



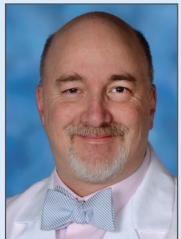
Outcomes 2019

Inova Neuroscience and Spine Institute



“The neurosurgery division is united in a common goal: to provide the best care for our patients. They often come to us feeling anxious, and the first part of our job is to reassure them. No matter how complicated or difficult the challenge, we can offer our patients everything they need to have world-class care and state-of-the-art treatment. Whatever the problem, we can treat it and move forward. The best part of our job is the satisfaction we see on the faces of patients and families when we have been able to reassure and help them, improve their health and well-being, and frequently save lives.”

Nilesh Vyas, MD
Associate Chair, Neurosurgery
Inova Neuroscience and Spine Institute



“At the Inova Neuroscience and Spine Institute, we pride ourselves on our interaction with patients – hearing their stories, answering their questions and doing our utmost to ensure we meet all aspects of their medical needs. We work in partnership with patients to determine the problem and how best to treat it. This level of cooperation sets our program apart and places the patient squarely at the center of all we do.”

Dan Larriviere, MD, JD, FAAN
Associate Chair, Neurology
Inova Neuroscience and Spine Institute



“Pediatric patients have some very special requirements, and the Inova Neuroscience and Spine Institute provides a needed service for them. We create a relationship that goes far beyond our ability to remove a tumor or correct a craniofacial abnormality. When children and their parents know we care about them, it strengthens the bond and enhances the quality of care we provide. It's a privilege to take care of these kids. That's why we're here.”

Leon E. Moores, MD, DSc
Associate Chair, Pediatric Neurosurgery
Inova Neuroscience and Spine Institute
President, Inova Physician Enterprise

Welcome

Dear Colleagues and Friends:



It is my pleasure to present the 2019 Inova Neuroscience and Spine Institute (INSI) Outcomes Report. We are aligned in our purpose to improve the lives of neuroscience patients by inspiring hope and delivering seamless, integrated care of the highest quality to those we serve.

We are a regional leader in the diagnosis, treatment and research of complex neurological conditions involving the brain, spine and nervous system. We offer therapeutic, rehabilitative and surgical

services across the continuum of patient care. Today, we have providers and services in more than 25 specialties, 14 of which are featured in this report. Our region's residents, including those in remote areas can access care close to home, eliminating the need for costly or stressful travel because we continue to expand access to care across our region.

We continue to maintain a culture of patient safety and thorough assessment of quality and safety measures as we expand access more consistently across the five hospitals in our system. This includes Inova Alexandria Hospital, Inova Fairfax Hospital, Inova Fair Oaks Hospital, Inova Loudoun Hospital and Inova Mount Vernon Hospital, and 17 rehabilitation clinics. Overall, we have surpassed our system-wide goals on clinical measures of success. In tandem, we have exceptional online reviews of our providers and excellent patient experience scores.

Patients come to us from nearly all 50 states and many countries. New innovations and approaches at INSI have helped our most severely challenged patients regain function and ability they never dreamed possible. We work as a team to tackle the most debilitating and complex cases, including brain diseases and disabling spine and peripheral nerve conditions. Our specialists work together to develop a personalized plan of care for patients to treat their condition and improve their quality of life.

Our INSI specialists offer minimally invasive surgery, intraoperative CT, complex spine surgery, computer-assisted brain surgery, stereotactic radiosurgery, awake brain surgery, laser interstitial thermal therapy and deep brain stimulation surgery. We maintain a level 1 trauma center with readiness day or night. In addition, our telemedicine capabilities allow us to meet with patients who live in remote areas of our region.

We are dedicated to comprehensive care in neurological and spine disease and injury. We continue to strengthen our academic and research partnerships to accelerate therapies that save and improve lives. We have partnered with University of Texas at Dallas on the development of a Brain Health Program. Additionally, our newly established neurosurgery residency program will educate the leaders of tomorrow. This concentration of expertise, research and technological innovations and techniques at INSI allows us to attract some of our field's top medical talent.

As you will find in this report, we are committed to quality care and ongoing innovation. These are possible thanks to the dedication and hard work of our INSI medical, nursing and professional staff at each of our five Inova hospitals and our clinics. It is my privilege to work with an exceptional group of people who feel honored to care for every patient who comes through our doors.

We are proud of our growth and contributions to the field of neuroscience and to the health of our patients. We continue to challenge ourselves to achieve the highest quality and safety measures to ensure the best outcomes for our patients today and generations to come.

Sincerely,

James Ecklund, MD

James Ecklund, MD, FACS

President, Inova Neuroscience and Spine Institute

"Our vision is to be a premier and innovative destination for neuroscience patient care, education, and clinical trials and outcomes research."

Preface

The rapid pace of developments in neuroscience, bolstered by modern imaging techniques is astounding. So too are the diagnosis and care of many distinct neurological diseases. The velocity of development in neuroscience has been recognized by United States presidents. In 1990, President George H.W. Bush declared the last decade of the 20th century the “Decade of the Brain.” Next, in 2013, President Barack Obama announced the Brain Research through Advancing Innovative Neurotechnologies® (BRAIN) Initiative with the National Institutes of Health.

Likewise, the Inova Neuroscience and Spine Institute (INSI) is advancing the field of neuroscience with a multifaceted model of clinical care, research and teaching. INSI brings together board-certified neurological specialists, neurosurgeons, interventional neuroradiologists, neuropathologists, orthopedic spine surgeons, neuroscience nurses, anesthesiologists, musculoskeletal radiologists, neuropsychiatrists, neuropsychologists, therapists, rehabilitation specialists, and scientific researchers. The majority of the Medical Directors of our specialty programs have advanced education and training in more than 25 neurological specialty areas. All of these individuals are experts in their respective neurological subspecialty, focusing on exceptional clinical care to optimize patient outcomes and advance the field of medicine. Their expertise is recognized in the volume of patient visits in our INSI programs, which are comparable to nationally recognized health systems.*

The care we provide reaches patients from nearly all 50 states in the nation (44 in 2019*) and a diverse global population. Our patients come to us for our expertise in patient care, therapies, technologies, rehabilitation and surgery. We also offer and host patient community support groups, knowing care can be enhanced with added support for patients and their families. We maintain a steady focus on continuous improvement in patient care, safety and satisfaction, as well as in achievement of strong quality metrics.

*Source: HPM hospital-based volumes, 12/2018-11/2019.



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Inova's Mission

The mission of Inova is to provide world-class healthcare – every time, every touch – to each person in every community we have the privilege to serve.

Purpose of the Inova Neuroscience and Spine Institute

To improve the lives of neuroscience patients by inspiring hope and delivering seamless, integrated care of the highest quality across all neurological subspecialties and simultaneously enhancing education and research.

Inova Neuroscience and Spine Institute (INSI)

Who We Are



5

Hospitals



25+

Specialty Programs



500+

Professional Staff

5

Neurosurgery
Outpatient Office
Locations

2

Acute Care
Neurorehabilitation
Facilities

4

Neurology
Office Locations



12

Dedicated Epilepsy
Monitoring Beds



3

Sleep Labs



100

Dedicated
Neuroscience Beds



19

Imaging and
Diagnostic Locations



\$1.3M

Clinical Trials
and Research

1

Fully Accredited
Neurosurgery
Residency Program



\$1.95M

Gifts Pledges and Donations

What We Do



75,000

Patient Visits*



7,900

Inpatient Admissions**



3,750+

Neurosurgical and
Spine Procedures**



3,100+

Sleep Lab Studies**



50+

Deep Brain Stimulation (DBS)
Procedures



44+

Locations Where Patients Originated
for Treatment (from nearly 50 states
and multiple countries) ***

*Source: Inova Medical Group Visit Data, 11/2018-12/2019

** Source: HPM hospital-based volumes,, 11/2018-12/2019

***Source: HPM hospital-based volumes, 12/2018-11/2019

Comprehensive Care

INSI has over 25 specialty neurological programs and/or centers led by physicians with advanced training:

Neurology-Based Programs

- Inova Neurology Practice
- Brain Health Program
- Epilepsy Center
- Headache Program
- Memory Program
- Parkinson's and Movement Disorders Center
- Multiple Sclerosis and Neuroimmunology Center
- Neurotrauma and Neurocritical Care Program
- Neuromuscular Program
- Neuro-Ophthalmology Program
- Sleep Disorders Program
- Stroke and Cerebrovascular Disease Program

- Pediatric Neuro ICU Program
- Pediatric Pain/Pain Psychology Program
- Pediatric Parkinson's and Movement Disorders Program
- Pediatric Spine Program
- Pediatric Tumor Program
- Pediatric Transcranial Magnetic Stimulation (TMS)
- Spina Bifida, Pediatric Spasticity Program

Neurosurgery-Based Programs

- Inova Neurosurgery Practice
- Brain and Spine Tumor Program
 - Pituitary and Skull Base Tumor Program
- Brain Injury and Concussion Program
- Functional Surgery Program
- Neurocritical Care Program
- Neuroimaging Program
- Neurotrauma Program
- Pain Management Program
- Peripheral Nerve Program
- Spine Program

Rehabilitation Program

Research Center

- INSI Center for Neuroscience Innovation
- INSI Core Clinical Research Program
- INSI Core Translational Research Program
- Inova-George Mason University Biomedical Research Internship
- Inova-George Mason University Neuroscience Research Fellowship
- Rotating Research Personnel – Master's and Postdoctoral Researchers

Education and Continuing Medical Education

- Continuing Medical Education (CME) Courses and Activities
- INSI Future ICU Fellowship Program
- INSI Future Neurology Residency Program
- INSI International Fellowship/Observership Program
- INSI Tuesday Academic Activities
- International Neuroradiology and Neuropathology Course
- Neurosurgery Residency Program
- Rotating Residents/Residency Program
- Virginia Commonwealth University Medical Student Partnership

Pediatric Neurosciences-Based Programs

- Biofeedback Clinic
- Craniofacial Program
- Fetal Care Program
- Infusion Center
- Ketogenic Clinic
- Neurogenetics Program
- Pediatric Concussion/Headache Program
- Pediatric Epilepsy Program

In 2018, more patients were admitted to Inova for neurological conditions than to any other health system in the Washington, DC metro region.*

*Source: 2018 Fiscal year data from Intellimед (Intellimед is an aggregator of hospital submitted inpatient volume. The 2019 data remains pending.)

INSI Hospital-Based Services



Inova Fairfax Hospital

3300 Gallows Rd.
Falls Church, VA 22042

Inova Fairfax Medical Campus (IFMC) is Inova Health System's flagship location and includes

Inova Fairfax Hospital (IFH), a 945-bed tertiary care hospital. It is home to INSI, a collaborative, multidisciplinary healthcare model that serves as the coordinating hub for the Inova Health System across all five hospitals and outpatient offices and locations. IFH offers neurology, neurosurgery, a neuro ICU, neuroradiology, neuropathology, an epilepsy EMU, a certified stroke center, spine care, and rehabilitation and therapeutic services.

Centers for Medicare and Medicaid Services

5-star Rated Hospital (highest level of performance)

The Leapfrog Group

Straight A's in Hospital Safety

Top Teaching Hospital two years running

U.S. News & World Report

Ranked as a High Performing Hospital

#1 in DC Metropolitan region

#3 in Virginia

National Association of Epilepsy Centers

Level 4 Epilepsy Center, highest designation from the NAEC (naec-epilepsy.org)

American Board of Registered Electroencephalographic and Evoked Potential Technologists

Accredited EEG laboratory

American Heart Association/American Stroke Association

Get With the Guidelines® - Stroke: Gold Plus; Target: Stroke Honor Roll Elite Plus

2019 Quality Achievement Award – Silver – Mission Lifeline® NSTEMI

2019 Quality Achievement Award – Silver – Mission Lifeline® STEMI Receiving Center

The Joint Commission

Inova Neurodiagnostic and Sleep Assessment Center Certification (satellite clinic)

Primary Stroke Certification

Inova Alexandria Hospital

4320 Seminary Rd.

Alexandria, VA 22304



Inova Alexandria Hospital (IAH) is a 318-bed acute care hospital with neurologists and neurosurgeons on staff. INSI capabilities available

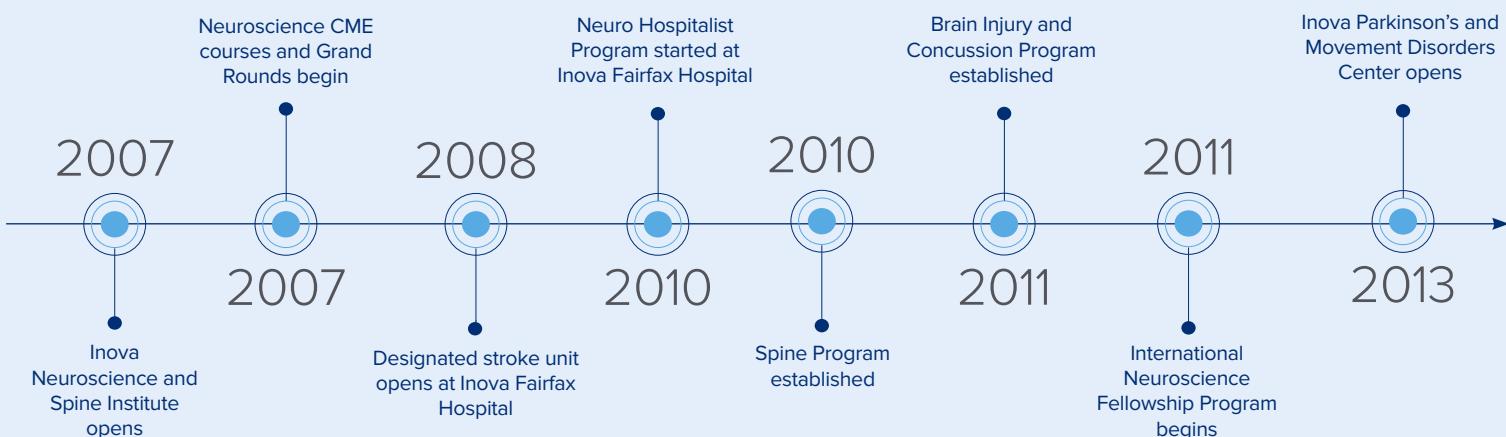
at IAH include EEG/EMG, interventional neuroradiology, pain management, sleep studies, spine care, spine surgery, craniotomy and stroke care services. There is also a neurovascular care unit and sleep lab.

The Leapfrog Group

Straight A's in Hospital Safety

Top General Hospital two years running

INSI Growth Over the Decades



U.S. News & World Report

Ranked as a High Performing Hospital

#5 in DC Metropolitan region

#8 in Virginia

American Heart Association /American Stroke Association

Get With the Guidelines® - Stroke: Gold Plus; Target: Stroke Honor Roll Elite

2019 Mission: Lifeline® Gold Plus STEMI Receiving Center Quality Achievement Award

2019 Mission: Lifeline® Silver NSTEMI Quality Achievement Award

The Joint Commission

Inova Neurodiagnostic and Sleep Assessment Center Certification (satellite clinic)

Thrombectomy-Capable Stroke Certification (4th hospital in the U.S. to be designated)

American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR)

Cardiac and Pulmonary Rehabilitation Program Certification

National Association of Epilepsy Centers

Level 3 Epilepsy Center, the second highest designation from the NAEC (naec-epilepsy.org)

American Nurses Credentialing Center (ANCC) Pathway to Excellence®

Recognized since 2018 for creating a positive nursing practice environment that empowers and engages staff.

**Inova Fair Oaks Hospital**

3600 Joseph Siewick Dr.

Fairfax, VA 22033

Inova Fair Oaks Hospital (IFOH) is a 182-bed acute care hospital serving the rapidly growing

suburbs of Northern Virginia. INSI capabilities available at IFOH include EEG/EMG, neurology, neurosurgery, pain management, sleep studies and spine and stroke services.

Centers for Medicare and Medicaid Services (CMS)

5-star Rated Hospital (highest level of performance)

The Leapfrog Group

Straight A's in Hospital Safety (2019 – 2016)

U.S. News & World Report

Best Hospital, #8 in DC Metropolitan region, and #11 in Virginia

American Nurse Credentialing Center's (ANCC) Magnet Recognition Program®

Magnet™ organization - one of the highest levels of recognition for excellence in nursing services.

Magnet Designation

Achieved Magnet designation for third consecutive year

American Heart Association/American Stroke Association

Get With the Guidelines® - Stroke: Gold Plus; Target: Stroke Honor Roll Elite Plus

The Joint Commission

Inova Neurodiagnostic and Sleep Assessment Center Certification (satellite clinic)

Primary Stroke Certification

Certified Spine Center of Excellence

Received NAEC Level 4
Epilepsy Center designation
at Inova Fairfax Hospital

New six-bed neuroscience
step-down unit open
at Inova Fairfax Hospital

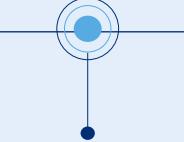
Use of Synaptive surgical and
robotic equipment

2014



2014

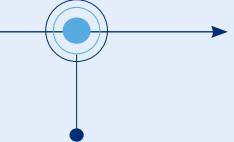
2014



2016

2016

2016



During on site Joint Commission survey, "INSI recognized with the best door-to-needle time of 8 minutes 56 seconds for acute stroke thrombolysis in the country at Inova Alexandria Hospital

Intraoperative CT
capability added

First MRI-guided
neurosurgery for DBS
implant surgery conducted

Accreditation for
Neurosurgery Residency
Program from the
Accreditation Council for
Medical Education (ACGME)

INSI Hospital-Based Services *(continued)*



Inova Loudoun Hospital

44045 Riverside Pkwy.

Leesburg, VA 20176

Inova Loudoun Hospital (ILH) is a nationally recognized, advanced acute care hospital located in Loudoun County

– the fastest-growing county in Virginia. Current clinical capabilities in neuroscience include: neurology, neurosurgery, outpatient neurological rehabilitation, EEG/EMG, concussion, dementia and memory disorders, spine and stroke programs. Inova Loudoun Hospital is a level 3 trauma center, Loudoun County's first and only trauma center.

ILH is currently expanding its facilities and services to meet the community's ever-growing needs. Highlights of the hospital's Master Plan expansion include an expanded emergency department on the Lansdowne campus, the addition of the Inova HealthPlex – Ashburn, the expansion of a surgical center, treatment of heart disease in the Inova Heart and Vascular Institute – Schaufeld Family Heart Center and the addition of a new Patient Tower opened in April 2020.

Centers for Medicare and Medicaid Services

5-star Rated Hospital (highest level of performance)

The Leapfrog Group

Straight A's in Hospital Safety (2019-2012)

The Joint Commission

Certified Spine Center of Excellence

Primary Stroke Certification (Lansdowne)

Acute Stroke-Ready Certification (Inova Emergency Room – Cornwall and Inova Emergency Room – Ashburn)

American Nurse Credentialing Center's (ANCC) Magnet Recognition Program®

Magnet™ organization - one of the highest levels of recognition for excellence in nursing

Magnet Designation

Achieved Magnet designation for fourth consecutive year

American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR)

Cardiac and Pulmonary Rehabilitation Program Certification

American Heart Association /American Stroke Association

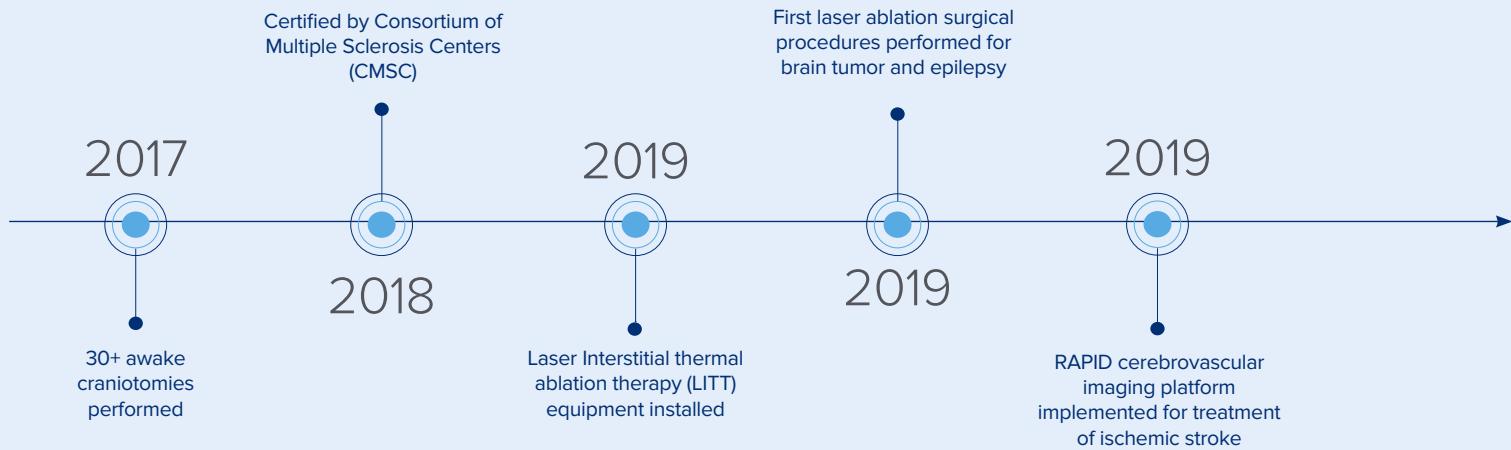
Get With the Guidelines® - Stroke: Gold Plus; Target: Stroke Honor Roll Elite

2019 Mission: Lifeline® Silver STEMI Receiving Center Quality Achievement Award

2019 Mission: Lifeline® Bronze NSTEMI Quality Achievement Award

47 Certified Nurses (certified Neuroscience Register Nurse & Stroke Certified Registered Nurse) SCRN & CNRN across the Inova health system.

INSI Growth Over the Decades *(continued)*





Inova Mount Vernon Hospital

2501 Parkers Ln.
Alexandria, VA 22306

Inova Mount Vernon Hospital (IMVH) is a 237-bed acute care hospital offering patients

convenience and state-of-the-art care in a unique healing environment. It is home to the nationally recognized Inova Rehabilitation Center. Clinical capabilities include a 67-bed inpatient rehabilitation program, neurological rehabilitation program, brain injury program, concussion program, EEG/EMG, outpatient neurological rehabilitation and a Bridge Program, and spine and stroke services.

The Bridge Program is an integrated program at Inova Mount Vernon Hospital which offers day treatment for those recovering from acquired brain injury. Treatment provides a structured setting for renegotiating independence and community living skills following a life-changing neurological incident. Our professionals designed this unique program to “bridge” the gap between hospitalization and the multiple services and agencies available within the community. The program combines group and individual therapies, with group therapy being the primary way clients work on their life-management skills.

Centers for Medicare and Medicaid Services

5-star Rated Hospital (Highest Level of Performance)

The Leapfrog Group

Straight A's in Hospital Safety (2019-2016)

The Joint Commission

Inova Rehabilitation Center – Gold Seal of Approval – Primary Stroke Certification

Inova Rehabilitation Center – Gold Seal of Approval – Stroke Rehabilitation

Primary Stroke Certification

American Heart Association/American Stroke Association

Get With the Guidelines® - Stroke: Gold Plus; Target: Stroke Honor Roll Elite Plus

Nurses Improving Care for Healthsystem Elders (NICHE)

IMVH is a designated NICHE hospital demonstrating better care and outcomes for older adult patients.

(Note: Founded in 1992, NICHE is a program of the Hartford Institute for Geriatric Nursing at New York University College of Nursing, that works to achieve systematic nursing change to benefit hospitalized older patients and has evolved into a national geriatric nursing program comprising over 620 hospitals in more than 40 states and parts of Canada.)

American College of Radiology (ACR) accreditation

Breast MRI, CT, mammography, MRI, nuclear medicine and PET, and ultrasound

+14,000

The INSI serves more than 14,000 adult and pediatric patients annually.

Source: HPM hospital-based volumes,
12/2018 - 11/2019.

Brain Health partnership
launched with the
University of Dallas



As we build upon our past progress and plan for the future, we continue to expand access to care in our region and strive to offer the latest technologies, education offerings and research with our vision of excellence in patient care.

INSI Neurological Services Across by Hospital Site

The Inova Health System covers a large geographical footprint in Northern Virginia as does INSI which operates across the full health system so that we can make our resources available closer to community members by their work or home. For a review of our major services by hospital location, noting we continue to seek to expand, please refer to the chart below:

Services	Inova Fairfax Medical Campus	Inova Alexandria Hospital	Inova Fair Oaks Medical Campus	Inova Loudoun Hospital	Inova Mount Vernon Hospital
Acute Inpatient Rehabilitation and Therapeutic Services	✓				✓
Concussion	✓	✓	✓	✓	✓
Dedicated Neuro ICU	✓	✓			
Dedicated Stroke and Cerebrovascular Beds	✓	✓			
Diagnostic Neuroradiology	✓	✓	✓	✓	✓
EEG	✓	✓	✓	✓	✓
Epilepsy Center/Monitoring Unit	✓	✓			
Functional MRI	✓				
Headache	✓	✓	✓	✓	✓
Neuro-Hospitalist Team	✓				
Interventional Neuroradiology	✓	✓			
Level 1 Trauma Center	✓				
Level 3 Trauma Center				✓	
Magnet® Hospital			✓	✓	
Neurology Physician on Staff	✓	✓	✓	✓	✓
Neuro-oncology/Brain and Spine Tumor Surgery	✓	✓			
Neuropathology	✓				
Neuroscience Unit/Step Down	✓				
Neurosurgery Specialist on Staff	✓	✓		✓	
Neurosurgery Physician on Staff	✓	✓	✓	✓	✓
Neurotrauma	✓				
Outpatient Neurodiagnostic Services	✓	✓	✓	✓	✓
Outpatient Rehabilitation	✓	✓	✓	✓	✓
Pain Management	✓	✓	✓		✓
Pediatric Anesthesia for Neuroimaging	✓			✓	
Pediatric Epilepsy Monitoring	✓				
Pediatric Intensive Care Unit	✓				
Pediatric Neurology	✓				
Pediatric Neurosurgery	✓				
Sleep Lab	✓	✓	✓		
Spine Program	✓	✓	✓	✓	✓
Stereotactic Radiosurgery	✓	✓			
Stroke Center Certification	✓	✓	✓	✓	✓
Transcranial Doppler	✓	✓			

Patient Experience, Outcomes and Safety

Each Inova hospital – Inova Alexandria, Inova Fairfax, Inova Fair Oaks, Inova Loudoun and Inova Mount Vernon – is deeply committed to providing the highest quality and safest care possible for our patients. Our leadership, physicians and staff have established benchmarks and goals to meet or surpass the standards set by industry leaders. We want to ensure each patient's experience and our outcomes are the best they can be.



Chapy Venkatsan, MD, MS, FACP
Chief Quality and Safety Officer
Inova Health System

Quality and World-Class Neuroscience Institute

Defining a world-class neuroscience institute requires continuous learning, training, measuring and improving. It also includes daily efforts focusing on organizational culture, measurement and continuous improvement to achieve superior quality and safety outcomes. This includes:

- Seeing quality as strategic and evolving
- Working collaboratively with Inova's Quality Department
- Certifying subspecialty programs within INSI
- Investing in the latest technologies and surgical care
- Conducting research and contributing to science and medicine for improved outcomes
- Offering comprehensive training and education to team members and community clinicians
- Establishing and measuring visible metrics on performance and outcomes
- Measuring our performance through our patients' eyes and outcomes
- Ensuring our monitoring process is qualitative and quantitative, data driven and benchmarked internally and externally
- Reporting regularly, both across the organization and to the public

"As a system, we are striving to meet our mission to provide world-class healthcare – every time, every touch. In order to become a leading health system, we will continue to work towards being a highly reliable system by embodying our values in all that we do."

HCAHPS Domains of Care

From 2018 to 2019, our neurology and neurosurgery teams **improved patient experience scores in 9 out of 10 HCAHPS domains** with an average increase of 3 points.

In 2019, our neurosurgery team **HCAHPS scores placed us above the national average top box score in all domains** while averaging 6 points above national median scores.

*Top box score: The percentage of people who answered the MOST POSITIVE option
Benchmarking period: 10/1/2019 to 12/31/2019.*

+3

Average point increase

+6

Points above national median scores

Patient Experience, Outcomes and Safety (continued)

Patient Experience

We use the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey to measure patients' perspectives of their hospital care at Inova. This standardized gauge allows us to compare our performance with that of other hospitals.

Outcomes

INSI embraces continuous monitoring of quality outcomes such as complication rates, length of stay, mortality and readmissions. We use internal and external data to provide comparisons and benchmark our results against those of more than 700 hospitals nationwide that are part Premier.

- From 2016 to 2019, system-wide neurology length of stay, mortality and readmissions consistently outperformed the average Premier client hospital.
- From 2016 to 2019, system-wide neurosurgery mortality and readmissions consistently outperformed the average Premier client hospital.

Patient-Reported Outcomes (PROs)

Patient-reported outcomes, or PROs, assess a patient's health, quality of life, behavior or functional status. Patients submit this information directly, without interpretation by a clinician. Inova uses PROs in our outpatient clinic settings. In 2018, we introduced electronic tablets to automate collection of this data, utilizing REDCap® technology.

Patient Safety

All five Inova hospitals were awarded a grade of "A" for hospital safety in the fall rankings, 2019 by The Leapfrog Group.

Leapfrog recognized Inova's achievements in protecting patients from harm and providing safer healthcare. The Leapfrog Group is a national organization that aims to improve healthcare quality and safety for consumers and purchasers. Leapfrog uses 28 measures of publicly available hospital safety data to assign grades to approximately 2,600 U.S. hospitals twice a year. It is peer reviewed, fully transparent and free to the public.

As an organization, we perform exceedingly well with all standardized infection ratios well below the O/E ratio of 1.0. Our exceptional performance on all hospital-associated infections drives our success in external ranking programs.

From 2018 to 2019, we experienced more than a 40% reduction in our central line-associated blood system infections (CLABSI), system-wide, which was over 50% fewer than expected, based on patient acuity.

From 2018 to 2019, we had a 10% reduction in system-wide catheter-associated urinary tract infections (CAUTIs) with more than 30% fewer than expected.

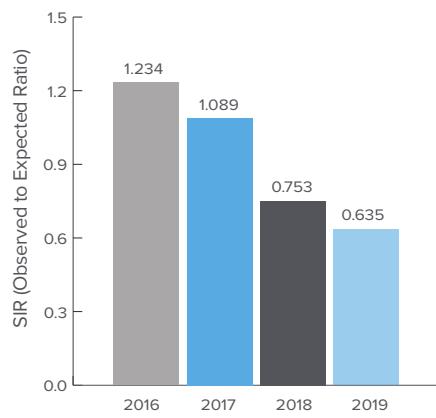
C. diff rates in 2019 continued to hold steady at an estimated 60% fewer than expected.

Techniques in Advancing Patient Care Across the Continuum

Our Patient and Care Partnership Through Teamwork

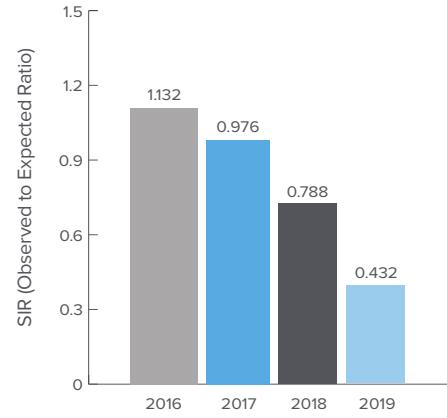
Inova follows the best possible processes to provide safe, high quality and efficient inpatient care. This is how we do it.

Catheter-Associated UTIs



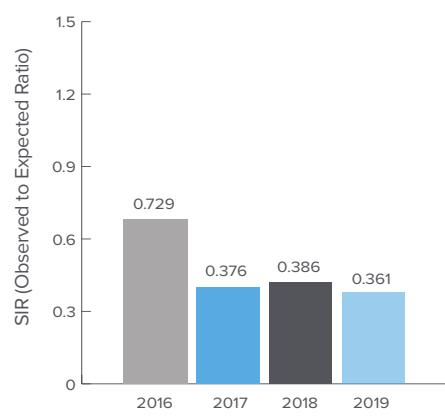
Source: Inova Health System

Central Line-Associated Bloodstream Infections



Source: Inova Health System

C.difficile Infections



Source: Inova Health System

A score of less than 1.0 indicates INSI performance is better than expected based on patient medical condition and risk profile. Readmission data are presented as a ratio of a hospital's observed readmission rate to its expected readmission rate (often called the observed-to-expected, or o/e, ratio).

Excellence in Nursing

The Inova care delivery model calls for physicians, nurses and clinical technicians to function as a team and engage in specific practices that promote and sustain partnerships with patients and their families. The following opportunities for developing nursing excellence through growth include, but are not limited to, professional development council, ADVANCE clinical ladder, Magnet® designation, continuous education (CE) offerings and annual skills fairs.



Multidisciplinary Team Rounds

The healing process is a partnership between the patient, family and care team. Open and honest communication allows us to provide opportunities for our patients to discuss or ask questions about their plan of care. All of our hospitals participate in hourly rounding, nurse and physician rounding, and bedside shift-change reporting.

Patient and Family Advisory Council (PFAC)

Inova values the voice of our patients and families. Each Inova hospital maintains its own Patient and Family Advisory Council (PFAC). The PFAC is dedicated to work in active partnership between former patients and family members and to our Inova affiliated healthcare providers to create an active partnership to enhance the patient and family experience.

Discharge Phone Calls

To ensure a seamless transition from the hospital to home, our clinical teams use an evidence-based support process where patients receive post discharge phone calls. During the phone call, the surveyor asks about key areas important in transitioning home, such as follow-up appointments and discharge medications and is able to escalate any further needs identified by the patient or family.

Fall Prevention Program

By working together, physicians, nurses and hospital staff can lower a patient's risk of injury from falling and make their stay as safe as possible. Our care teams review the safety plan with each patient and family. For patients at high fall risk, we use the AvaSys telesitter program, a visual and audio monitoring platform. In some cases, continuous one-on-one supervision is provided in order to maximize patient safety.

Nurse Patient Navigation

A nurse patient navigator is a key resource in guiding patients through their continuum of care. The navigation process

involves integration of patient-specific clinical specialties to ensure ease of care. The nurse navigator is available to assist the patient with answers to their questions, provide education, guide them to the next step in their care and assist in outlining a follow-up plan customized to their needs. The nurse navigator model of care has been a strong feature of several of INSI's programs.



Shamaila Iqbal, RN
Spine Patient Navigator



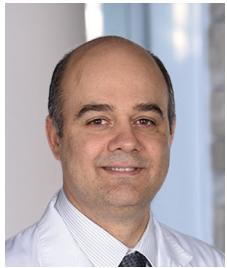
Becky Shrews, RN
Epilepsy Patient Navigator

Hand Hygiene Campaign

Hand hygiene reduces the incidence of healthcare-associated infections. In 2015, Inova began a system-wide hand hygiene campaign to improve hand hygiene compliance through accountability. Each Inova hospital has implemented multiple initiatives to sustain and improve healthcare provider adherence to best practices for reduction of infections, including secret shoppers, improved communication, peer feedback and increased signage. Overall hand hygiene compliance in 2019 was 88%, which exceeded our goal of 85%.



Featured Programs



Mateo Ziu, MD, FAANS

Medical Director,

*Brain and Spine Tumor Program,
Inova Neuroscience and Spine
Institute and Surgical Neuro-
Oncology Program, Inova Schar
Cancer Institute*

"We are committed to providing an accurate and specific diagnosis, communicating all of the patient's treatment options and offering conventional and experimental therapy, with the goal of providing the best care possible with the dignity and respect that everyone deserves. We look forward to assisting your patients in this journey."

Brain and Spine Tumor Program

Inova offers neuro-oncology patients highly specialized treatment for all brain and spine tumors, including primary and metastatic, benign (noncancerous) and malignant (cancerous). Inova's Brain and Spine Tumor Program is a unique and comprehensive neuro-oncology treatment program in Northern Virginia and operates as part of the Inova Schar Cancer Institute and INSI. Our goal is to provide excellent patient care through education, expertise and innovation.

Our program has on-staff neurosurgeons and neuro-oncologists with advanced fellowship training in the treatment of brain and spine tumors. Our neurosurgeons participate as investigators in national clinical trials to identify new technology and treatment for brain and spine tumor patients. Communication is a vital component of our care structure. We include all members of the care team in the process, starting with the primary care physician. We collaborate with our patients and their families to ensure the best possible outcomes.

We use the most advanced technologies and surgical approaches, including CyberKnife® radiation, laser ablation and surgical navigation with advanced tractography imaging, as well as awake craniotomy and intraoperative mapping of important functions for safe treatment of these tumors.

Conditions We Treat

We treat a wide range of brain tumors, including:

- Acoustic neuromas
- Astrocytomas
- Craniopharyngiomas
- Colloid cysts
- Chordomas
- Ependymomas
- Glioblastomas
- Gliomas
- Medulloblastomas
- Meningiomas
- Metastatic brain tumors
- Oligodendrogiomas
- Pediatric brain tumors
- Pineal region tumors
- Pituitary tumors/adenomas
- Oligodendrogiomas
- Skull base tumors

Spine tumors are abnormal tissue growths within or surrounding the spinal cord. Symptoms depend on the location of the tumor. The most frequently seen spine tumors we treat include:

Common benign spine tumors:

- Aneurysmal bone cyst (ABC)
- Giant cell tumor (GCT)
- Hemangioblastomas
- Osteoblastomas
- Osteoid osteomas

Common malignant spine tumors:

- Chordomas
- Chondrosarcomas
- Ewing sarcomas
- Lymphomas
- Metastatic tumors
- Multiple myeloma
- Osteosarcomas
- Plasmacytomas

In the past 20 years, research has shown in certain spine tumors that surgical intervention combined with radiation therapy is better than radiation alone. In other tumors, surgical intervention may be the only treatment option. Each case is unique, and our surgeons have the advanced training to evaluate and recommend the most appropriate course of action.

Treatments

There are a number of treatments for brain and spinal cord tumors. Your treatment depends on the type of tumor you have, where it is and your general health. Treatment can consist of:

Surgery:

- Minimally invasive neurosurgery
- Image-guided minimally invasive laser ablation
- Neuro-navigation tools
- Skull base surgical techniques

Non-surgical options for metastatic tumors:

- Chemotherapy
- Radiation
- Radiotherapy

Brain Tumor Outcomes

INSI's brain tumor outcomes for length of stay and mortality consistently performed better than the average Premier client hospitalization.

- In 2019, more than 70% brain tumor patients were reviewed in a multidisciplinary neuro-oncology conference to meet the AAN quality standard. The American Academy of Neurology (AAN) and the Society for Neuro-Oncology (SNO) working group identified five areas to drive performance in practice. One of the quality measurement areas includes patients with a multidisciplinary tumor board treatment plan. Since 2017, more than 70% of INSI's brain tumor patients were reviewed in a multidisciplinary neuro-oncology conference to meet this quality standard.

Source: Improving the Quality of Care for Patients Diagnosed with Glioma During the Perioperative Period by Natalie B.V. Riblet, MD, MPH; Evelyn M. Schlosser, MA, MPH, RN; and Karen Homa, PhD.

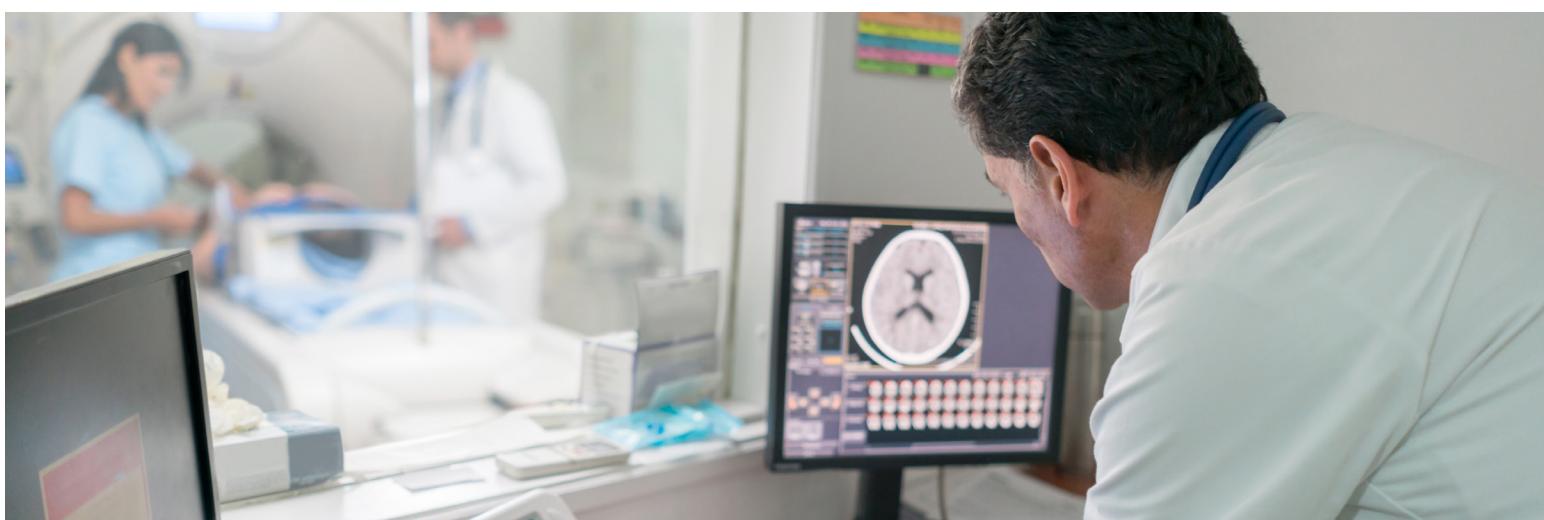
- In 2019, within INSI's Brain and Spine Tumor program, in the patient population there were zero reported Patient Safety indicators (PSIs), which exceed Premier's 10 percentile.

Source: Premier Benchmark, 1/1/2019-9/31/2019



Contact Us | Refer a Patient

For more information on brain and spine tumor diagnosis, treatment and second opinions, or to schedule an appointment, please call **703.776.4700**.





Melissa Womble, PhD
Medical Director,
Inova Sports Medicine and
Co-Medical Director,
Concussion Program,
Inova Neuroscience and Spine
Institute

"Concussion is treatable if managed appropriately via comprehensive evaluations and with involvement of a thorough multidisciplinary team."



Charlotte Kastl, MD
Co-Medical Director,
Headache Program
Inova Neuroscience and Spine
Institute

"Concussion injury can vary. We are able to help people at any range of concussion from very mild to severe no matter the age of the person affected."

Brain Injury and Concussion Program

Concussion is a growing problem associated with sporting activities, but concussion can happen to anyone. Slipping and falling at home. Injuring yourself at work. Being involved in a motor vehicle accident. These situations, and others, can put people of all ages at risk for concussion, traumatic brain injury (TBI) or other head injuries.

Inova offers a comprehensive program to diagnose, manage and treat concussions. Our team includes neuropsychologists, sports medicine physicians, neurologists, physical therapists and athletic trainers, all of whom are focused on the care of the patient. The multidisciplinary team works together to ensure treatment is specifically targeted to the individual. In more complex cases with prolonged symptoms or structural abnormalities, physical medicine and rehabilitation physicians, neurologists and neurosurgeons are also involved as part of the team.

At INSI, we treat the very mild to the most severe cases. Most mild brain injuries are self-limiting conditions that can be resolved through rest, medical observation and monitoring one's condition. Since the effects of concussion often cannot be seen on MRI scans, CT scans or other neuroimaging, our Brain Injury and Concussion Program focuses on neuropsychological evaluations in diagnosing a concussion. When left undiagnosed, the brain may not have the proper time needed to heal, which can lead to more serious, long-term effects if another head injury is sustained.

Our team is specially trained to treat concussions that result from a sports injury, a car accident or other trauma.

We Offer

- Baseline neurocognitive performance testing
- Concussion education
- Post injury concussion care
- 24-hour concussion hotline

The program features a physician-based team of experts trained in recognizing the signs and symptoms of concussion quickly to optimize and individualize care, recovery and return to daily activities. We strive to offer all necessary services in one location to make management and treatment as convenient as possible for our patients.

In addition to post injury services, our Brain Injury and Concussion Program provides prevention education for athletes, parents and coaches. Inova partners with many local adult and youth sports organizations in concussion education and prevention efforts.

We strive to remain at the forefront of care by providing the best management and treatment options for brain injury and concussion. We have developed a research program and concussion registry with more than 500 patients currently enrolled. We believe the clinical database will quickly become one of the most comprehensive in the nation – rivaling other leading concussion clinical and research programs. We had multiple, national presentations at conferences based on data collected from our program in 2019. Data will be used to establish INSI as a leader in concussion clinical care and research.

The goal of our research program is to advance the education, assessment, management and treatment of sports-related concussion. Our team is committed to research that leads to improvements in patient care.



Contact Us | Refer a Patient

For more information on brain injury and concussion prevention, or to schedule an appointment, please call **703.776.4700**.

Epilepsy Center

The Inova Epilepsy Center is a top-tier program for epilepsy care in the mid-Atlantic region, led by a multidisciplinary team of an epileptologist, neurosurgeons, neuropsychologists, neuroradiologists and interventional radiologists, nurse specialists, EEG technologists, social workers and others with training and experience in epilepsy care. We offer comprehensive services and advanced technology to treat the most complex cases, and our program continues to expand. Inova has 12 neurological monitoring beds to diagnose and treat adult and pediatric patients, as well as capabilities to evaluate effective therapeutic and surgical interventions and treatments. Epilepsy patients who have uncontrolled seizures for over 12 months are helped by admittance to Inova's specialized epilepsy center, staffed with an epileptologist.

Our robust research program includes ongoing clinical investigations to evaluate, optimize and develop the most effective treatments.

Conditions We Treat

- Epilepsy
- Epilepsy-related to brain tumors
- Medial temporal sclerosis and cortical dysplasia
- Post-traumatic epilepsy
- Uncontrolled seizures

We Offer

- Care and education after a first seizure
- Epilepsy monitoring unit (for adults and children)
- Diagnostic imaging
- Full range of surgery options, including resection
- Interventional testing including Wada test, spectroscopy
- Laser interstitial thermal ablation (LITT) surgical technique
- Neuropsychological testing
- Positron emission tomography (PET)
- Responsive neuro stimulation (RNS®) – NeuroPace
- Routine, ambulatory and video EEG
- Second opinions for complicated epilepsy
- Subdural electrode placement
- Surgical evaluations
- Surgical treatments
- Treatment with anti-epileptic medications (current and investigational)
- Vagal nerve stimulation

Quality, Safety, Range of Treatment Options and Certifications

- Inova Fairfax Hospital – Level 4 accreditation from NAEC (since 2014)
- Inova Alexandria Hospital - Level 3 accreditation from NAEC (since 2017)



Mohankumar Kurukumbi, MD
Medical Director,
Inova Epilepsy Center
Inova Neuroscience and Spine
Institute

"It is our purpose to help people with epilepsy gain control and achieve a better quality of life with advanced treatment options resulting in freedom from seizures. This is made possible through our team of highly trained specialists who provide excellent care at our NAEC level 4 epilepsy center."

One in 26 Americans will develop epilepsy.

2800+

Patients seen annually and the volume continues to grow.

"In Northern Virginia, 25,000 people live with epilepsy, and 9,000 of them have refractory epilepsy. Now they can come to our level 4 epilepsy center and get treated for better quality of life."

Mohankumar Kurukumbi, MD
Medical Director
Inova Epilepsy Center
Inova Neuroscience and Spine Institute

A patient should be referred to an epileptologist at an epilepsy center if they are still experiencing seizures after 12 months of care by a general neurologist.

In Northern Virginia, 25,000 people live with epilepsy, and 9,000 of them have refractory epilepsy.

Epilepsy Center *(continued)*

Notable Points

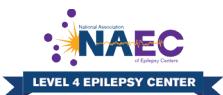
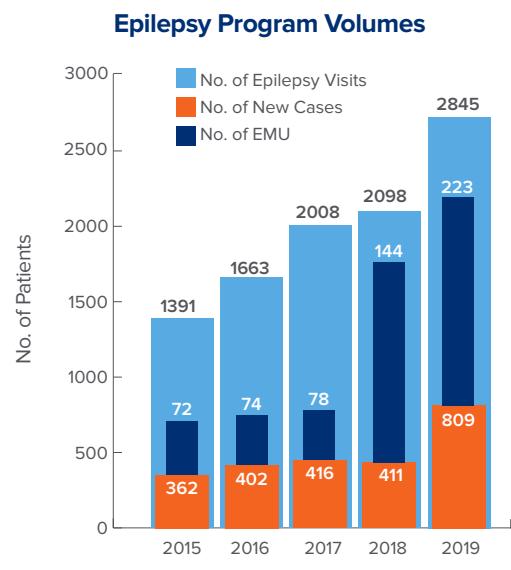
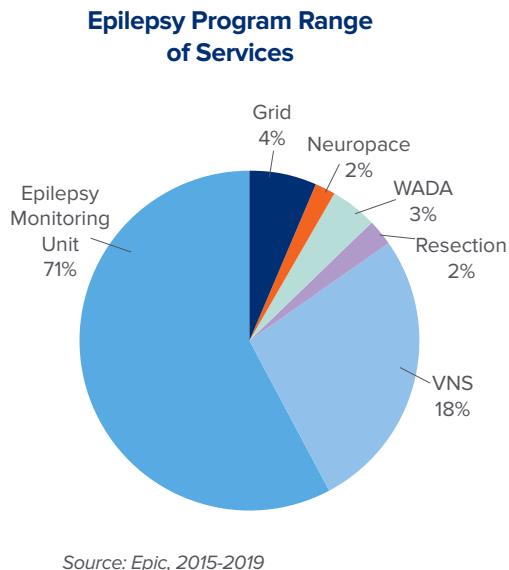
Dedicated Patient Nurse Navigator

A registered nurse specially trained to coordinate care for patients with complex needs, including continuous video EEG monitoring, presurgical evaluations and diagnosis or treatment of medically intractable epilepsy is part of our care team.

The nurse navigator also facilitates a monthly Epilepsy Support Group for adults living with epilepsy.

Monthly Epilepsy Support Group

A program designed to improve the quality of life for those living with epilepsy through education, advocacy and community resources. Our group offers a safe place to connect with others who share similar experiences, hear from experts and receive encouragement to overcome day-to-day challenges. For more information about this support group, visit inova.org/epilepsy/support.



*Epilepsy Centers provide a comprehensive team approach to the diagnosis and treatment of epilepsy. The National Association of Epilepsy Centers recognizes four levels of epilepsy care and accredits epilepsy centers. Inova Fairfax Hospital has maintained credentialing as a level 4 epilepsy center since 2014.

Level 1 epilepsy care typically occurs at an emergency room or a primary care physician's office with an epilepsy evaluation.

Level 2 epilepsy care involves a consultation with general neurologists.

Level 3 epilepsy care offers 24-hour monitoring. Inova Alexandria Hospital has a level 3 epilepsy center.

Level 4 epilepsy care includes a 24-hour monitoring and surgery, as indicated. This is the highest level available. Inova Fairfax Hospital has a level 4 epilepsy center since 2014. Visit: www.naec-epilepsy.org.

EPILEPSY CASE • Meet Leila

Surgery can provide a cure from seizures and change the life of an epilepsy patient.

Leila Ait Abdedaim's seizures began when she was just five years old. By the time she was in elementary school, they would happen more than ten times a week. Her doctors in her native Morocco were stumped. Her family and relatives thought she might be possessed by demons.

Desperate for answers, Leila came to the U.S., where doctors diagnosed epilepsy. Unfortunately, the doctors were unable to control seizures with multiple medication trials. In fact, Leila's seizures got worse.

Finally, a seizure episode brought her to the Inova Fairfax Hospital Emergency Room where she got the help she needed. Because the hospital has a level 4 epilepsy center, Leila was able to spend three days in the Epilepsy Monitoring Unit (EMU) where her seizures were recorded and localized. With the help of special monitoring devices, Mohankumar Kurukumbi, MD, the center's Medical Director, was able to pinpoint that all of her seizures were coming from her right temporal lobe. He diagnosed her refractory temporal lobe epilepsy, also known as drug-resistant epilepsy.

With her seizures accurately localized, Leila was eligible for a brain resection, which can cure seizures in up to 80 percent of epilepsy patients. Inova neurosurgeon James Leiphart, MD, stepped in to collaborate with Dr. Kurukumbi and performed the right temporal lobe resection. Leila was the first patient to have the procedure at Inova. Afterward, her seizures were gone.

INSI's Epilepsy Center is accredited by the National Association of Epilepsy Centers as a level 4 program, which means it provides the highest level of epilepsy care and advanced treatment. Surgical options include surgeries, vagal nerve stimulator, responsive neurostimulation and intracranial electrode monitoring. Patients who qualify for diagnosis and treatment for this type of care can come to Inova.

Seizure-free for four and a half years, Leila is a new person. Her result was so positive that she now advocates for other patients in the monthly Epilepsy Support Group, which often features guest speakers. Several of the qualifying patients Leila has interacted with have chosen to follow her footsteps and have elected to have resection surgery, too. About her positive outcome and helping others, Leila says, "It makes me really happy that other people can feel the same freedom I feel."

"My life has completely changed and I can do anything I want – all without the fear of having a debilitating seizure."

Leila Ait Abdedaim



Contact Us | Refer a Patient

For more information on the Epilepsy Center, please call Inova Neurology at **703.845.1500**.



Headache Program

The Headache Program offers experts in the diagnosis and treatment of headaches and neurological conditions. Headache affects one in four Americans, not to mention countless hours lost to family and quality of life. Headaches come in various intensities, lengths and locations. Our team of headache specialists offers the latest diagnoses and treatment options for all types of headaches and all types of patients. We are dedicated to finding the best treatment for each individual who comes to us for care.

There are very few academic, multidisciplinary headache programs in the region. This means our patients have access to a team of neurologists, psychologists and physical therapists, all of whom have expertise in treating headaches. As part of hospital system engaged in clinical research, we are conducting leading-edge headache and migraine research to help bring access to the latest treatments, therapies and preventive methods to our patients.

Physician Led Community Education

Our institution has long-valued community education and interaction. Today's physicians can capitalize on newer communications technologies to reach people of all ages and backgrounds beyond clinic walls. Ignored or improperly diagnosed severe headaches can have consequences. Our Co-Medical Directors of the Inova Headache Program each developed community-based, public, Facebook Live! education sessions. These enabled quick dissemination of information on headaches at large, type of headaches such as migraines, as well as tips of when a person may need to seek medical care. For a replay go online to <https://www.facebook.com/InovaHealth/> and click videos.

"Dr. Kastl understands her specialty well and is quick to translate her knowledge to recommendations for treating migraines. She has a professional and empathetic bedside manner."
- 2019 Inova patient





Laura Miller, MD
Co-Medical Director
Headache Program
Inova Neuroscience and Spine
Institute

"Headaches come in many forms, such as migraine and cluster headaches. We strive to stay abreast of the newest medications and research in order to offer the widest option of treatments to our patients. Our patients include those with new-onset headache pain as well as those with chronic, everyday headache."

Conditions We Treat

- Primary headaches, such as a tension headache or migraines
- Secondary headaches, such as sinus headaches or headaches that result from bleeding in the brain, a brain injury or a brain tumor

Primary headache disorders, including migraine, are one of the top 10 leading causes of disability worldwide.

Headache affects one in four Americans and costs our economy more than 30 billion dollars a year.



Contact Us | Refer a Patient

For more information on the Headache Program, please call **703.845.1500**.



Sean Rogers, MD, PhD

*Medical Director
Memory Program
Inova Neuroscience and
Spine Institute*

"It seems that every one of us has a friend or a family member who suffers from some form of memory loss, and the causes of that memory decline can be vast. At the Memory Program, we understand how much memory loss can affect our patients' lives, and our goal is to provide the best diagnosis and treatment options to improve the quality of life for our patients and their loved ones."

Memory Program

The Memory Program offers care from a multidisciplinary team specializing in memory disorders. Our specialists treat memory loss resulting from stroke, brain infection, injury, normal pressure hydrocephalus, Alzheimer's or other types of dementia. We focus on early detection of cognitive issues and use cutting-edge medications and treatments to manage conditions that impact memory.

Our program builds on the expertise of highly experienced specialists and subspecialists from different fields of medicine, including neurology, psychiatry, neuropsychology, geriatric medicine, geriatric psychiatry, radiology, cognitive rehabilitation and research.

We Offer

- Advanced brain imaging
- Bloodwork
- Cognitive therapy
- Genetic testing
- Lumbar puncture
- Neuropsychological testing
- Sleep studies

Notable Points

ElderLink is a partnership between Inova, the Fairfax Area Agency on Aging and the Alzheimer's Association of Northern Virginia. It offers care management services from a staff of skilled geriatric specialists, as well as a wide array of resources, programs and services to caregivers and clients. ElderLink coordinates and manages all elements of patient care (medical, social, legal and financial), minimizing the stress and confusion families often experience when dealing with multiple service providers.



One in three seniors dies with Alzheimer's disease or another type of dementia.

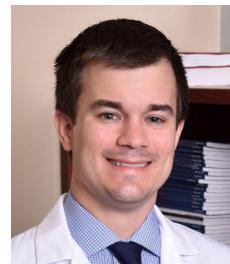


Contact Us | Refer a Patient

For more information about the Memory Program, please call **703.845.1500**.

Parkinson's and Movement Disorders Center

At the Parkinson's and Movement Disorders Center, we offer personalized, comprehensive care that replicates the successful academic model for movement disorders but is rooted in the community. Our program pairs the highest level of science-driven therapeutics with a foundation of accessibility and patient education.



Conditions We Treat

- Essential tremor and other tremors
- Excessive salivation
- Dystonia
- Huntington's disease
- Parkinson's disease and Parkinsonism, including multisystem atrophy, progressive supranuclear palsy and corticobasal degeneration
- Tic disorders
- Trigeminal neuralgia spasticity
- Other movement disorders

We Offer

- Comprehensive care covering all aspects of Parkinson's disease and other movement disorders
- DUOPA dopamine intestinal gel for Parkinson's disease
- EMG-guided botulinum toxin injections for dystonia or any condition where muscles are overly tightened, or for excessive salivation (sialorrhea)
- MRI-guided, sleep and awake DBS for Parkinson's disease, essential tremor and dystonia
- Neurorestoration

Parkinson's disease

Among movement disorders, Parkinson's disease is a very diverse disease as the progression of symptoms varies from one person to another. With a growing "baby boomer" population, rates of the disease are expected to increase in the next decade. For patients, a diagnosis of Parkinson's can be terrifying because many believe the disease to be aggressive and terminal. The experts at Inova are prepared to help.

As Parkinson's specialists, we have the privilege of righting the misperception of this being a terminal disease, by offering effective and transformative treatments for the disease and providing hope. One treatment method is Deep Brain Stimulation (DBS).

Drew Falconer, MD

*Co-Medical Director
Parkinson's and Movement
Disorders Center
Inova Neuroscience and Spine
Institute*

"There is nothing better than proving wrong the preconceptions about a disease such as Parkinson's disease. Through modern therapies and a smart implementation of technology, we can restore a person's life and return the most important ingredient: hope."



Sean Rogers, MD, PhD

*Co-Medical Director
Parkinson's and Movement
Disorders Center
Inova Neuroscience and
Spine Institute*

"At the Inova Parkinson's and Movement Disorders Center, we treat a range of diseases, including tremor, dystonia, Huntington's disease and Parkinson's. We work to understand each person's unique condition, so that we can bring a range of treatment options to help manage the disease and achieve the best possible quality of life and function."

5,130

Number of clinic visits in 2019
to the Inova Parkinson's and
Movement Disorders Center

Source: EPIC



Mahesh Shenai, MD, MBA, MSE
*Medical Director
 Functional and Restorative
 Neurosurgery
 Parkinson's and Movement
 Disorders Center
 Inova Neuroscience and
 Spine Institute*

"Only a handful of hospitals nationwide have a community-based deep brain stimulation program. But Inova has streamlined the process to overcome these barriers – and have the right people and equipment to offer a top-tier program in a community setting."

Parkinson's and Movement Disorders Center *(continued)*

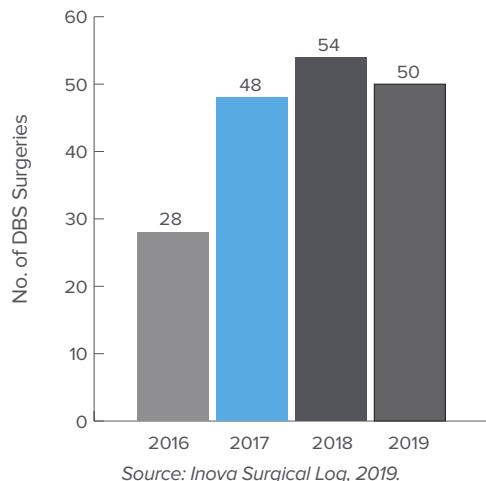
Deep Brain Stimulation

In 2019, INSI conducted more than 50 unique DBS procedures, 2 MRI-guided DBS placements, and 24 lead implantations.

DBS is a surgical technique for qualified patients who do not improve with medication. It is an established treatment that involves implanting electrodes within certain areas of the brain. These electrodes produce electrical impulses that regulate abnormal impulses, or the electrical impulses can affect certain cells and chemicals within the brain, which can help lessen symptoms, reduce the use of medications and improve quality of life.

A team of experts, including a movement disorder specialist (a neurologist with additional training in Parkinson's disease) and a neurosurgeon conduct an extensive assessment when considering DBS to ensure it is a safe and appropriate option for our patients.

Deep Brain Stimulation (DBS) Surgeries: Volumes



INSI offers both the classic Medtronic DBS platform as well as the directional system from Abbott with its St. Jude DBS System.



Notable Points

- Lee Silverman Voice Therapy LSVT BIG® and LSVT LOUD® is a unique, specialty rehabilitation program offered through Inova Rehabilitation that trains people with Parkinson's disease to use their body more normally for a better quality of life.
- Inova Parkinson's and Movement Disorders Center:
 - Averages 15-20 new patient consultations weekly
 - Promotes fifteen support groups for patients and caregivers in the region
 - Treats more than 500 patients per year with botulinum toxin injection
- Actively participates in several industry and investigator initiated clinical trials
- Biannual lecture series followed by Q&A attended by more than 150 patients and their families
- Only Parkinson's and Movement Disorders Center in the Washington, DC metro area to offer asleep and MRI-guided DBS
- Offers both the classic Medtronic DBS platform and the directional Abbott/St. Jude directional DBS system

ESSENTIAL TREMOR CASE • Meet Karen

Parkinson's and Movement Disorders Center Patient

The once-simple pleasures of building Legos with her 5-year-old grandson and sewing prize-winning quilts became monumental tasks for Karen Troutman as the tremors in her hands grew progressively worse. Suffering since her 30's from essential tremor — an often-inherited chronic trembling of the hands, head or voice — Karen's medication to treat the movement disorder gradually lost effectiveness. Frustratingly, the Alexandria, Virginia resident couldn't even hand write her annual Christmas cards. "My grandson would say, 'Grandma, your hand is shaking again,'" recalls Karen, 58, who vividly remembers her own grandfather's exasperation with the condition when she was a child. "That really got to me."

But the burgeoning use of a life-altering technology known as DBS meant that Karen didn't have to settle for her grandfather's fate. Following a three-year ramp-up and \$500,000 investment in leading-edge equipment as part of the expanded Inova Parkinson's and Movement Disorders Center, Karen was the first patient at Inova to undergo DBS — often described as a pacemaker for the brain because it delivers constant electrical pulses to counteract abnormal brain activity — at Inova four years ago. Since that time, her tremor has not returned, and she has resumed her love of competitive quilting, winning numerous quilting awards. Every visit back to our program is a joyous time reflecting on the activities she can now complete since her tremor is controlled.

"During surgery, I felt completely in control. I knew exactly what was happening."

Karen Troutman



Parkinson's and Movement Disorders Center *(continued)*

PARKINSON'S DISEASE CASE • Meet Bashir

Parkinson's and Movement Disorders Center Patient

Living with debilitating Parkinson's disease for 11 years, Bachir Flih wondered if he'd ever find relief. Worsening symptoms made it difficult for him to perform simple, everyday tasks. Worsening depression made him lose interest in everything that once brought joy, including his favorite activity: cooking for his family.

Searching for a solution, Bachir's wife Carrie learned of the Inova Parkinson's and Movement Disorders Center. From the moment they stepped through the door, the couple knew they were in good hands. They met with Sean Rogers, MD, PhD, a neurologist and the center's co-founder. "He was such a breath of fresh air and brought a whole new approach to everything," Carrie recalls.

Dr. Rogers immediately noticed that Bachir was taking too many medications, which contributed to his depression. He also told him he'd be a good candidate for DBS, which is an established treatment for movement disorders. In this procedure, an electrode is implanted deep in the brain and produces electrical stimulation that blocks abnormal impulses. These electrical stimulations can affect certain cells and chemicals within the brain.

There was just one problem. Traditionally, the patient is awake during DBS surgery, so clinicians can get direct feedback on how the stimulation affects the tremors. But because Bachir is claustrophobic, he couldn't tolerate an awake procedure. The team had to come up with something different.

Dr. Rogers collaborated with Mahesh Shenai, MD, a neurosurgeon and Director of Functional and Restorative Neurosurgery at Inova Fairfax Hospital to work it out. He and his team strategized to transform the MRI suite into an operating room, so the surgery could be done with Bachir asleep.

The breakthrough treatment has brought hope to the world of Parkinson's disease. "We're excited we now have this opportunity to use MRI-based DBS to benefit so many patients," Dr. Rogers says. "We can provide this wonderful technology to those who need it, but previously were not good candidates because of their inability to tolerate an awake procedure."

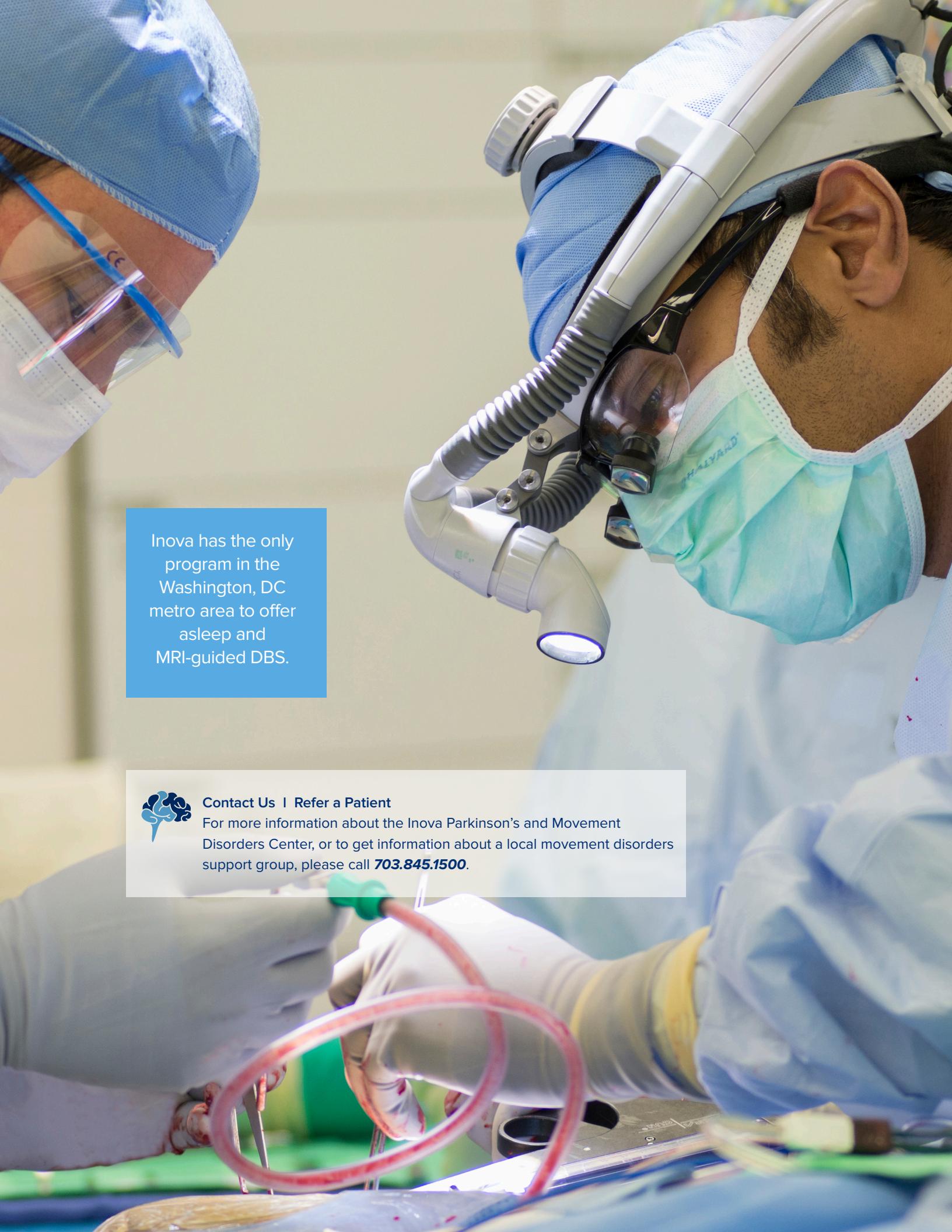
Since his surgery, Bachir is a totally different person. He moves better, writes better and thinks better. He takes less medication and his depression is gone. "I'm confident enough now to do anything I want," he says. "I'm so happy."

For Carrie, the difference is night and day. "I have my husband back; my son has his father back. He's present in the family, where before he was not really interested in being there. It's opened up so many opportunities. We're starting life again."

"I have been fantastic since the surgery. I move better, I write better, I think better."

Bachir Flih



A surgeon wearing a blue surgical cap and mask is shown from the side, focused on an operation. A bright surgical light is positioned above the patient's head, illuminating the surgical site. The patient is lying down, wearing a blue surgical mask.

Inova has the only
program in the
Washington, DC
metro area to offer
asleep and
MRI-guided DBS.



Contact Us | Refer a Patient

For more information about the Inova Parkinson's and Movement Disorders Center, or to get information about a local movement disorders support group, please call **703.845.1500**.



Rahul Davé, MD, PhD

Medical Director

*Multiple Sclerosis and
Neuroimmunology Center
Inova Neuroscience and Spine
Institute*

"We now understand Multiple Sclerosis is a diverse disease, and there are several diseases that look like it, but are treated differently. That's why we call it the Multiple Sclerosis and Neuroimmunology Center. Our focus is to ensure that each patient receives a personalized evaluation, treatment and monitoring program that helps them to stay healthy."

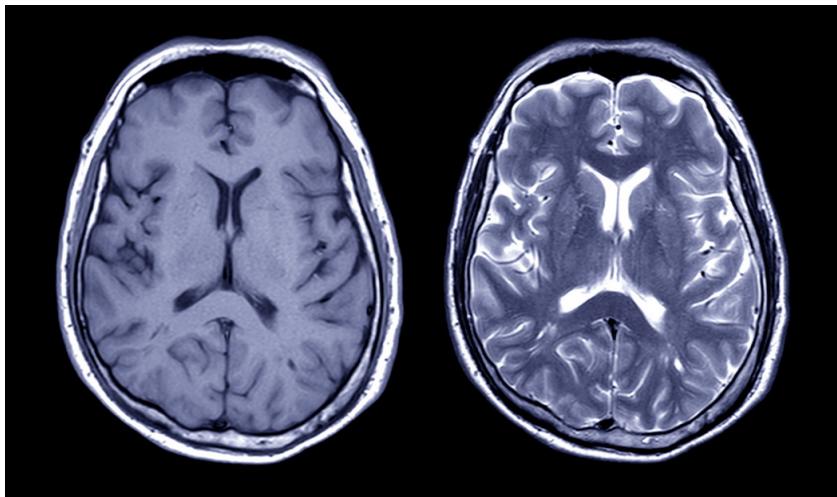
Multiple Sclerosis and Neuroimmunology Center

The Multiple Sclerosis and Neuroimmunology Center offers a multidisciplinary program that includes advanced imaging; diagnostic testing; consultations with rheumatology, psychology and urology; rehabilitation services; and the latest research. We treat patients with multiple sclerosis as well as inflammatory disorders of the nervous system such as autoimmune encephalitis, CNS vasculitis, neuro-lupus, neuro-sarcoid, optic neuritis and transverse myelitis. Our team provides multiple sclerosis-specific cognitive evaluations and neurology-specific rehabilitation programs.



*Inova Neurology is certified by the Consortium of
Multiple Sclerosis Centers (CMSC)*

INSI is the only regional center
that treats the entire range of
neuroimmunologic diseases



Contact Us | Refer a Patient

For more information about our Multiple Sclerosis and Neuroimmunology Center, or to schedule an appointment, please call **703.845.1500**.

Neurocritical Care Program

The Neurocritical Care Unit at Inova Fairfax Hospital is a closed unit that provides intensive care to patients with severe primary neurological illness, neurological complications of systemic illness and neurosurgical conditions. The unit ensures 24-hour specialized care for patients. It also functions as a major tertiary referral center for neurological and neurosurgical emergencies across Northern Virginia, Southern Maryland and West Virginia.

Timely and early interventions can decrease the risk of further brain damage and improve prognosis of rare and complex conditions. The Neurocritical Care Unit is equipped with advanced monitoring and treatment techniques capable of improving prognosis in serious neurological and neurosurgical conditions.

The team of board-certified neurocritical physicians, together with on-call neurosurgeons, interventional neuroradiologists and neurologists, is trained to meet the specific needs of critically ill neurological patients. In addition to expert physician coverage, patients benefit from constant surveillance and monitoring by neurocritical advanced practice providers and nurses.

We Offer

- Brain tissue oxygen monitoring
- Continuous electroencephalographic (EEG) monitoring, including quantitative EEG
- Intracranial pressure monitoring
- Invasive hemodynamic monitoring
- Transcranial doppler ultrasonography

Conditions We Treat

- Acute Ischemic stroke
- Brain arteriovenous malformations
- Brain tumors
- Coma
- Dural sinus thrombosis
- Guillain-Barre syndrome and other neuromuscular diseases
- Hydrocephalus
- Intracerebral and intraventricular hemorrhage
- Meningitis and encephalitis
- Myasthenia gravis
- Postoperative care after neurovascular, neurosurgical and neurointerventional radiology procedures
- Seizures and status epilepticus
- Spine arteriovenous malformations
- Status post cardiac arrest
- Subarachnoid hemorrhage and unruptured brain aneurysms



Dan Dinescu, MD

*Medical Director
Neurocritical Care Program
Inova Neuroscience and Spine Institute*

"The Neurocritical Care Unit at Inova Fairfax Hospital functions as a tertiary care center for patients with neurocritical care conditions. The highly trained and specialized multidisciplinary team uses advanced multimodality monitoring and can support patients before and after complex neurosurgical and neurointerventional radiology procedures. Our unit manages the highest number of complex neurocritical care cases in the area, all of which translates to better care."

Advancing our Patient Care through Education

Since 2016, our neurocritical care teams consisting of critical care physicians, advanced care providers and nurses have joined together to advance professional growth through achieving ENLS certification or teaching the ENLS curriculum.

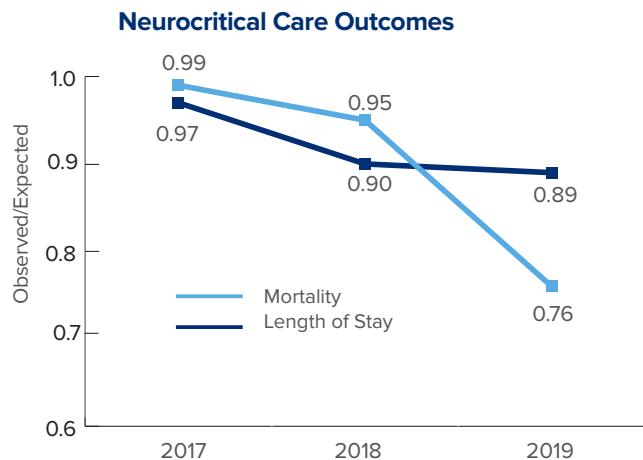
(Note: ENLS is the Emergency Neurological Life Support certification and National Specialty Certification.)

Neurocritical Care Program (continued)

Neurocritical Care Outcomes

One of the criteria by which patients choose Inova is our attention to patient safety and our outcomes scores.

From 2017 to 2019, our neurocritical care outcomes for length of stay and mortality consistently performed better than the ‘average’ Premier client hospital.



Source: Premier

Note: A score of less than 1.0 indicates INSI performance is better than expected based on patient medical condition and risk profile.
Data are presented as a ratio of a hospital's observed rate as compared to its expected rate.



Contact Us | Refer a Patient

For more information about our Neurotrauma and Neurocritical Care Program, please visit inova.org.



Pain Management Program

Inova's comprehensive Pain Management Program offers a wide range of services for patients dealing with acute or chronic pain. Through a multidisciplinary approach, our providers treat the entire patient, addressing each problem that contributes to pain and inability to function. We know that the source of pain varies from patient to patient; there is no one-size-fits-all treatment.

Our goal is to decrease each patient's level of pain and suffering, maximize function and independence, and return quality of life.



Greg Fischer, MD
Medical Director
Pain Management Program
Inova Neuroscience and Spine Institute

We Offer

- Celiac plexus blocks
- Epidural steroid Injections
- Facet/medial branch blocks
- Fluoroscopic and ultrasound-guided nerve blocks and joint injections
- Ganglion impar blocks
- Genicular nerve blocks
- Inferior hypogastric plexus blocks
- Intrathecal pump
- Lumbar sympathetic blocks
- Neurolytic blocks
- Radiofrequency ablation
- Spinal cord stimulation
- Stellate ganglion blocks

Nonsurgical Procedures

- Aquatic therapy
- Behavioral health modalities
- Comprehensive addiction treatment services
- Comprehensive rehabilitative exercise training
- Concussion Management Program
- Dry needling
- Electrical stimulation
- Myofascial release therapy
- Occupational therapy modalities
- Physical therapy modalities
- Ultrasound

Surgical Procedures

- Anterior lumbar interbody fusion (ALIF)
- Cervical spinal fusion
- Foraminotomy
- Kyphoplasty for compression fractures
- Laminectomy
- Lateral lumbar spinal fusion
- Lumbar and cervical disc replacement
- Microdiscectomy
- Minimally invasive spine surgery
- Posterior lumbar interbody fusion (PLIF) surgery
- Scoliosis surgery

"At Inova, we work very hard to evaluate all care options for our patients. We strive for the best care possible. Our team of anesthesiologists, physiatrists, neurologists, surgeons, psychologists, physical and occupational therapists, physician assistants, and nurse practitioners works with each patient to help restore quality of life."



Contact Us | Refer a Patient

For more information about our Pain Management Program, or to schedule an appointment, please call **703.776.4700**.



Leon E. Moores, MD, DSc
*Associate Chair,
 Pediatric Neurosurgery
 Inova Neuroscience and Spine
 Institute
 President, Inova Physician Enterprise*

"INSI's partnership with Pediatric Specialists of Virginia (PSV) brings pediatric neurology and neurosurgery expertise to the children of Northern Virginia in both inpatient and outpatient settings. PSV neuroscience physicians are an integral part of INSI and hold top-tier credentials. Our pediatric subspecialty providers in neurosurgery and neurology evaluate and treat the entire spectrum of pediatric brain, spinal cord and peripheral nerve disorders, including tumors, seizures, headaches, concussions, movement disorders, congenital abnormalities and more."

Pediatric Neurosciences Program

The combined specialized expertise of INSI and Pediatric Specialists (PSV) of Virginia consists of pediatric neurologists, pediatric neurosurgeons and pediatric critical care physicians in our dedicated Pediatric Intensive Care Unit (PICU) and Neonatal Intensive Care Unit (NICU), as well as pediatric hospitalists, pediatric hematologists, pediatric oncologists and pediatric psychiatrists, advanced practice providers and nurses form the foundation of care excellence.

Extensive ancillary services and programs help children and families throughout their experience. Child life specialists; social workers; physical, occupational and speech therapists; nutritionists and support groups all contribute to the care experience. Our robust maternal-fetal medicine team provides multidisciplinary perinatal support to mothers whose babies have complicated neurologic diagnoses.

The specialists at Inova Children's Hospital are experts in treating a broad range of pediatric neurological disorders, ranging from the management of epilepsy and seizures to advanced concussion care. Uniquely, the working relationship with the INSI adult neuroscience pediatric team and co-location at the Inova Fairfax Medical Campus allow for a seamless transition from pediatric to adult care co-coordinated with the award-winning Inova Children's Hospital.

Certified therapeutic recreation specialists collaborate with patients, families and therapists to address health, recovery and well-being using meaningful goal-oriented leisure activities. Some specialized services in the therapeutic recreation program include Horticulture Group, ArtSpire Painting Group, pet therapy and community outings.

Many of our neurologists and our neurosurgeons are involved in research endeavors and frequently present at national and international meetings. They are recipients of numerous teaching and research awards as well as millions of dollars in grant funding.

A Ronald McDonald House is located on the campus of Inova Fairfax Hospital, so families can stay close to their hospitalized child. There is little or no cost to the family.

Pediatric Neurology and Neurosurgery Hospital Volumes

INSI offers pediatric neurology and neurosurgery services, offering subspecialty expertise in every area. Patients benefit from convenient access to the top-rated Inova Children's Hospital, which has a family-friendly environment.

We Offer

Neurological Testing:

- Acute onset of stupor/coma
- Acute paralysis
- Brain and spinal cord tumors
- Concussion and traumatic brain injury (TBI)
- Congenital anomalies of the central nervous system
- Epilepsy
- Headache
- Movement disorders
- Sleep disorders

- Spinal cord injuries
- Stroke

Diagnostic Testing:

- CT (computed tomography)
- EEG
- Evoked potentials/response
- Intraoperative CT
- Intraoperative evoked potential monitoring
- MRI and fetal MRI

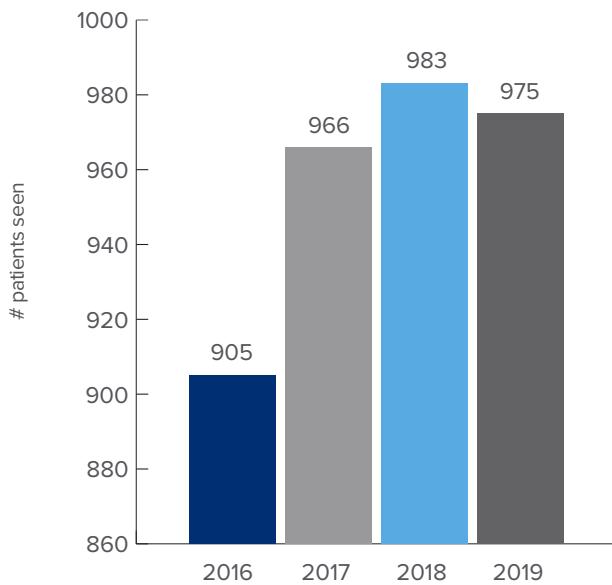
"Dr. Moores' and Peggy's care, skill and most of all their compassion during our infant daughter's two back-to-back brain surgeries were above what any parent could hope for. They took care of our girl as if she was their own and for that we are forever thankful."

- Gilingham family

Inova Health System Hospital-Based Volumes

Neurology and Neurosurgery- Pediatrics only

2016-2019



Source: HPM



Pediatric Neurosciences Program (*continued*)

"Brain and spine surgery can be intimidating for tiny patients and their families. We try to make the entire experience from diagnosis to discharge and follow up, an individual adventure - tailored to each patient's age and needs. For some, that's having details shown and explained at every step, for others its providing distraction and fun to comfort them."

- Peggy Vollstad, MMSc, PA-C,
Pediatric Neurosurgery Physician
Assistant

Conditions We Treat

Pediatric Neurology

- Ataxias
- Concussion
- Developmental delay
- Epilepsy of all types and new onset seizures
- Guillain-Barré syndrome
- Headache/migraine
- Intracranial hypertension, including pseudo tumor cerebri
- Movement disorders, including tic disorders and Tourette syndrome
- Myasthenia gravis
- Neurodegenerative disorders
- Neuromuscular disorders
- Neurocutaneous syndromes, including tuberous sclerosis
- Neuromuscular disorders
- Sleep disorders
- Spinal muscular atrophy
- Strokes and vascular anomalies
- Tremors

Pediatric Neurosurgery

- All tumors of the brain, spine and peripheral nerves
- Congenital malformations of the brain and spine (cysts, spina bifida, tethered spinal cord, Chiari malformations)
- Craniofacial abnormalities
- Head and spinal column trauma
- Hydrocephalus
- Tethered cord syndrome
- Vascular malformations of the brain and spine, including moyamoya disease, aneurysms and arteriovenous malformations



PEDIATRIC BRAIN TUMOR CASE • Meet Baby M

Pediatric Neurosurgery

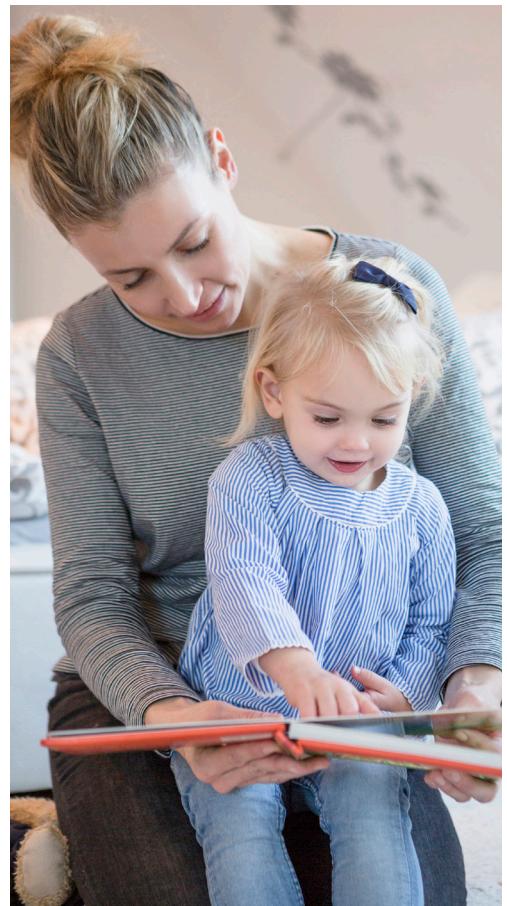
Thankfully, her tumor was benign. She will likely live a long, cancer-free life with normal neurologic function. It doesn't get more critical than facing a brain and spine tumor.

After she was seen by an Inova pediatric neurologist, who noted a facial droop that persisted longer than expected, Inova's team of pediatric anesthesiologists shepherded the critically ill child safely through a brain and spine MRI. It revealed a very large brain tumor involving major feeding arteries to the cerebellum and brainstem and surrounding the cranial nerves to her face.

The little girl was admitted to the hospital, and her tumor was safely removed in a 10-hour surgery.

Baby M celebrated her first birthday two days before major lifesaving neurosurgery.

Specialized care was also at the heart of Baby M's recovery. Highly skilled pediatric nurses took great care of Baby M and her family before transferring her to the Pediatric Intensive Care Unit in Inova Children's Hospital. Her family knew she was getting the most technologically advanced care possible from a multidisciplinary team of pediatric intensive care, hematology neurosurgery physicians and nurses.



One out of every ten babies in the United States is born prematurely — a rate that has steadily increased in the past decade. Many of these infants are at greater risk for neurological impairments like cerebral palsy, cognitive delays and visual and hearing impairments.



Contact Us | Refer a Patient

For more information about our Pediatric Neurosurgery Program, or to schedule an appointment, please call PSV **703.876.2788**.

**Eric Sklar, MD**

*Medical Director
Sleep Disorders Program
Inova Neuroscience and Spine
Institute*

"Our highly skilled team of professionals takes a comprehensive approach to diagnosing and treating sleep-related disorders. Our goal is to alleviate as many symptoms as possible in order for patients to enjoy improved sleep."

Sleep Disorders Program

The experienced physicians and staff at the Sleep Disorders Program have the expertise to evaluate, diagnose and treat sleep-related problems. Our physicians specialize in sleep medicine, pulmonary medicine and critical care medicine. Staff includes registered polysomnographic technologists with additional experience in respiratory care, neurodiagnostic and cardiac monitoring. Oversight is provided by a board-certified sleep physician.

Our state-of-the-art Neurodiagnostic and Sleep Assessment Centers are located at Inova Alexandria Hospital, Inova Fair Oaks Hospital and Inova Fairfax Hospital. Each sleep room features video monitoring and computerized diagnostic capabilities, allowing for timely results. Additional neurodiagnostic capabilities, including EEG, are available at two of the locations.

Conditions We Treat

- Insomnia
- Narcolepsy
- Parasomnias
- Restless leg syndrome (RLS)
- Sleep apnea

We Offer

- Home sleep tests
- Multiple sleep latency test
- Nasal continuous positive airway pressure (CPAP) titration
- Overnight polysomnogram

Notable Points

The Sleep Center at Inova Alexandria Hospital pioneered the first treatment center for sleep disorders in Northern Virginia.

3,100+

Sleep studies
in 2019.*

Source: EPIC

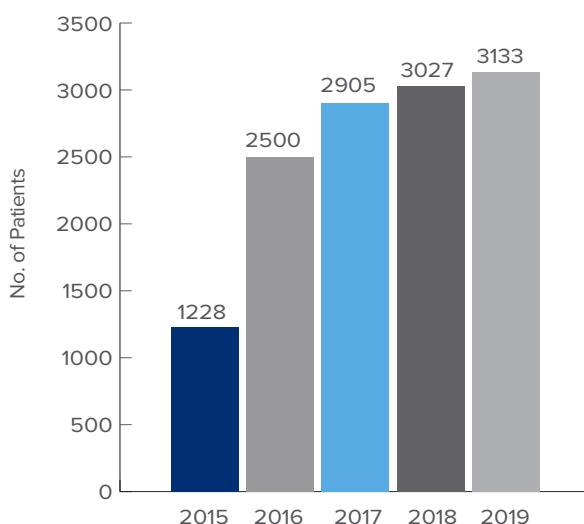


Sleep studies are important in the correct diagnosis and treatment of sleep apnea, as serious complications can result. Conditions linked to sleep apnea include high blood pressure, increased stroke risk, metabolic syndrome or obesity, to name a few. Knowing one's risk level is important to long-term health. Inova has three Neurodiagnostic and Sleep Assessment Centers, located at three of our five hospital locations and staffed by experts in the field. These centers help to ensure testing is available to meet our patient population's growing need..

INSI's Sleep Centers from 2015 -2019 completed 11,000+ sleep studies with easy accessibility through any one of three outpatient centers.

More than 522 million Americans have sleep apnea. 80% of the moderate to severe cases are diagnosed.

Neurodiagnostic Sleep Study Volumes



Source: HPM

INSI's Sleep Centers completed 11,000+ sleep studies with easy accessibility through any one of three outpatient centers.

* Source: HPM, 2016-2019

INSI's sleep study patients come from over 234 ZIP codes*.

*Source: HPM 12/2018-11/2019.



Contact Us | Refer a Patient

For more information about our Sleep Disorders Program, or to schedule an appointment at one of the sleep labs, please call **703.776.4700**

**Nilesh Vyas, MD**

*Associate Chair
Neurosurgery
Inova Neuroscience and Spine
Institute*

"The comprehensive Inova Spine Program includes both orthopedic and neurosurgery spine physicians. Our expert team members are experts in the fields of neurosurgery, orthopedics, physical medicine and rehabilitation to provide a full spectrum of care that uses traditional and nontraditional methods to restore each patient's function and quality of life."

Spine Program

Back pain is one of the most common reasons patients visit a healthcare provider or an urgent care clinic. We have a full complement of experienced neurosurgeons, orthopedic spine surgeons, neuroradiologists, neurologists, rehabilitation specialists, and nurses skilled in the treatment of back pain, neck injury, spinal cord trauma and more.

Our comprehensive care team and physician spine specialists help to diagnose and manage pain and determine the best treatment option for our patients. Nonsurgical treatment options are used whenever possible. Our goal is to help patients lead pain-free and active lifestyles. Our nurse navigators are available to improve care coordination.

Leading-edge, minimally invasive surgical techniques minimize discomfort and speed recovery. Our surgeons are experienced in contemporary procedures.

Conditions We Treat

- Arthritis of the spine
- Back and neck pain
- Cervical arthritis
- Cervical disk rupture
- Chiari malformation
- Compression fractures of spine
- Degenerative spine disease
- Disc herniation
- Kyphosis
- Low back pain
- Myelopathy
- Radiculopathy
- Sciatica
- Scoliosis
- Spinal cord injury
- Spinal deformity
- Spinal infections
- Spinal fracture
- Spinal instability
- Spinal stenosis
- Spinal trauma
- Spinal tumors
- Spinal vascular malformation, fistulas
- Spondylolisthesis
- Tethered cord

We Offer

- Microdiscectomy
- Minimally invasive spine surgery
- Spinal decompression
- Spinal fusion
- Spinal cord and nerve surgery
- Spinal reconstruction

2,200+

Spine surgeries
in 2019.

We also treat back pain and low back pain, providing relief for a vast range of acute and chronic conditions. Treatments vary depending on severity and include:

- Base brain and spine tumor
- Correction of complex deformities
- Epidural steroid blocks
- Facet blocks
- Laminectomy
- Medication
- Physical therapy
- Selective nerve root blocks/transforaminal epidural steroid blocks
- Spinal fusion
- Spine tumor

Interventional Treatments

Our pain management physicians offer acute pain management services, including epidural and trigger point injections, facet injections, nerve blocks, neurostimulation and rehabilitation.

Notable Points

- When a spinal trauma patient is admitted to our Level I trauma center, our spinal cord injury team immediately directs time-dependent efforts to stabilize and reverse any neurological injuries.
- Spine patients receive sophisticated qualitative neuromuscular diagnosis and treatment, including our consultative services and an electromyography laboratory, available on both an inpatient and outpatient basis.

Spine Program Medical Directors at Inova Hospitals



Ronald C. Childs, MD
Co-Medical Director
Spine Program
Inova Fairfax Hospital,
Orthopedic Surgeon



John Hamilton, MD
Co-Medical Director
Spine Program
Inova Fairfax Hospital,
Neurosurgeon



Don Hope, MD
Co-Medical Director
Spine Program
Inova Fair Oaks Hospital,
Neurosurgeon



Christopher Silveri, MD
Co-Medical Director
Spine Program
Inova Fair Oaks Hospital,
Orthopedic Surgeon



Ali Moshirfar, MD
Medical Director
Spine Program
Inova Loudoun Hospital
President, Medical Staff
Inova Loudoun Hospital,
Orthopedic Surgeon



Correy Wallach, MD
Medical Director
Spine Program
Inova Alexandria Hospital
Inova Mount Vernon Hospital,
Orthopedic Surgeon

Inova spine surgery outcomes for length of stay and readmissions consistently performed better to the average from 2015 to 2018 as compared to the average Premier client hospital (1200+).

Approximately 80%
of Americans will
suffer from back pain
in their life.

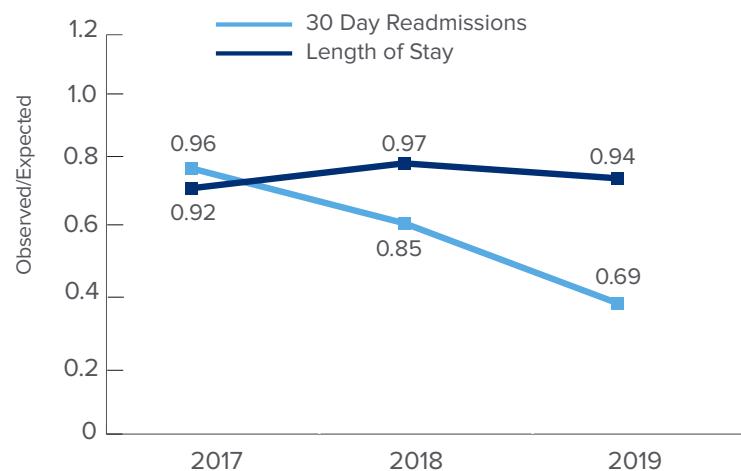
Spine Program (continued)

Spine Surgery Outcomes

Our spine surgeons performed more than 2,200 spine surgeries in 2019.

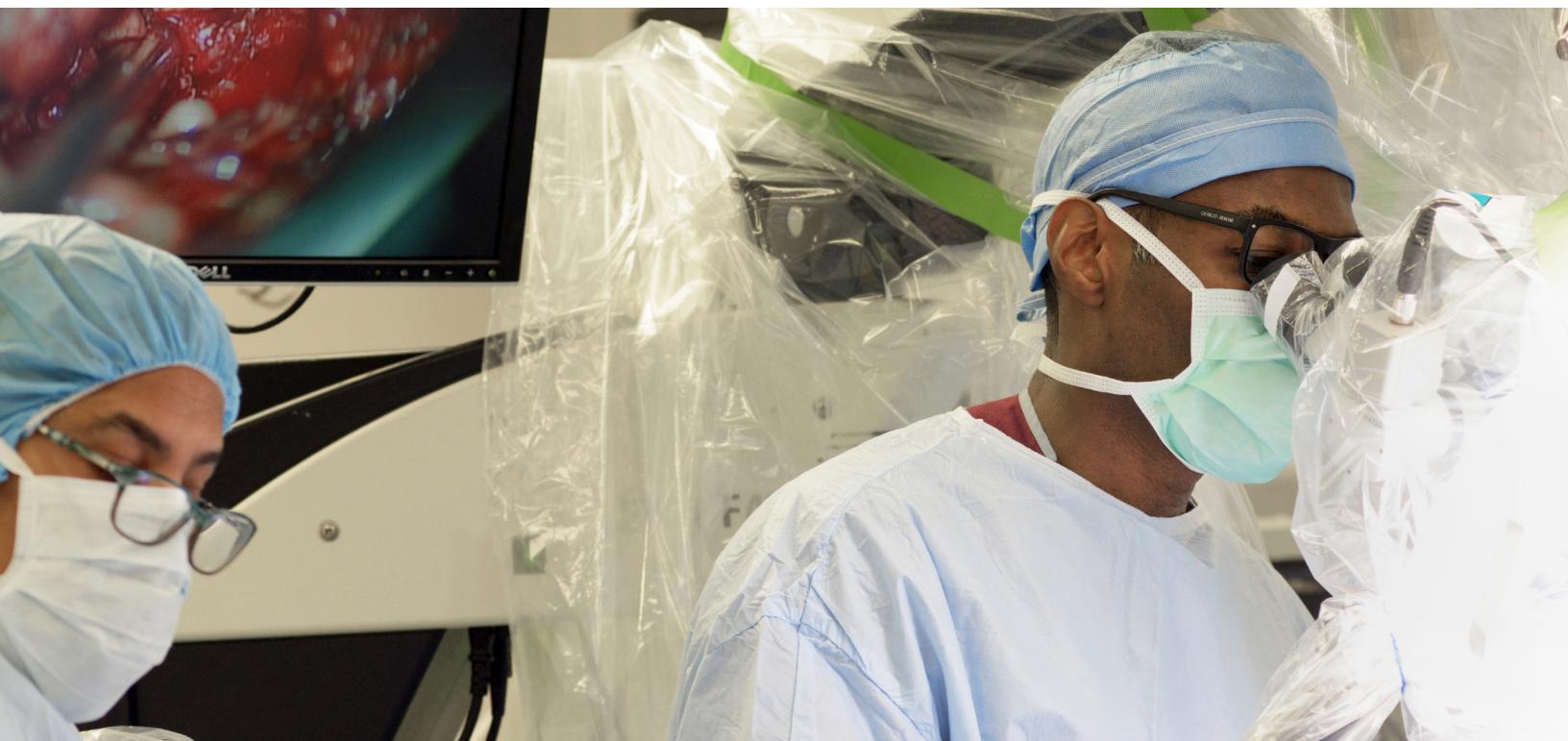
Importantly, INSI's system-wide spine surgery outcomes for length of stay and readmissions have consistently performed better than the average Premier client hospital. Patients' postsurgical care is coordinated in the hospital unit for a safe discharge and transition home. Education instructions are included, as well as follow up phone calls and appointments customized to a patient's individual needs. Coordination of rehabilitation will be included, if indicated.

Spine Surgery Outcomes



Source: Premier

Note: A score of less than 1.0 indicates INSI performance is better than expected based on patient medical condition and risk profile. Data are presented as a ratio of a hospital's observed rate as compared to its expected rate.



SPINE CASE • Meet Mike

Spine Program

Mark Mildorf has always loved being active, doing things like running, hiking and cycling. But he began to be bothered by strange leg pain that came and went: he could easily hike a steep trail in the mountains of Peru one week, and the next week, he would have excruciating pain while walking across the grocery store parking lot. Mark consulted with Corey Wallach, MD, orthopedic surgeon and Medical Director of the Inova Spine Program at Inova Alexandria Hospital and Inova Mount Vernon Hospital.

Mark had spinal stenosis, a narrowing of the spinal canal, which was compressing his spinal nerves and causing his symptoms. He also had arthritis in his spine that was beginning to make the spine itself curve, a condition called degenerative scoliosis. But despite these diagnoses, Dr. Wallach did not initially recommend surgery.

"One of the benefits of Inova's spine program is that our spine expertise enables us to provide a thorough workup with appropriate diagnosis, so we can provide the right care and avoid unnecessary surgeries," Dr. Wallach said.

Dr. Wallach and Mark used a variety of nonsurgical treatments, including conservative care and epidural steroid injections, to treat his symptoms initially. During this time, Mark completed a cycling milestone – his first 100-mile Century Ride – while his back continued to worsen.

When the pain was so bad that he thought twice about a simple trip to the coffee shop, Mark decided that the time for surgery had come. There was only one problem – he was training for the Seagull Century, a storied 100-mile bike ride along Maryland's Eastern Shore. Could he do both?

Dr. Wallach recommended decompression, removing a portion of the narrowed vertebrae to give the nerves more room. He also recommended a two-level spinal fusion, which would turn three adjacent vertebrae in Mark's lower back into one long, single bone with more stability.

Mark decided to have the recommended surgery, which took place at the Inova Mount Vernon Hospital. The surgery went

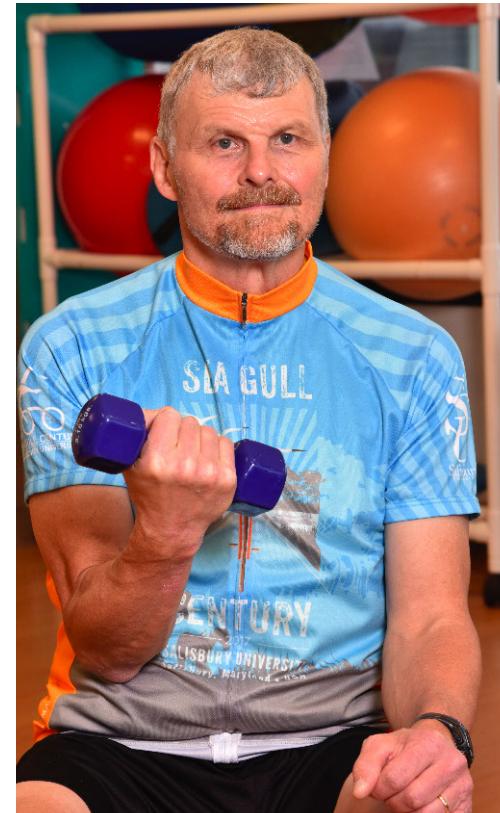
"Before, during and after surgery, the whole team was with me every step of the way."

Mark Mildorf

smoothly, and Mark dedicated himself to the recovery process. After about a week, Mark was walking several miles a day without pain. Two months later, he received the all-clear from Dr. Wallach to start training. Mark said. "Dr. Wallach and Inova did what was right for me.

Following his renewed training and exactly 100 days after his surgery, Mark successfully completed the Seagull Century bike ride in Maryland.

"I have a picture in my office of Mark holding his bike over his head in triumph after completing the ride." Dr. Wallach said. "It's very rewarding to see what a positive effect we had on Mark's life."



Contact Us | Refer a Patient

For more information about our spine program, or to schedule an appointment, please call **703.776.4700**.

Stroke and Cerebrovascular Disease Program

Stroke is a medical emergency as serious as a heart attack. Receiving medical attention as early as possible within the first three hours of a stroke can be the difference between life and death, or the difference between complete recovery and a lifetime of disability.

Certification

Certification from The Joint Commission is a symbol of quality, safety and satisfaction for patients and healthcare professionals. It recognizes we improve the quality of patient care by reducing variation in clinical processes, remain objective in assessment of clinical excellence and foster a culture for excellence.

- All five Inova hospitals have earned The Joint Commission's Gold Seal of Approval® for stroke care and operate as certified Primary Stroke Centers.
- Inova Alexandria Hospital is the first Thrombectomy Capable Stroke Center in Virginia.

For information on The Joint Commission Gold Seal of Approval® visit: jointcommission.org/stroke
Inova's comprehensive, regionally recognized stroke and rehabilitation programs seek to return stroke patients to productive daily life. Our team provides a comprehensive approach to stroke care before, during and after a stroke through preventive, emergency and rehabilitative care to give each patient the best chance at stroke recovery. We have outpatient clinical centers to aggressively follow up and monitor patients to prevent recurrence, as well as community support groups at all of our hospitals.

Inova Fairfax Hospital remains at the forefront in stroke care as a Primary Stroke Center and is in the process of obtaining additional certification as a Comprehensive Stroke Center, which is only available to Joint Commission-accredited acute care hospitals that meet all of the general eligibility requirements.

Techniques and Technology

The Inova Stroke and Cerebrovascular Disease Program employs a variety of leading-edge treatment options aided by the latest in imaging technology.

Conditions We Treat

- Arteriovenous malformation
- Aneurysms associated with moyamoya disease
- Hemorrhagic stroke
- Intracerebral hemorrhage
- Ischemic stroke
- Post stroke complications
- Subarachnoid hemorrhage
- Transient ischemic attack

We Offer

- AVM resection
- AVM stereotactic radiosurgery
- Aneurysm clipping
- Aneurysm coiling
- Aneurysm flow diversion
- Aneurysm hunting
- Carotid endarterectomy
- Carotid stenting
- Cerebral bypass
- Craniotomy
- Emergent stroke thrombectomy
- Endovascular NBCA and Onyx embolization
- Intravenous t-PA
- RAPID software technology for advanced visualization of the brain for expedited stroke evaluation and diagnosis



John Cochran, MD

Medical Director

Stroke and Cerebrovascular

Disease Program

Inova Neuroscience and Spine

Institute

"The science of acute stroke care continues to evolve with a common theme: time is brain. Every second counts when someone is having a stroke. At Inova, we work hard to shorten each step of the process to ensure the best possible outcome – educating the public to recognize the signs and symptoms of stroke, getting to the appropriate setting as fast as possible, and continuing to spare precious seconds off onset-to-treatment times."

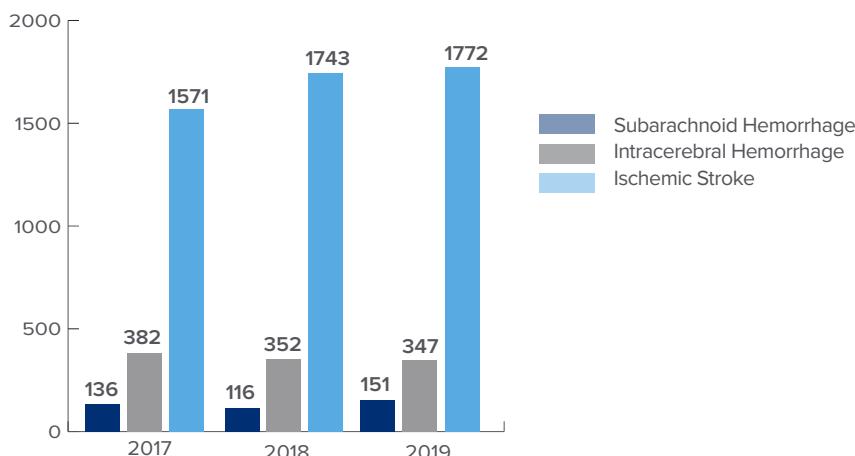
Notable Points

- In cases of acute stroke, an immediate neurological history and physical examination is carried out. Patients are closely watched for signs of increased pressure on the brain.
- Specially trained stroke response teams assess incoming stroke patients at all five Inova hospitals.
- Triage protocol includes a call to the stroke response team to evaluate all patients presenting with stroke-like symptoms.

- We are working with EMS and regional emergency departments to develop a stroke telemedicine program that will provide seamless access to appropriate and expeditious treatment of all stroke patients in and outside our region.
- We offer sophisticated brain imaging and monitoring equipment, including computerized tomography (CT), magnetic imaging (MR), magnetic resonance angiography (MRA) and RAPID software technology.

Inova Alexandria Hospital was the fourth hospital in the U.S. to be designated a Certified Thrombectomy-Capable Stroke Center.

Stroke Volumes

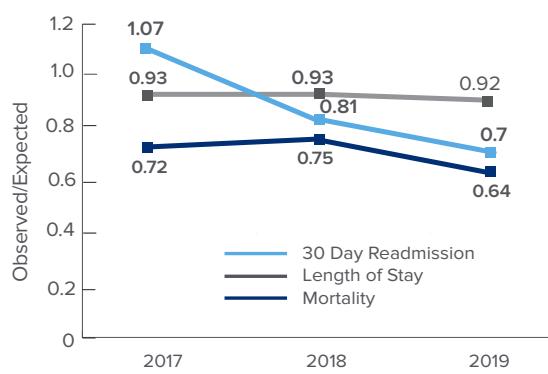


Source: Premier

99%

In 2019, Inova provided Stroke care across Inova's five hospitals was in compliance with The Joint Commission's National Quality Measures for Stroke for 99% of patients from October 2018 through September 2019.

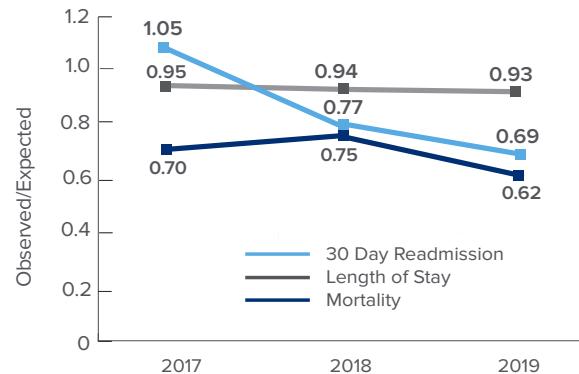
Cerebrovascular Outcomes



Source: Premier

Note: A score of less than 1.0 indicates INSI performance is better than expected based on patient medical condition and risk profile. Data are presented as a ratio of a hospital's observed rate as compared to its expected rate.

Stroke Outcomes



Source: Premier

Stroke and Cerebrovascular Disease Program *(continued)*

STROKE CASE • Meet Barbara

Stroke and Cerebrovascular Program Patient

Barbara Detrich knew something was terribly wrong. Her 84-year-old mother Sophie, who'd been cheerfully answering TV game show questions, suddenly went quiet. Her eyes were frozen open and her mouth vibrated. Barbara thought Sophie was choking, but paramedics recognized the signs of a stroke.

Sophie was rushed to the Inova Fairfax Hospital Emergency Room, where a dedicated neurointerventional team began treatment. A CT scan revealed a large vessel stroke in the dominant hemisphere of her brain. Her condition was so severe that she required a breathing tube to stay alive.

Because she had suffered a stroke three months earlier, Sophie could not receive the clot-busting drug tPA. Instead, interventional neuroradiologist Edward Greenberg, MD, and his team performed a mechanical endovascular thrombectomy, an advanced procedure using state-of-the-art equipment to find and remove the clot. With fluoroscopic guidance to see the instruments and arteries in real time, Dr. Greenberg threaded a series of small catheters into the blocked artery in Sophie's brain. He then used two different mechanical techniques to extract the clot: the Penumbra System (a vacuum device) and the Trevo® Retriever (a specially designed stent).

Despite a grim prognosis, Sophie's procedure was a complete success. "We were able to restore her brain function to normal," Dr. Greenberg says. "One of the most amazing things

"Everyone was top-notch, but also warm, attentive and caring," says Barbara. "It was so reassuring to feel that commitment. We couldn't be more satisfied."

Barbara Detrich



is that there is no evidence of even a small stroke on the subsequent brain imaging that was performed. So she did indeed escape completely unscathed."

Nobody was more amazed by the outcome than Barbara, who credits timely action by EMS and the hospital's neurointerventional team with saving her mother's life. "Everything went like clockwork," she says. "From the time the paramedics arrived at our house to the time the team wheeled her into the operating room, not a single second was lost."

Following the surgery, Sophie went back home to Springfield, Virginia, where today she is as independent as ever. Both Barbara and Sophie are grateful for the quality of care available so close to home.

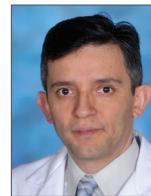
Stroke Program Medical Directors at Inova Hospitals



Laith Altawee, MD
Medical Director
Stroke Program
Inova Fairfax Hospital



Jaswinder S. Khosia, MD
Medical Director
Stroke Program
Inova Mount Vernon Hospital



Richard Ospina, MD
Medical Director
Stroke Program
Inova Fair Oaks Hospital



Dimitrious C. Papadouris, MD
Medical Director
Stroke Program
Inova Alexandria Hospital



Edward V. Puccio, MD
Medical Director
Stroke Program
Inova Loudoun Hospital



Contact Us | Refer a Patient

For more information about our Stroke and Cerebrovascular Disease Program, or to schedule an appointment, please call **703.845.1500**.

Rehabilitation Center

Inova offers highly regarded rehabilitation services to help individuals affected by back and neck pain/dysfunction, stroke, traumatic brain injury, spinal cord injury and other neuromuscular diseases achieve independence in day to day functioning.

Each of the five Inova hospitals offers rehabilitation services including physical, occupational and speech therapy for inpatients and outpatients. Pediatric therapy, psychological and neuropsychological services are available at some locations. Mount Vernon Hospital and Fairfax Hospital also provide acute rehabilitation services. Additionally, throughout Northern Virginia Inova offers comprehensive outpatient physical therapy in non-hospital clinics.

Many of the clinicians at hospital and clinic locations have specialty certifications including:

- Assistive Technology Professional (ATP)
- Certified Brain Injury Specialist (CBIS)
- Lee Silverman Voice Treatment -LSVT BIG® and LSVT LOUD®
- Neurologic Specialist Certification (NCS)
- Stroke Certification Specialist (CSRS)
- Neurodevelopmental Treatment (NDT)
- Modified Barium Swallow Impairment Profile (MBSIIP)
- Orthopedic Specialist Certification (OCS)
- Vestibular Rehab Specialist

This certification list is expanding as the team members continue to pursue excellence in evidence-based practice.

Inova also recognizes the role of family and peers in recovery. Patient-family advisory councils, peer mentoring programs and support groups are available at many locations and supported by rehab team members.



Ali G. Ganjei, MD
Medical Director
Physical Medicine and
Rehabilitation Program
Inova Neuroscience and Spine
Institute

"Inova has developed extensive, high quality rehabilitative services to meet the needs of people recovering from neurological conditions and injuries. Our highly skilled practitioners provide individualized care to the patients they treat and support them on their road to recovery. In addition to traditional rehabilitative services, we offer specialized programs that address specific conditions, such as stroke and traumatic brain injury. We continue to grow and expand our programs in order to provide a full continuum of care to a broader patient population."

More than 556 of our neuroscience patients received inpatient rehabilitation care from our extensive team of professionals.

Rehabilitation Center *(continued)*

We Offer

- Amputee Rehabilitation Program
- Augmentative and Alternative Communication Program
- Brain Injury Program
- Bridge Program (recovering from acquired brain injury: outpatient)
- Cancer rehabilitation
- Concussion Clinic (outpatient)
- Driving evaluation (outpatient)
- Dysphagia Program (VFSS, FEES, etc.)
- Neurological rehabilitation
- Orthotic and Prosthetic Clinic
- Parkinson's and Movement Disorders Center
- Patient education and support groups
- Spinal Cord Injury Program
- Stroke Program
- Vestibular rehabilitation
- Wheelchair, Seating and Mobility Clinic

Rehabilitation Specialists Include

- Case management and social work
- Chaplaincy
- Nutrition counseling
- Occupational therapy
- Palliative care
- Physical therapy
- Psychology/neuropsychology
- Rehabilitation nursing (acute rehab)
- Speech-language pathology
- Therapeutic recreation
- Physiatry



Notable Points

Peer Mentor Program

A unique collaboration that brings recovered survivors (of brain injury, stroke and more) into a mentoring relationship with patients newly adjusting to their lives as survivors of the same conditions on an inpatient and outpatient basis.

Bridge Program

A program providing a fully individualized approach to treatment with a structured setting for negotiating independence and community living skills following a life-changing neurological incident. The program includes one-on-one and group treatment sessions to help optimize achievement of each person's goals.



Contact Us | Refer a Patient

For more information about our rehabilitation programs, or to schedule an appointment, please call **703.664.7190** (outpatient) or **703.664.7592** (inpatient).





Geoffrey Ling, MD, PhD

*Vice Chair
Research Program
Inova Neuroscience and Spine
Institute*

"Research is a foundational activity and an essential part of INSI. It enables our physicians, other providers and scientists the basis by which they can use their clinical expertise to collaborate and provide the finest state-of-the-art quality care to our patients so they can have a greater longevity with a better quality of life."

Research

Our research program's goal is to improve clinical care. We do this with a multipronged approach for research in the laboratory, clinical trials with our hospital and patients, research via databases and data analytics, and research via devices. We bring together laboratory practices of biochemistry, neuroscience, molecular biology, genomics and advanced data analytics to test hypotheses that address important issues related to clinical practice and patient outcomes.

Our center is distinct because it brings together basic benchtop laboratory science and combines it with human clinical research conducted in the operating room and hospital units. Our research efforts are providing the groundwork for maintaining and advancing excellent clinical care. Our research team of physicians, nurses, therapists, scientists, database builders and statisticians strive to interlink research goals to future outcomes for diagnosis as well as treatment and/or cure of a wide variety of neurological health conditions. We collaborate with other academic institutions to share knowledge and research findings as well as to broaden capabilities and contribute with presentations before industry for further collaboration.

Research Focus Areas

INSI's research began in 2008. Between 2008 and 2019, we helped advance scientific knowledge with over 150 peer-reviewed publications, books and book chapters from clinicians and scientists. More than 250 presentations were shared with colleagues and the Inova community related to a wide range of neuroscience diseases, including aneurysmal subarachnoid hemorrhages, traumatic brain injuries, epilepsy, Parkinson's disease and many other neurological disorders in direct association with our areas of study.

Research Highlights

Pioneering Research for Pretesting Drug Therapies Effectiveness on Brain Tumors: Brain Tumor Lab and Glioblastoma Research

Through generous philanthropic support of our Inova community, Kara Foshay, PhD, Research Investigator, Inova Neuroscience and Spine Institute, has developed a unique test that is enabling a precision medicine approach to treating brain tumors, particularly glioblastoma multiforme (GBM), which is a deadly tumor. Currently, there are no effective therapies to either prevent or cure GBM. Patients typically have only a few months to live after diagnosis – in spite of the heroic efforts on the part of neurosurgeons and neuro-oncologists.

Dr. Foshay's work is based on a novel cell culture method using donated tumor cells. This test uses a biopsy sample from each patient's tumor to grow a cell culture that is unique to that patient. The culture is then used to test various drugs to identify the most effective medication for the particular patient's tumor. It is essentially a "test tube" version of the patient. Dr. Foshay is at the early stage of her research using this test on donated tumor cells. If successful, it would allow Inova to address this tragic disease by using a first-of-its-kind approach, presenting a unique opportunity for Inova patients and, ultimately, for GBM patients worldwide.

Research Combating Neurological Diseases to Ease Human Suffering

Genomics, Alzheimer's disease and GRIN2B

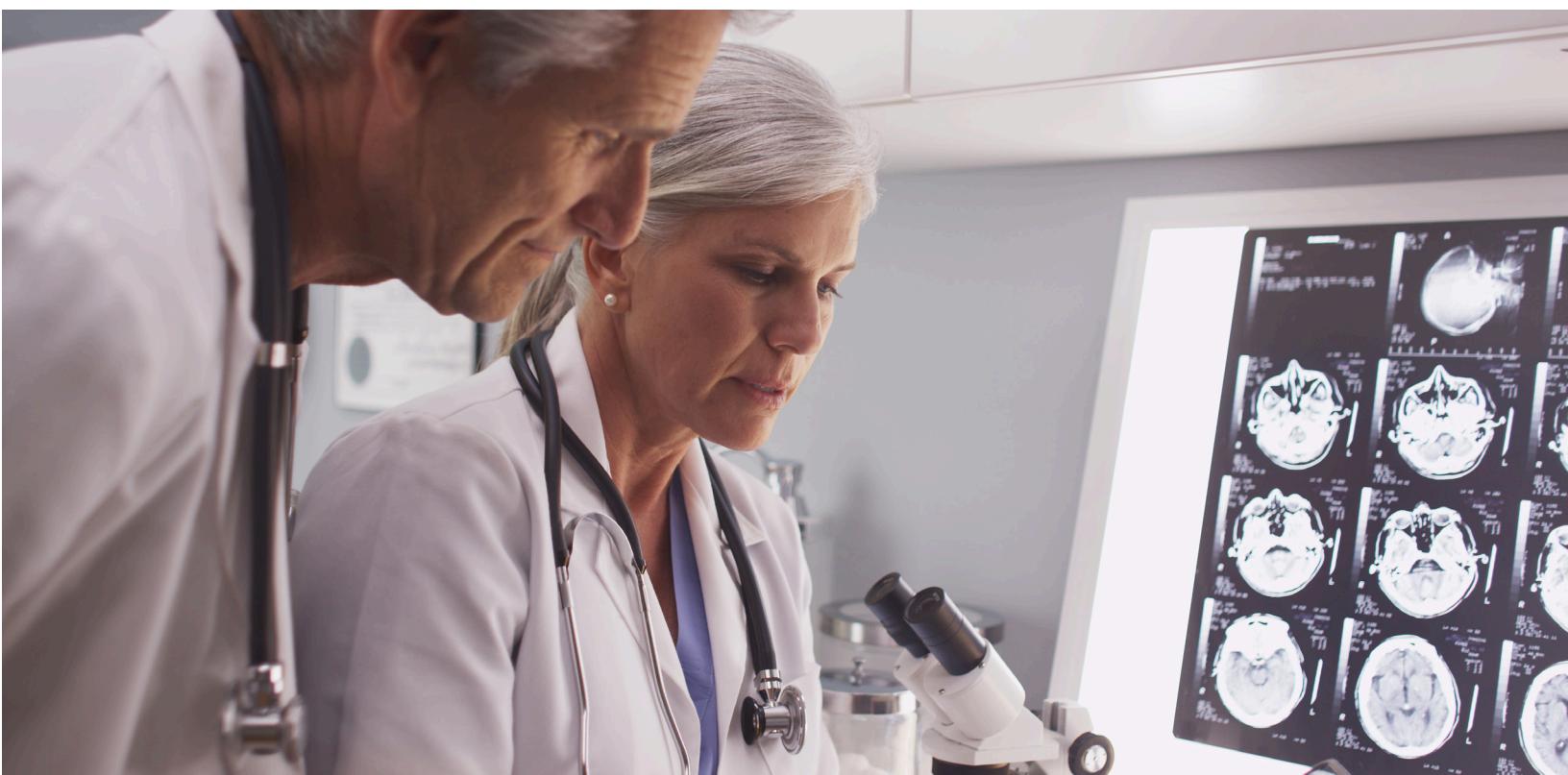
Alzheimer's disease is a dreaded affliction that affects 5.5 million of Americans. It is projected that by the year 2050, 46 million people will be diagnosed with the disease. There is no cure, prevention or effective treatment to slow it from ultimately robbing people of their identity and quality of life.

Through the dedication of Robert Lipsky, PhD, a new genetic test is being developed using his discovery of a revolutionary genetic marker for Alzheimer's called GRIN2B. It has been shown to be associated with Alzheimer's development in people of European descent. Using this marker, Dr. Lipsky is now testing different interventions that may prevent this devastating disease. It is well recognized that not all treatments need to be medications or surgery; lifestyle changes can support brain health. Improved brain health means better brain performance for healthy individuals. Therefore, this work will be linked to INSI's Brain Health Program.

Genetics Affects Recovery from Spinal Cord Injury

Spinal cord injury (SCI) exacts a tremendous financial, physical and psychological toll on those affected. The neurological deficit resulting from acute SCI is not simply a consequence of the initial tissue impact, but rather a combination of the resultant injury and the secondary inflammatory response, which in turn leads to further neural destruction. Certain genes have the potential to modify this inflammatory response.

One of these genes, called CHRFAM7A, was studied by INSI researchers and colleagues from George Mason University, the University of Kentucky and the University of Pittsburgh. We



Research *(continued)*

discovered that certain variants of the CHRFAM7A gene are associated with reduced levels of inflammatory biomarkers in blood and better clinical outcomes, including a reduction in nerve pain developed by SCI patients.

The study was published in 2019. (Wan Huang, Nadine Kabbani, Tricia K. Brannan, Ming Kuan Lin, Mark M. Theiss, John F. Hamilton, James M. Ecklund, Yvette P. Conley, Yoram Vodovotz, David Brienza, Amy K. Wagner, Emily Robbins, Gwendolyn A. Sowa and Robert H. Lipsky, "Association of a Functional Polymorphism in the CHRFAM7A Gene with Inflammatory Response Mediators and Neuropathic Pain after Spinal Cord Injury." *Journal of Neurotrauma*, Nov 2019; <http://doi.org/10.1089/neu.2018.6200>.) Since about half of all SCI patients develop nerve pain following their injury, this information could be used to more effectively treat SCI patients who have nerve pain.

Research Aimed to Help Solve Public Health Crisis

Opioid Crisis and Biomarkers Research Project

The opioid crisis is a growing epidemic in the United States. Currently, a project to develop different treatment options via biomarkers and advanced data analytics is in research. We are working with a pharmaceutical industry partner to discover the genetic basis of how individuals with opioid addiction respond to therapy. We expect that a series of genes are affected that will predict how well patients respond to their medication. In this way, treatment will be paired with individuals based on their genetics.

Clinical Trials

The INSI research team works together to conduct multiple research projects. These are either designated FDA clinical trials (drug and device) or investigator-initiated trials. Current trials include:

- Brain tumor: TOCAGEN and GBM-Targeting Tumor Cell Invasion (ClinicalTrials.gov Identifier: NCT01156584)
- Critical care: A-Lung, IO Trial and Ketamine (ClinicalTrials.gov Identifier: NCT03255057)
- Epilepsy: Epilepsy Database (ClinicalTrials.gov Identifier: NCT03283371)
- Headache: Cluster Headache and AMGEN (ClinicalTrials.gov Identifier: NCT01952574)
- Parkinson's disease: RESTORE, PRO-Go, Pharma 2B, IMPAX, INSTYIE and vitamin deficiencies(ClinicalTrials.gov Identifiers: NCT2586623, NCT03152292, NCT3329508, NCT03670953, NCT03884231, NCT03670953)
- SPRING and STRIVE (ClinicalTrials.gov Identifiers: NCT02669849, NCT02388165)
- Stroke studies: aSAH, RAS and Ketamine, GEMSTONE (ClinicalTrials.gov Identifier: NCT03470506)
- Traumatic brain injury: TBI database (Inova protocol)

Neurological Research in Tandem with Universities

We are collaborating with academic institutions to share knowledge and research findings that broaden our own capabilities. For example, Laith Altaweeel, MD, Assistant Director, Research, Inova Fairfax Medical Campus and Robert Lipsky, PhD, Director, Translational Medicine are working with the University of Virginia on a research study related to the microbiome and the correlation with stroke.

Nilesh Vyas, MD, is collaborating on a multicenter stroke study with the University of Alabama at Birmingham. This study has produced more than 15 journal articles regarding the correlation between renin angiotensin and aneurysmal subarachnoid hemorrhages. Mahesh Shenai, MD, is working with George Mason University and the University of Virginia on the development of surgical robotics.

We are partnering with University of Texas at Dallas's Center for Brain Health on a multi-million dollar, multi-center prospective study of modifiable lifestyle factors associated with maintaining good brain health. The goal of this project, called The Brain Health Project, is to identify lifestyle factors that enable people to take individualized control over their habits to better optimize brain function and, in turn, match healthy cognitive capacity with longevity.

Neurological Research and Data Analytics

In 2019, INSI's physicians, scientific researchers and nurses published over 20 peer-reviewed journal articles, multiple abstracts and books, as well as contributed to multiple book chapters. In addition to the publications, INSI's clinical care and research have been presented at 50 different national and international conferences, including the Neurocritical Care Society Conference, the American Epilepsy Society Conference, the American Association of Neurosurgical Surgeons conference, the American College of Surgeons conference and academic institutions such as Harvard's Cerebrovascular and Skull Base Symposium, among many others.

We are active in educational opportunities for future clinicians, scientists, nurses, database managers and others. Our team provides an environment of learning for those interested in neuroscience clinically or in the laboratory.



Contact Us | Refer a Patient

To inquire about participation in research trials or collaboration, contact: Karlie Smith, Interim Manager of INSI's Research Program, at **703.269.4759** or karlie.smith@inova.org.

To locate the INSI Research website, go to: inova.org/neuroscience/research/current-research

A list of research publications from INSI for 2019 can be found in the back of this report.

To inquire about donations to INSI neuroscience and neurological research development, contact: Janet Filip, INSI's Director of Institutional Giving at **703.776.3328** or Janet.Filip@inova.org.

To locate the INSI Foundation website, go to: <https://www.inova.org/our-services/inova-neuroscience-and-spine-institute/research/donate-now>



James Leiphart, MD

*Vice Chair
Education
Inova Neuroscience and Spine
Institute*

"At INSI, we remain committed to the advancement of the existing academic programs as well as the development of new academic programs, while continuing to grow our capacity to care for patients with neurological diseases."

Education and Continuing Medical Education

Inova Neuroscience and Spine Institute Academic Programs

Education is one of INSI's highest priorities. We are committed to the education of future clinicians as well as maintaining leading-edge knowledge for clinicians within our organization and the surrounding community. With this focus, we continue to expand the depth and breadth of our academic offerings, and welcomed our first neurological surgery resident in 2017.

Notable highlights

- In 2019, INSI organized five national neuroscience conferences, including the prestigious Smirniotopoulos Washington Neuroradiology & Dr. Kenneth M. Earle Memorial Neuropathology Review.
- Since 2005, INSI has offered continuing medical education (CME) events for physicians and other clinical providers, including the hosting of more than 23 nationally and internationally recognized visiting professors.
- The INSI education program has more than 15 conferences and other educational activities each month, open to employee and other clinical guests.
- INSI also provides nursing education, not only through the CME events and recurring conferences, but also through courses specifically targeted to nursing staff and operating room personnel.

In all of these ways, INSI contributes to the continuing education of medical providers within Inova, the local community, the nation and the world.

Neurological Surgery Residency

The Neurological Surgery Residency Program is a comprehensive seven-year program, fully accredited by the Accreditation Council of Graduate Medical Education (ACGME). It provides each resident with thorough training in neurosurgical clinical care, surgical skills and research.

The neurosurgery residency was accredited by the ACGME in 2016, and welcomed its first resident, Sethesh Mansinghani, MD, in 2017.

The program welcomed the second resident in 2018. Danielle Dang, MD, Class of 2025, joined the neurosurgery residency program in 2018. She is currently a PGY-2.

This was followed by Luke Mugge, MD. He is currently a PGY-1.

For Information on INSI's neurosurgical residency program, go online to: <https://www.inova.org/education/gme/neurosurgical-residency-program>.

For information on the neurosurgery residency program, contact: Marisol Rivera, INSI Neurosurgery Residency Program Coordinator at 703.776.6375 or marisol.rivera@inova.org.

Virginia Commonwealth University School of Medicine

Medical Student Clerkship

In 2004, Inova Fairfax Hospital expanded its educational offerings through a partnership with the Virginia Commonwealth University School of Medicine. Together, we developed the first regional branch medical campus in Northern Virginia.

INSI runs the requisite four-week neurology clerkship in which the 32 third-year medical students enhance their skills in evaluating, diagnosing and treating neurological patients.

During their fourth year of medical school, medical students are permitted to participate in a four-week clerkship rotation in either neurology or neurological surgery.

The clerkships are conducted by neuroscience faculty and are an opportunity for the students to explore the possibility of selecting neurology or neurological surgery specialty. It is also an opportunity to further hone their skills in the evaluation and treatment of neurological disorders. A four-week neurological surgery rotation is also available to fourth-year medical students from other medical schools as an away rotation. INSI hosted one fourth-year visiting medical student for a four-week neurosurgery rotation in 2019.

International Fellowship

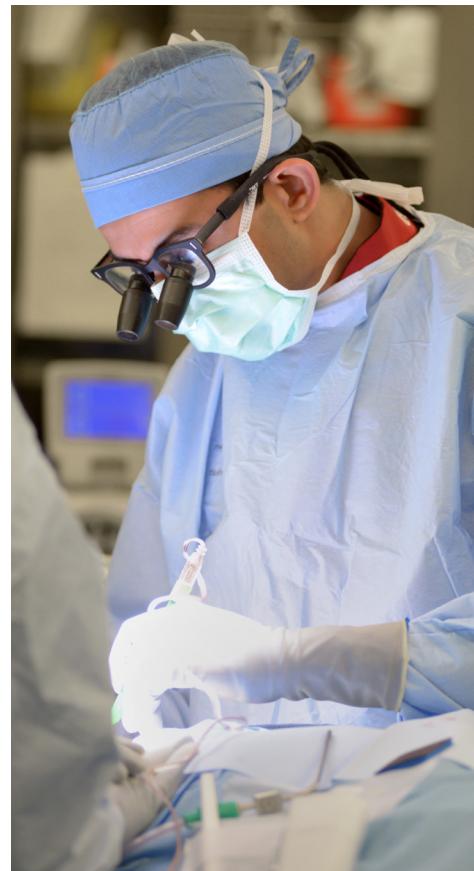
The INSI international fellowship, started in 2011, has trained three international clinicians. This is one of the many ways INSI has contributed to the education of neuroscience physicians.

Now in its ninth year, the INSI neurosurgical international fellowship program is for practicing neurosurgeons outside the U.S. who are interested in further developing their skills in leading-edge neurological procedures, practice and research. Upon completion of the program, they are expected to return and develop new programs in their home countries. Past participants were drawn from countries such as Greece and Lebanon, and participated for a period of one to two years.

The international fellowship provides an individual with a comprehensive, supervised, full-time educational experience in caring for neurosurgical patients, including the comprehensive management of patients with neurological illnesses, the performance of surgical procedures and the clinical management of patients.

CME Symposia

INSI began offering national conferences in 2011, with the Dr. Kenneth M. Earle Memorial Neuropathology Review and Washington Neuroradiology Review course, formerly known as the Armed Forces Institute of Pathology (AFIP) Neuroradiology and Neuropathology Review Course. In 2019, INSI offered five annual conferences that will continue to be held on an annual basis, including the Dr. Kenneth M. Earle Memorial conference. These conferences are multidisciplinary symposia, attracting speakers from throughout the country to provide the



Education and CME (continued)

education necessary for medical and clinical participants to enhance their skills in an engaging, thought-provoking environment. The ultimate goal of these symposia is to improve patient care. Symposia-related programs for 2019 included:

- Dr. Kenneth M. Earle Memorial Neuropathology Review and Washington Neuroradiology Review: Jan. 12-16, 2019
- Third Annual National Neuroscience Review: May 31, 2019
- Third Annual National Art and Science of Brain Health Seminar: Sept. 13, 2019
- First Annual Sleep Symposium: Oct. 24, 2019
- First Annual Neuroscience Nursing CE Conference: Nov. 7-8, 2019

Visiting Professor Program

Each year, eminent clinical neuroscientists are invited to Inova to participate as faculty during Neuroscience Grand Rounds and evening lectures. In 2019, guests included:



Anthony Asher, MD, FACS

Program Director, Neurosurgical Surgery Residency Program, Carolinas Medical Center President, Neuroscience Institute, Atrium Health
Surgical Director, Adult Brain and Spinal Cord Tumor Programs, Atrium Health, Levine Cancer Institute

Neoadjuvant Radiosurgery: An Evolving Treatment Paradigm in the Surgical Management of Cerebral Metastases and Clinical Databases in Neurosurgery – The Quality Outcome Database (QOD) and ABNS POST

Feb. 19, 2019, Fairview Park Marriott, Falls Church, VA

Nicholas Marko, MD, FAANS

Director, Brain Tumor Center, University of Cincinnati, Gardner Neuroscience Institute Associate Professor, Department of Surgery, University of Cincinnati

Surgery for Infiltrating Gliomas in Eloquent Cortex

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Gary W. Mathern, MD, FAANS

The Davies/ Crandall Endowed Chair of Epilepsy Research Director, Epilepsy Surgery, Pediatric Epilepsy Program, University of California, Los Angeles
Professor, Departments of Neurosurgery & Psychiatry, University of California Los Angeles, David Geffen School of Medicine

Pediatric Epilepsy Surgery

Sept. 24, 2019, Fairview Park Marriott, Falls Church, VA

Grand Rounds and Programmatic Continuing Medical Educational Lectures

Each year, medical experts from INSI's primary programs and affiliated community clinical leaders give lectures for faculty and community physicians, providing instruction on new guidelines or illustration of new procedures and technologies. In 2019, these lectures included:

Mateo Ziu, MD, MBA, FAANS

Medical Director, Brain and Spine Tumor Program, Inova Neuroscience and Spine Institute
Medical Director, Neuro-Oncology, Inova Schar Cancer Institute
Associate Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Benefits of Surgical Intervention in Patients with Primary Brain Tumors

Feb. 5, 2019, Fairview Park Marriott,
Falls Church, VA

Mahesh Shenai, MD, MBA

Medical Director of Functional and Restorative Neurosurgery, Inova Neuroscience and Spine Institute, Physician Practice Leader, Inova Neurosurgery

Drew Falconer, MD

Co-Medical Director, Parkinson's and Movement Disorders Center, Inova Neuroscience and Spine Institute
Director, Neurology Clerkship, Virginia Commonwealth University, School of Medicine, Inova Campus

Sean Rogers, MD, PhD

Co-Medical Director, Parkinson's and Movement Disorders Center, Inova Neuroscience and Spine Institute
Associate Director, Neurology Clerkship, Virginia Commonwealth University, School of Medicine, Inova Campus

Improving Parkinson's Outcomes Through Use of Modern Therapies: An Update on

Advancements in Treatment

March 12, 2019, Fairview Park Marriott,
Falls Church, VA

John F. Hamilton, MD, PhD

Medical Director, Spine and Peripheral Nerve Surgery, Inova Neuroscience and Spine Institute, Associate Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Management of Spinal Metastases

April 9, 2019, Fairview Park Marriott,
Falls Church, VA

Rahul Davé, MD

Medical Director, Multiple Sclerosis and Neuroimmunology Center, Inova Neuroscience and Spine Institute, Assistant Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Rethinking Multiple Sclerosis: Navigating a Changing Landscape

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Drew Falconer, MD

Co-Medical Director, Parkinson's and Movement Disorders Center, Inova Neuroscience and Spine Institute, Director, Neurology Clerkship, Virginia Commonwealth University, School of Medicine, Inova Campus

Shifting the Paradigm for Parkinson's disease Through Modern Treatments

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Charlotte Kastl, MD

Co-Medical Director, Headache Program, Inova Neuroscience and Spine Institute

Migraine Headache – A New Therapeutic Approach

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Education and CME (continued)

Mahesh Shenai, MD, MBA

Medical Director of Functional and Restorative Neurosurgery, Inova Neuroscience and Spine Institute, Physician Practice Leader, Inova Neurosurgery

Surgical Treatment for Parkinson's disease – The Past, Present and Future

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Eric Bruce Sklar, MD

Medical Director, Sleep Disorders Program, Inova Neuroscience and Spine Institute

Overview of Sleep Disorders in Neurology

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Nilesh Vyas, MD, FAANS

Associate Chair, Neurosurgery, Inova Neuroscience and Spine Institute

Latest Treatments of Anterior-Venous Malformations

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Mateo Ziu, MD, MBA, FAANS

Medical Director, Brain and Spine Tumor Program, Inova Neuroscience and Spine Institute, Medical Director, Neuro-Oncology, Inova Schar Cancer Institute, Associate Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Surgical Treatments of Spontaneous Intracranial Hemorrhages: Is There any Hope?

May 31, 2019, Inova Center for Personalized Health, Falls Church, VA

Greg D. Fischer, MD

Medical Director, Pain Management Program, Inova Neuroscience and Spine Institute

Martin H. Brown, MD

Emergency Medicine, Inova Alexandria Hospital
President, Alteon Health

Husam Alathari, MD

Medical Director, Inova Behavioral Health Services, Comprehensive Addiction Treatment Services (CATS)

Peter Wei, MD

Physiatrist, Inova Spine Program, Inova Neuroscience and Spine Institute

Appropriate Prescribing of Controlled Substances: Recognition and Management of Addiction

June 4, 2019, Fairview Park Marriott, Falls Church, VA

Andrew Fanous, MD

Neurosurgeon, Inova Neurosurgery, Inova Neuroscience and Spine Institute, Assistant Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Low Back Pain's Missing Piece: Sacroiliac Joint Disease

July 9, 2019, Fairview Park Marriott, Falls Church, VA

Laura Miller, MD

Co-Director, Headache Program, Inova Neuroscience and Spine Institute

Charlotte Kastl, MD

Co-Director, Headache Program, Inova Neuroscience and Spine Institute

Updates in Headache Diagnosis and Treatment

Aug. 30, 2019, Fairview Park Marriott, Falls Church, VA



James Leiphart, MD, PhD

Vice Chair, Education, Inova Neuroscience and Spine Institute, Director, Neurosurgery Residency Program, Inova Neuroscience and Spine Institute, Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Mohan Kurukumbi, MD

Medical Director, Epilepsy Center, Inova Neuroscience and Spine Institute, Assistant Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Epilepsy Update: What Happens in a Level 4 Inova Epilepsy Center

Oct. 15, 2019, Fairview Park Marriott, Falls Church, VA

Sairah Bashir, MD

Lead Physician, Inpatient Neurology, Inova Neuroscience and Spine Institute

Neuroimaging in Clinical Practice

Sept. 13, 2019, Inova Center for Personalized Health Conference Center, Falls Church, VA

Sean Rogers, MD, PhD

Co-Medical Director, Parkinson's and Movement Disorders Center, Inova Neuroscience and Spine Institute, Associate Director, Neurology Clerkship, Virginia Commonwealth University, School of Medicine, Inova Campus

Deep Brain Stimulation: From Parkinson's and Tremor to Depression, Epilepsy and More

Sept. 13, 2019, Inova Center for Personalized Health Conference Center, Falls Church, VA

Jacquelyn F. Gamino, PhD

Director, Adolescent Reasoning Initiative, University of Texas at Dallas, Center for Brain Health, Assistant Research Professor, University of Texas at Dallas

Cognition in the Classroom – Building Young Brains for the Future

Sept. 13, 2019, Inova Center for Personalized Health Conference Center, Falls Church, VA

Andre Culpepper, MD, MS

Physician, Vascular Neurology, Inova Neuroscience and Spine Institute

Secondary Stroke Prevention

Sept. 13, 2019, Inova Center for Personalized Health Conference Center, Falls Church, VA

Laura Miller, MD

Co-Medical Director, Headache Program, Inova Neuroscience and Spine Institute

Current Concepts in Concussion

Sept. 13, 2019, Inova Center for Personalized Health Conference Center, Falls Church, VA

Eric Bruce Sklar, MD

Medical Director, Sleep Disorders Program, Inova Neuroscience and Spine Institute

Sleep Apnea: Overview and Consequences

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Amit Vaid, MD

Physician, Pulmonary and Sleep Medicine, Inova Neuroscience and Spine Institute

Sleep Apnea: Positive Airway Pressure Treatment

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Virginia Runko, PhD, CBSM, DBSM

Psychologist, Behavioral Sleep Medicine

Cognitive Behavioral Therapy for Insomnia

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Howard Charles Jelinek, Jr., DDS

Dental Sleep Medicine

How Sleep Apnea Affected My Life

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Education and CME *(continued)*

Maria Tadic, RD, CSOWM

Registered Dietitian, Inova Fair Oaks Hospital

Managing Sleep Apnea with Nutrition

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Amir H. Moazzez, MD, FACS

Medical Director, Inova Weight Loss Surgery Program

Bariatric Surgery: A Treatment for Sleep Apnea

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Timothy Egan, MD

Ear, Nose and Throat/Sleep Medicine, Inova Fairfax Hospital

Hypoglossal Nerve Stimulation Therapy for Obstructive Sleep Apnea

Oct. 24, 2019, Inova Physicians Conference Center, Falls Church, VA

Laith Altaweeil, MD

Stroke Medical Director, Inova Fairfax Hospital, Inova Neuroscience and Spine Institute

Sairah Bashir, MD

Lead Physician, Inpatient Neurology, Inova Neuroscience and Spine Institute

TeleStroke and Tele-Acute Care Neurology

Dec. 17, 2019, Fairview Park Marriott, Falls Church, VA

Pouya Tahsili Fahadan, MD

Neurocritical Care, Inova Fairfax Hospital

Complete Neuro Exam/NIHSS

Nov. 7, 2019, Inova Epic Training Center, Falls Church, VA

Mary Hollist, DO

Vascular Neurology, Inova Neuroscience and Spine Institute

Stroke Etiologies Clinical Cases

Nov. 7, 2019, Inova Epic Training Center, Falls Church, VA

Edward D. Greenberg, MD

Interventional Neuroradiology, Inova Fairfax Hospital

Neurointerventional Radiology

Nov. 8, 2019, Inova Epic Training Center, Falls Church, VA

Saqib Chaudhry, MD

Medical Director, Stroke Quality and Research, Inova Neuroscience and Spine Institute

Ischemic Stroke Evolution

Nov. 8, 2019, Inova Epic Training Center, Falls Church, VA

Ameet Chitale, MD

Endovascular Neurosurgery, Inova Neuroscience and Spine Institute

Emergency Neurosurgical Intervention

Nov. 8, 2019, Inova Epic Training Center, Falls Church, VA

Riva Kamat, MD, FAAP

Pediatrics, Inova Fairfax Hospital

Self-Care, Resilience and Burnout

Nov. 8, 2019, Inova Epic Training Center, Falls Church, VA

Nursing Perioperative Neurosurgical Training Workshops

These workshops are designed to provide medical and clinical participants education to improve patient care. The goal is to enhance healthcare professionals' skills within the neuroscience operating room in an engaging, thought-provoking environment.

Susan Wooddell, RN and Jordan Simpson

Perioperative Services, Inova Neuroscience and Spine Institute

Back to Basics

March 23, 2019, Inova Fairfax Hospital, Falls Church, VA

Nilesh Vyas, MD, FAANS

Associate Chair, Neurosurgery, Inova Neuroscience and Spine Institute

Aneurysm Clipping

June 22, 2019, Inova Fairfax Hospital, Falls Church, VA

James Leiphart, MD, PhD

Vice Chair, Education, Inova Neuroscience and Spine Institute, Director, Neurosurgery Residency Program, Inova Neuroscience and Spine Institute, Professor, Virginia Commonwealth University, School of Medicine, Inova Campus

Craniotomy and Shunt Basics

Oct. 5, 2019, Inova Fairfax Hospital, Falls Church, VA

Ameet Chitale, MD

Endovascular Neurosurgery, Inova Neuroscience and Spine Institute

Spine Surgical Interventions

Dec. 7, 2019, Inova Fairfax Hospital, Falls Church, VA

Neurocritical Care Society (ENLS) Certification Courses

Inova Fairfax Hospital conducted the annual Emergency Neurological Life Support Training for the Neurocritical Care Society's ENLS Certification

Course. The purpose of the course is to have providers learn what to do in the first critical hour of a neurological emergency. The course took place on May 8, 2019, at Inova Fairfax Hospital. Each module was taught by Dan Dinescu, MD, Medical Director, Neurocritical Care Program, Inova Neuroscience and Spine Institute.

Clinical Teaching Activities

INSI's academic program consists of a coordinated schedule of conferences and lectures in the basic and clinical neurosciences, as well as a structured curriculum. The teaching conference schedule is structured to involve faculty participation and interaction. Regularly scheduled conferences draw attendees from Inova and the local community. Physicians from the community are welcome to attend most of the conferences that do not include peer review.

Standard conferences include:

- Cerebrovascular Quality Case Conference and Peer Review
- Cerebrovascular Journal Club Series (added in 2019)
- Head and Neck Tumor Board Case Conference (added in 2019)
- Monthly Faculty Development
- Multidisciplinary Epilepsy Case Conference
- Neurodiagnostic Case Conference
- Neuro-oncology Case Conference
- Neurosciences Grand Rounds and Visiting Professor Series
- Neurosurgery Journal Club
- Neurosurgery Peer Review
- Neurosurgery School
- Neuroscience Intensive Care Unit (NSICU) Rounds Conference
- Ortho-Neuro-Spine Case Conference
- Stroke Bootcamp Series (added in 2019)
- Trauma/Neuroradiology Case Conference



Education and CME *(continued)*

INSI Advanced Education – Corporate

INSI has developed customized educational programs targeted to meet a specific need or audience. Examples of programs include medical education tailored for athletic trainers, physical therapists, U.S. law enforcement and U.S. emergency management personnel.

INSI Advanced Education – Academia

The emergent field of neurotechnologies and “wiring up” human brains is leading us into a new future. Examples include big data-enhanced diagnostics and treatments, brain-computer interfaces for brain control, real-time neuromonitoring, and brain-responsive computer systems. Current research now seeks to optimize the long-term stability and biocompatibility of such brain implants to make them viable for practical use.

INSI faculty have collaborated with George Mason University to offer undergraduate and graduate-level engineering courses that give students applied experience in clinical technologies related to neurotechnologies and biomedical commercialization. The goal of these courses is to help students further their study, innovation and applied thinking.

Courses developed include:

- Introduction to Biomedical Commercialization – a course designed to introduce students to the process of commercialization, with discussions on design, validation, patents, business strategy and fundraising.
- Introduction to Neurotechnologies – a course designed to provide senior students with applied clinical technologies experience, including VP shunts, radiology, spinal instrumentation, stereotaxy, Neuropace and EEG technologies.



Contact Us | Refer a Patient

For more information about INSI's educational programs, contact Marie Bermudez, INSI Academic Program Manager at **703.776.3130** or [**marie.bermudez@inova.org**](mailto:marie.bermudez@inova.org).

What's Ahead

In 2019, INSI launched a new Brain Health Program, as well as expanded access and services for both Inova Neurology and Inova Neurosurgery with the opening of an office location in Gainesville, Virginia. INSI continues to expand neurology and neurosurgical services across the five Inova hospitals in the health system and to use telemedicine to help patients in remote areas of Northern Virginia have improved access to care.



Brain Health Program

Brain health involves an individual's cognitive, neuropsychological and mental state. Brain health determines our ability to perform well in the classroom, at work and at home. INSI's Brain Health Program, which opened in 2019, is Northern Virginia's first program focused on improving and maintaining brain wellness and cognitive performance for all ages, in both healthy and at-risk populations. We provide a comprehensive program that assesses and coaches individuals. Clients undergo a baseline screening. Scientific research has demonstrated that people can make simple lifestyle changes that support brain health. Improved brain health means better brain performance for healthy individuals, as well as individuals with neurological condition or injury (e.g., stroke or TBI).

The Brain Health Program has a strategic partnership with the Center for BrainHealth® at The University of Texas at Dallas (UTD).^{*} In conjunction with UTD, the Inova Brain Health Program will conduct research to further understanding and knowledge related to optimization of brain health and performance.

We note that UTD is a leading research university that has pioneered much of the brain health scientific understanding and intervention programs currently available.

We Offer

Services will include cognitive training and coaching on diet, sleep, social networking and other relevant interventions, as well as guidance on how to incorporate these into normal life routines. Follow-up assessments will gauge progress and facilitate continued coaching.

Mary Fountain, MPH

Director

Brain Health Program

Inova Neuroscience and Spine Institute

"Our individual performance is significantly impacted by our brain function. The Inova Brain Health Program will offer innovative services supported by scientific evidence to help achieve optimal brain health and performance. We are very excited to launch the first Brain Health Program of this kind in our region."





Steven Dean, MS
*Administrator Director of
 Telemedicine Operations*
Inova Health System

"Telemedicine is the remote delivery of healthcare services using telecommunications technology as defined by the American Telemedicine Association. For INSI, our telemedicine services follow the same clinical principles for delivery of patient care, safety and desired outcome as in-person consultations. The difference is that our neurologists and neurosurgeons utilize virtual health tools to deliver care in remote areas for patients who are unable to make it to our care centers. At its core, telemedicine is helps increase access to quality care."

What's Ahead *(continued)*

Telemedicine

Overview

Since 2004, when Inova's Telemedicine Program became one of the first tele-ICUs in the country, we have improved patient health by applying communications technology to patient care delivery, research and education. By using modern technology, we are able to extend clinical expertise to patients at any geographic location in our area. Today, the Telemedicine Program supports 18 service lines at nearly 50 locations throughout Virginia.

Awards

The program was the first in the country to be awarded the American Association of Critical Care Nurses' prestigious Gold Beacon Award. It also manages the virtual technology for the Northern Virginia Hospital Alliance emergency preparedness program.

INSI Use of Telemedicine

Telemedicine extends INSI's access to patients who have difficulty coming to a main center for a neurological or neurosurgery clinical specialist consult or stroke center triage, where time is of the essence.

INSI will continue to use telemedicine to reach those in remote locations and connect them with our neurologists and neurosurgeons.

Remote Stroke Triage

Our emergency rooms are equipped with specially designed mobile carts that enable our neurologists to remotely assess potential stroke patients. Leveraging synchronous, secure videoconferencing software, clinicians have access to the patient's bedside location for remote evaluation when urgent decisions are needed.

Funding the Future

We thank all INSI donors who have joined with our clinicians and staff to help us get to where we are today: a leader in the diagnosis, treatment and research of complex neurological conditions involving the brain, spine and peripheral nervous system. We now have every specialty represented as well as coordinated work in research and education.

We remain true to the quest of improving the lives of neuroscience patients by inspiring hope and delivering seamless, integrated care of the highest quality across all of INSI's specialties, while simultaneously enhancing education and research. We still feel a sense of urgency to continue to accelerate our capabilities, and there are many ways that philanthropic support can further our work.



Contact Us | Refer a Patient

For more information about donations to help build the future of INSI, please contact Janet Flip, Executive Director of Development, Inova Neuroscience and Spine Institute, at janet.flip@inova.org or **703.776.3328**.

2019 INSI Research Publications

Abdelmalik PA, Draghic N, Ling GSF. Management of moderate and severe traumatic brain injury. *Transfusion*. 2019; 59: 1529-1538. doi:10.1111/trf.15171.

Bliden KP, Raviv G, Tantry US, Chaudhary R, Cochran JW, Navarese EP, Brannan T, Vyas A, Gurbel PA. Blueprinting thrombogenicity and antithrombotic drug at the bedside in patients presenting emergently with symptoms of acute stroke. *J Thromb Thrombolysis* 2019; 47: 192. <https://doi.org/10.1007/s11239-019-01813-0>.

Chaudhary R, Sukhi A, Chaudhary R, Jindal M, Vyas A, Rout A, Bliden K, Tantry U, Gurbel P. Gender differences in thrombogenicity among patients with angina and non-obstructive coronary artery disease. *J Thromb Thrombolysis*. 2019 Oct;48(3):373-381. doi: 10.1007/s11239-019-01901-1. PMID: 31218482

Falconer R, Shah T, Rogers S, Green A, Shenai M. Utilizing the flexibility of directional deep brain stimulation intraperatively (if needed) to minimize microelectrode lead repositioning. *Cureus*. 2019; 11(7): e5276. doi:10.7759/cureus.5276.

Falconer RA, Shah T, Giles A, Shenai M, Rogers S. Unilateral hyperkinetic choreiform movements due to calcification of the putamen and caudate from an underlying developmental venous anomaly. *Cureus*. 2019; 11(1): e3990. doi:10.7759/cureus.3990.

Famous AA, Tumialan LM, Wang MY. Kambin's triangle: Definition and new classification schema. *J Neurosurgery Spine*. 2019. Nov 29: 1-9. doi: 10.3171/2019.8.SPINE181475. [Epub ahead of print].

Hanley DF, Thompson RE, Rosenblum M, Yenokyan G, Lane K, McBee N, Mayo SW, Bistran-Hall AJ, Gandhi D, Mould WA, Ullman N, Ali H, Carhuapoma JR, Kase CS, Lees KR, Dawson J, Wilson A, Betz JF, Sugar EA, Hao Y, Avadhani R, Caron JL, Harrigan MR, Carlson AP, Bulters D, LeDoux D, Huang J, Cobb C, Gupta G, Kitagawa R, Chicoine MR, Patel H, Dodd R, Camarata PJ, Wolfe S, Stadnik A, Money PL, Mitchell P, Sarabia R, Harnof S, Barzo P, Unterberg A, Teitelbaum JS, Wang W, Anderson CS, Mendelow AD, Gregson B, Janis S, Vespa P, Ziai W, Zuccarello M, Awad IA; MISTIE III Investigators. Efficacy and safety of minimally invasive surgery with thrombolysis in intracerebral haemorrhage evacuation (MISTIE III): A randomised, controlled, open-label, blinded endpoint phase 3 trial. *Lancet*. 2019 Mar 9;393(10175):1021-1032. doi: 10.1016/S0140-6736(19)30195-3. Epub 2019 Feb 7. Erratum in: *Lancet*. 2019 Apr 20;393(10181):1596. PMID: 30739747; PMCID: PMC6894906.

Hendrix P, Foreman PM, Senger S, Burkhardt BW, Harrigan MR, Fisher WS 3rd, Vyas NA, Lipsky RH, Walters BC, Tubbs RS, Shoja MM, Griessenauer CJ. Loss of consciousness at onset of aneurysmal subarachnoid hemorrhage in good-grade patients. *Neurosurg Rev* 2019. doi:10.1007/s10143-019-01142-z.

Huang W, Kabbani N, Brannan TK, Lin MK, Theiss MM, Hamilton JF, Ecklund JM, Conley YP, Vodovotz Y, Brienza D, Wagner AK, Robbins E, Sowa GA, Lipsky RH. Association of a functional polymorphism in the CHRFAM7A gene with inflammatory response mediators and neuropathic pain after spinal cord injury. *Journal of Neurotrauma*. 2019. doi: 10.1089/neu.2018.6200.

Kurukumbi M, Leiphart J, Singer L. A rare case of insular epilepsy: Not to be missed in refractory epilepsy patients. *Cureus*. 2019 Aug 20;11(8):e5434. doi: 10.7759/cureus.5434. PMID: 31482049; PMCID: PMC6701894.

Kurukumbi M, Leiphart J, Asif A, Wang J. Vagus nerve stimulation (VNS) in super refractory new onset refractory status epilepticus (NORSE). *Case Rep Neurol Med*. 2019 Jan 21;2019:7852017. doi: 10.1155/2019/7852017. PMID: 30805233; PMCID: PMC6360559.

Leiphart J, Barrett M, Shenai MB. Economic inequities in the application of neuromodulation devices. *Cureus*. 2019. 11(9): e5685. doi:10.7759/cureus.5685.

2019 INSI Research Publications *(continued)*

Leiphart JW, Ye Z, Lee M, Loew MH. Threshold for tonic motor effects from random waveform in a rat experimental model of frontal cortex stimulation. *Stereotact Funct Neurosurg.* 2019;97(5-6):313-318. doi: 10.1159/000503022. Epub 2020 Jan 7. PMID: 31910428.

Li, M, Griessenaue, CJ, Starke RM, Tubbs RS, Shoja MM, Foreman PM, Vyas NA, Walters BC, Harrigan MR, Hendrix P, Fisher WS, Pittet JF, Mathru M, Lipsky RH. Haplotype analysis of SERPINE1 gene: Risk for aneurysmal subarachnoid hemorrhage and clinical outcomes. *Mol Genet Genomic Med.* 2019. 7:e737. <https://doi.org/10.1002/mgg3.737>.

Ling G, Draghic, N. Aerial drones for blood delivery. *Transfusion.* 2019; 59: 1608-1611. doi: 10.1111/trf.15195.

Morr S, Vakharia K, Fanous AA, Wagas M, Siddiqui AH. Utility of intravascular ultrasound during carotid angioplasty and stenting with proximal protection. *Cureus.* 2019. 11 (6): e4935. doi: 10.7759/cureus.4

Prolo LM, Li A, Owen SF, Parker JJ, Foshay K, Nitta RT, Morgens DW, Bolin S, Wilson CM, Vega JCM, Luo EF, Nwagbo G, Waziri A, Li G, Reimer RJ, Bassik MC, Grant GA. Targeted genomic CRISPR-Cas9 screen identifies MAP4K4 as essential for glioblastoma invasion. *Sci Rep* 2019. 9 (1): 14020. doi: 10.1038/s41598-019-50160-w.

Shenai MB, Falconer R, Rogers S. A. cupriavidus pauculus infection in a patient with a deep brain stimulation implant. *Cureus.* 2019. 11(11): e6104. 209 Nov 8. doi:10.7759/cureus.6104.935

Ullman NL, Tahsili-Fahadan P, Thompson CB, Siai WC, Hanley DF. Third ventricle obstruction by thalamic intracerebral hemorrhage predicts poor functional outcome among patients treated with alteplase in the CLEAR III trial. *Neurocrit Care* 30:380–386 2019. doi:10.1007/s12028-018-0610-0.

Wang J, Fang Y, Ramesh S, Zakaria A, Putman MT, Dinescu D, Paik J, Geocadin RG, Tahsili-Fahadan P, Altaweeil LR. Intraosseous administration of 23.4% NaCl for treatment of intracranial hypertension. *Neurocrit Care* 2019. 30: 364-371. <https://doi.org/10.1007/s12028-018-0637-2>.

Wang, J., Fang, Y., Ramesh, S. et al. Intraosseous administration of 23.4% NaCl for treatment of intracranial hypertension. *Neurocrit Care.* 2019. 30:364-371. <https://doi.org/10.1007/s12028-018-0637-2>.

Ziu M. Commentary: Congress of neurological surgeons systematic review and evidence-based guidelines on the use of stereotactic radiosurgery in the treatment of adults with metastatic brain tumors. *Neurosurgery.* 2019. 84 (3): E171–E172. doi.org/10.1093/neuros/nyy599.

Ziu M. Commentary: Congress of neurological surgeons systematic review and evidence-based guidelines on the role of prophylactic anticonvulsants in the treatment of adults with metastatic brain tumors. *Neurosurgery.* 2019. 84 (3): E199–E200. doi.org/10.1093/neuros/nyy597.

Ziu M. Commentary: Congress of neurological surgeons systematic review and evidence-based guidelines on treatment options for adults with multiple metastatic brain tumors. *Neurosurgery* 84.3 March 2019, Pages E187–E188, <https://doi.org/10.1093/neuros/nyy598>.

Ziu M, Traylor JL, Paxman J, Goodgame BW. Stereotactic vertebroplasty for spinal metastases with multilevel bilateral pedicle fractures: A technical note. *Cureus.* 2019 Feb 22;11(2):e4123. doi: 10.7759/cureus.4123.

Inova Neuroscience and Spine Institute Physicians

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Azzam	Charles	MD	Neurosurgery
Bashir	Sairah	MD	Neurology
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Bicksel	James	MD	Neurology
Brenner	Richard	MD	Orthopedic Surgery
Bryan	Candace	MD	Neurology
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Chaudry	Saquib	MD	Neurocritical Care
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Childs	Ronald	MD	Orthopedic Surgery
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Cochran	John (Jack)	MD	Neurology
Culpepper	Andre	MD	Vascular Neurology
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Davé	Rahul	MD, PhD	Neurology
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Eberly	Lewis	MD	Neurology
Ecklund	James	MD	Neurosurgery
Ehsan	Tajammul	MD	Neurology
Falconer	Ramsey (Drew)	MD	Neurology
Fanous	Andrew	MD	Neurosurgery
Fischer	Greg	MD	Anesthesiology
Fitzpatrick	Kevin	MD	Physical Medicine/ Rehabilitation
Ganjei	Ali	MD	Physical Medicine/ Rehabilitation
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Special Acknowledgements

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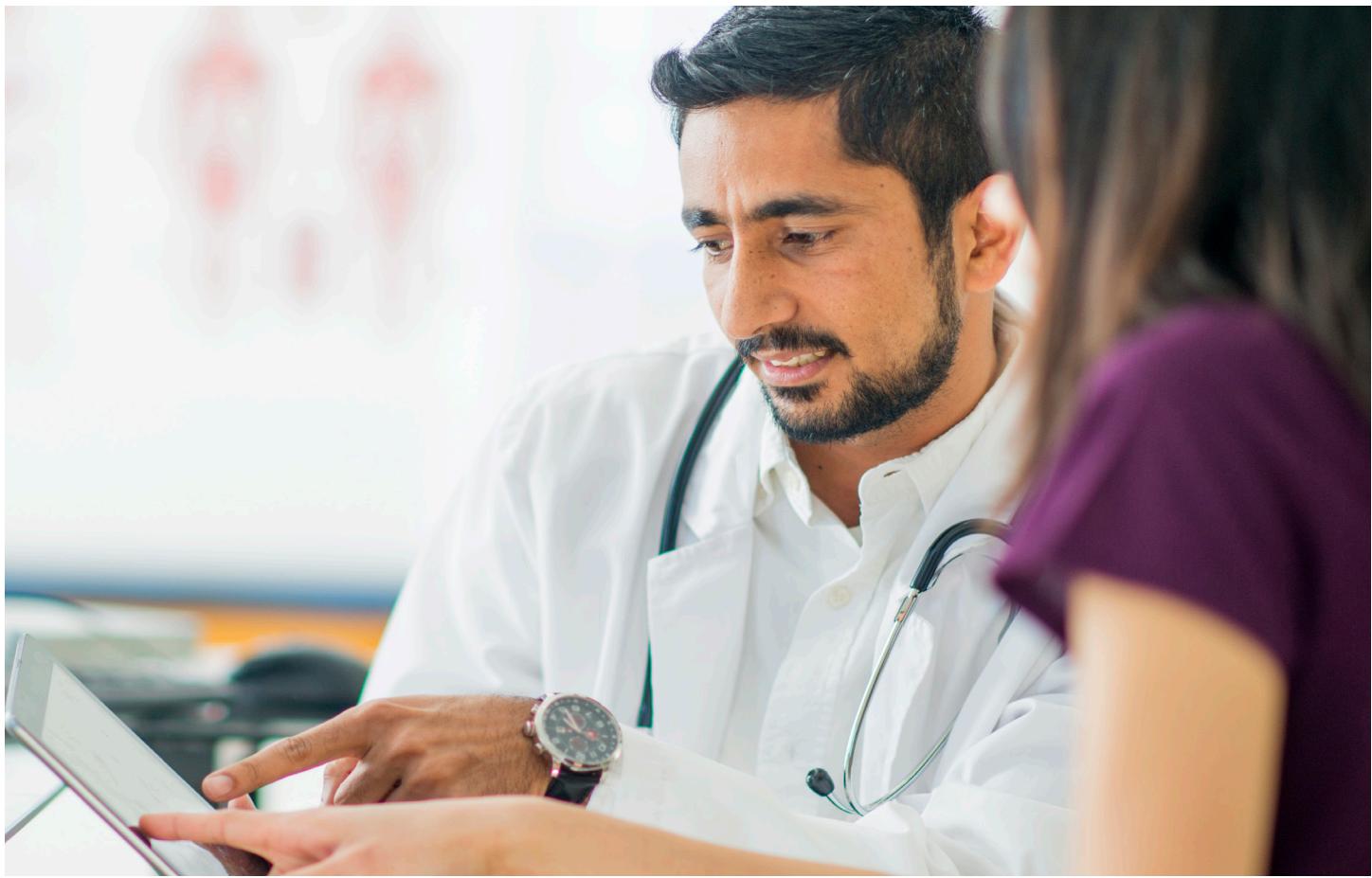
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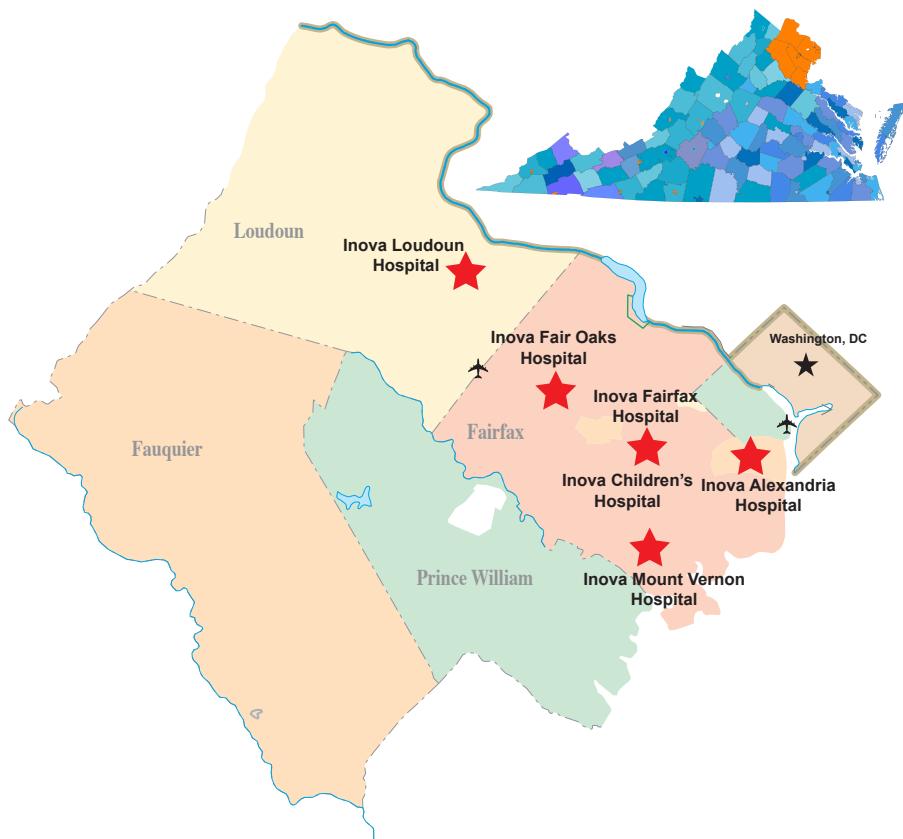
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Outcomes 2019

Inova Neuroscience and Spine Institute

Patients and Providers

To make an Inova Neurology appointment or referral, call **703.776.4700**.

To make an Inova Neurosurgery appointment or referral, call **703.970.2670**.

Inquiries

To request a media spokesperson on topics related to Neurology or Neuroscience, call **703.289.2087** and leave your name, news outlet and request.

To inquire about a presenter for a medical and/or clinical research conference or event, call **703.776.3130** and leave your name and event request.

To inquire about making a donation or bequest related to Neurology or Neuroscience, call **703.776.3328** and leave your name and contact.



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