GB, HP



Bernadette Schoneburg, MD

Expertise: Movement Disorders
Locations: GB, SK



Irene Semenov, DO

Expertise: Headaches; EMG/
NCV Testing; General
Neurology; Neurophysiology
Locations: GB, HP, SK



Tiffani Stroup, DO

Expertise: Multiple Sclerosis;
General Neurology
Locations: GR, HP, SK



Jesse Taber, MD

Expertise: General
Neurology; Dizziness;
EEG Testing; Neurophysiology
Locations: EV, SK



Mari Viola-Saltzman, DO

Expertise: Sleep Medicine
Location: GB



Charles Wang, MD

Expertise: Neurophysiology;
General Neurology; EMG/NCV
Testing; Concussion
Location: SK



Chad Yucus, MD

Expertise: Memory Disorders;
Brain Health
Location: GB

Neurosurgeons



Julian Bailes, MD

*Chairman, Department of
Neurosurgery*
*Co-Director, NorthShore
Neurological Institute*
Expertise: Brain Disorders; Aneurysm;
Spinal Disorders; Epilepsy Surgery;
General Neurosurgery
Locations: EV, HP



Leonard Cerullo, MD

Expertise: General Neurosurgery;
Brain Tumors
Locations: CH, SK, VH



Shakeel Chowdhry, MD

Expertise: Surgery for Aneurysms;
Endovascular Treatment for
Aneurysms; Arteriovenous
Malformations (AVMs); Interventional
Stroke Therapy; Brain Tumors;
Pituitary Tumors; Spinal Tumors
Locations: EV, GB



Edward Mkrdichian, MD

Expertise: General Neurosurgery;
Primary and Metastatic Brain
Tumors: Gliomas/Meningiomas;
Spinal Cord Tumors
Locations: GB, SK



Michael Musacchio, MD

Expertise: Neurosurgery; Complex
Spine Reconstruction, Joint
Replacement of the Spine, Minimally
Invasive Spine Surgery, Spine
Surgery
Locations: GB, GR, SKS



Noam Stadlan, MD

Vice Chair, Quality and Informatics
Expertise: Minimally Invasive Spine
Surgery; Complex Spine Surgery and
Reconstruction
Locations: HP, SKS



Ricky Wong, MD

Expertise: Deep Brain and Vagal
Nerve Stimulators; Brain and Skull
Base Tumors; Pituitary Tumor;
Cerebral Aneurysms; Arterio-Venous
Malformation (AVM); Trigeminal
Neuralgia
Locations: EV, GB

Physiatrists



Joseph Alleva, MD

*Division Head, Physical Medicine
and Rehabilitation, Department
of Medicine*
Expertise: Acute and Chronic
Spine Pain and EMG
Locations: EV, GB



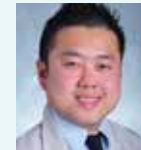
Khalida Anwar, MD

Expertise: Physical Medicine and
Rehabilitation; Narcotic Medication
Pain Program; Chronic Pain
Management
Locations: GB, HP, VH



Catherine Choi, MD

*Medical Director, Chronic Pain
Services*
Expertise: Physical Medicine and
Rehabilitation; Narcotic Medication
Pain Program; Chronic Pain
Management
Location: GB



Matthew Co, DO

Expertise: Physical Medicine and
Rehabilitation
Locations: CH, SK



Kristina Drabkin, DO

Expertise: Carpal Tunnel (CTS);
Diabetic Neuropathy; Peripheral
Neuropathy; Quadriplegia;
Rehabilitation of Neurological
Conditions; Amputation
Location: EV



Miledones Eliades, MD

Expertise: Physical Medicine and
Rehabilitation; Stroke Rehabilitation
Locations: EV, GB



Joseph Feldman, MD

Expertise: Physical Medicine
and Rehabilitation; Lymphedema;
EMG Testing
Locations: EV, GVP, HP



Thomas Hudgins, MD

Expertise: Orthopaedic and Spine
Injury Management for Athletes (All
Ages and Levels)
Locations: GB, HP, SK



Daniel Hurley, MD

Expertise: Nonsurgical Treatment
of Neurological and Neuromuscular
Conditions; Cervicogenic
Headaches
Locations: CH, SK

continued >>

Physiatrists (continued)



Rachel Kermen, MD

Expertise: Parkinson's Disease; Stroke; Multiple Sclerosis; Chronic Pain; Recurrent Falling; General Debility; Spasticity

Locations: GB, GR



Danielle Schiff, MD

Expertise: Physical Medicine and Rehabilitation; Lymphedema

Locations: EV, GVP, HP



Naila Shaikh, MD

Expertise: Physical Medicine and Rehabilitation; Women's Health Issues; Cancer Rehabilitation

Location: EV

Pediatric Neurologists



Kent Kelley, MD

Division Head, Pediatric Neurology, Department of Pediatrics

Expertise: Pediatric Neurology; Epilepsy; Neurophysiology

Locations: EV, GB, HP



Susan Fielkow, MD

Expertise: Attention Deficit Hyperactivity Disorder (ADHD); Autism Spectrum Disorders; Autism; Developmental Delays; Developmental-Behavioral Disorders; Evaluations/Testing

Locations: EV, SKP



Leslie Finkel, MD

Expertise: Pediatric Neurology; Epilepsy; Motor Developmental Delay; Headaches

Locations: EV, HP, SKP



Margaret Michelson, MD

Expertise: Pediatric Neurology; Epilepsy; Motor Developmental Delay; Headaches

Locations: EV, GB

Neuropathologist



John Lee, MD, PhD

Director, Residency Program, Department of Pathology

Expertise: Neuropathology; Pathology

Location: EH

Neuropsychologists



Jerry Sweet, PhD

Vice Chair, Department of Psychiatry & Behavioral Sciences

Expertise: Concussion; Dementias; Memory Disorders; Traumatic Brain Injury

Location: DS



Elizabeth Geary, PhD

Expertise: Dementia; Epilepsy; Movement Disorder; Multiple Sclerosis (MS); Traumatic Brain Injury

Locations: DS, GB



Leslie Guidotti Breting, PhD

Expertise: Alzheimer's Disease; Attention Deficit Hyperactivity Disorder (ADHD); Concussion; Dementia; Epilepsy/Seizure Disorder; Learning Functioning; Memory Disorders; Neurological Disorders

Location: DS



Elizabeth Heideman, PhD

Expertise: Anxiety; Attention Deficit Hyperactivity Disorder (ADHD); Concussion; Depression; Learning Functioning; Neurological Disorders; Pediatric Epilepsy; Pediatric Genetic Disorders

Locations: DS, GV



Marietta Hoogs, PhD

Expertise: Alzheimer's Disease; Attention Deficit Hyperactivity Disorder (ADHD); Dementias; Neurological Disorders; Learning Functioning

Locations: GB, DF



Elizabeth Pieroth, PsyD

Expertise: Concussions; Sports Concussion; Traumatic Brain Injury

Locations: GB, GVP, OB



Alona Ramati, PhD

Expertise: Alzheimer's Disease; Attention Deficit Hyperactivity Disorder (ADHD); Concussion; Dementias; Epilepsy/Seizure Disorder; Learning Disorders; Learning Functioning; Memory Disorders; Movement Disorders; Multiple Sclerosis (MS); Parkinson's Disease (PD); Stroke, Traumatic Brain Injury

Location: GB



Victoria Tuchscherer, PhD

Expertise: Autism Spectrum Disorder; Attention Deficit Hyperactivity Disorder (ADHD); Learning Deficits; Traumatic Brain Injury; Anxiety/Depression; Pediatric Epilepsy; Hydrocephalus; Pediatric Genetic Disorders

Location: GB

Neuroradiologists



Matthew Walker, MD

Head, Division of Neuroradiology, Department of Radiology

Expertise: Neuroradiology

Location: EH



William Ankenbrandt, MD

Expertise: Neuroradiology; Interventional Radiology

Location: EH



Anne Doppenberg, MD

Expertise: Neuroradiology

Locations: EH, HPH



Kenneth Goldberg, MD

Expertise: Neuroradiology

Location: EH



Michael Gorey, MD

Expertise: Neuroradiology

Location: EH



Joel Meyer, MD

Expertise: Neuroradiology

Location: EH



Kristina Olsen, MD

Expertise: Neuroradiology

Location: EH



Bojan Petrovic, MD

Expertise: Neuroradiology

Location: EH



Jordan Prager, MD

Expertise: Neuroradiology

Location: EH



Doris Yip, MD

Expertise: Neuroradiology

Location: EH

NorthShore Neurological Institute provides nationally recognized expertise and comprehensive programs for patients and their families.

We offer superior access, advanced technology and outstanding care coordination to treat a variety of neurological diseases and conditions.

We welcome the opportunity to partner with health professionals interested in referring patients for treatment.

Please call **(877) 570-7020** for more information or to schedule an appointment.

 **NorthShore**
University HealthSystem
Neurological Institute

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Evanston, Illinois 60201

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NorthShore Neurological Institute offers patients and their families superior access, proven expertise, advanced technology and outstanding care coordination to treat a variety of neurological diseases and conditions.

NorthShore's multidisciplinary team of neurospecialists—neurologists, neurosurgeons, physiatrists and others—provide personalized, patient-centered care that uniquely draws upon the strength of our extensive experience and collaborative environment. Learn more about our capabilities at northshore.org/neuro.