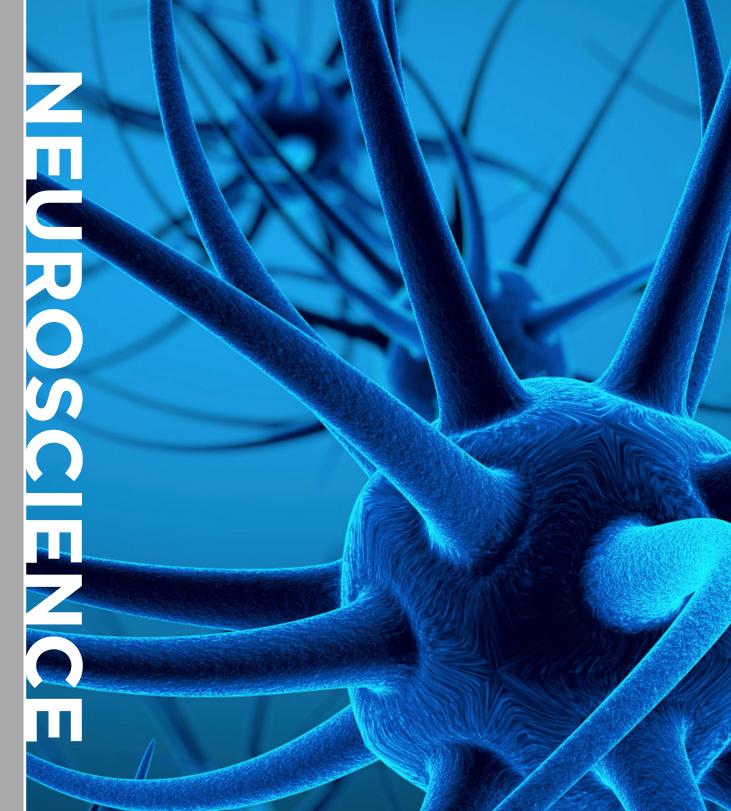
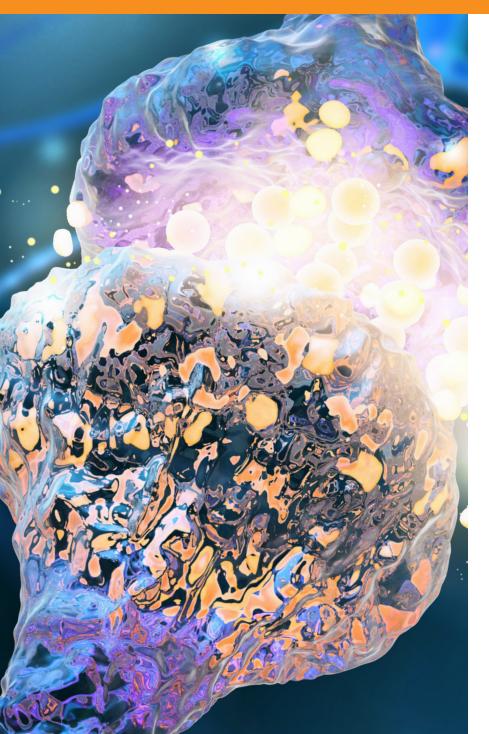
# ANNUAL REPORT 2016





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# Message from the Chair

## **CHANGES IN HEALTH CARE**

Integrated health care delivery networks (IDNs) are operating in a new economic reality, they still must deliver affordable care and continue to control costs and generate proportional value.

While many perceive this to be a period of uncertainty, we believe it has the potential to present predictable and far more transparent opportunity. Much like other industries such as the housing and mortgage industry, the changes in the health care economy have now forced it to move towards true market dynamics and be governed by market forces to empower the ultimate relationship between the patient and the health care provider.

This relationship represents the common denominator between all of the constituent stakeholders and the ultimate stakeholder—the patient. Understanding the nexus of this relationship in a transforming data-driven and tech-enabled direct-consumer economy will be critical. As this transformation occurs, the health care industry will develop supply and demand rules between providers and consumers, market forces will come to bear, and the remainder of the ecosystem will adjust based on these more predictable governing rules.

# **HEALTH CARE REFORM**

In order to serve our patients, we must prepare ourselves and the next generation of health care providers with not just the state-of-the-art technology and technical skills (the goods), but equally important, we must prepare them to be patient-centered in an integrated delivery model (the services). This will allow the current generation to truly meet its obligation to equip the 21st century health care ecosystem and all stakeholders with the skills and knowledge needed to positively transform health care, and in so doing, transform the broader American economy.

This will culminate in a model that is fiscally durable, while serving the needs of the patients, especially the under-resourced and underprivileged, and maintaining sustainability. With all the current perceived uncertainty, the only thing that is certain is the increasing impact of charitable and unreimbursed care and how it will be shared by the various constituents of the ecosystem.

## AURORA HEALTH CARE'S RESPONSE

Aurora Health Care is uniquely positioned to positively disrupt the current ecosystem and create a forward facing transformational system that nurtures strategic partnerships across all sectors to fully capture, extract, and transfer the value back to the patient. To perpetually innovate market relevant goods and facilitate their delivery via equally innovative and optimized service lines is the definition of disruptive global health care innovation.

All of the available health care intelligence and predictive analytics suggest that many service lines are in a phase of contraction, while neurosciences represents double-digit growth opportunities. However, the same data sources clearly articulate the barriers to such growth being integration, technology enablement, complexity, and MDC service models. Three short years ago, Aurora Health Care noted these barriers and committed to developing a truly unprecedented tech-enabled goods and services model. Aurora took the risk upon them and put the patient-physician relationship at the epicenter, leading to the creation and development of the Neuroscience service line and establishment of the Aurora Neuroscience Innovation Institute (ANII).

In response to the changing healthcare marketplace, ANII recognized the need to remove the delivery silos of care. ANII set the goal of turning the patient into the primary stakeholder, establishing scope-constraint by enhancing patient ownership and making sure the right team member was providing the right care at the right time. This required breaking down silos, removing some of the encumbrances inherent in health care. This delivery model, in and of itself, has required as much innovation as the robotic technology and enhancing imaging models employed.

Everything included in the following report, be it venues of care like new advanced robotic operating rooms or an integrated, tech-enabled, single-reporting structure faculty, have all been built over the course of the last three years. ANII operates under a culture of collaboration with adjacent departments to ensure the patient remains truly the central, primary focus and is empowered to determine their own care. Many internationally-known physicians have joined the Aurora team since the service line's inception and continue to advance and progress its innovative and patient-centered purpose.

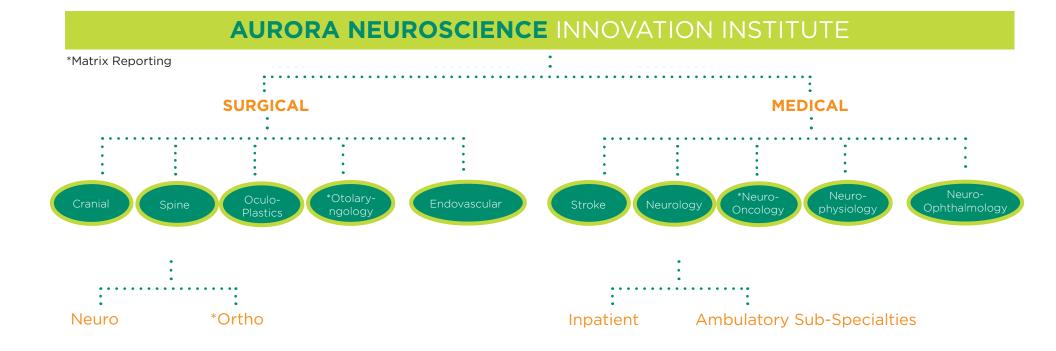
Like other medical disciplines, neuroscience is moving toward a performance-based market demanding increased specialization, which translates to patients often requiring multiple providers to meet their care needs. This market environment is driving the need for highly integrated systems of care where multi-disciplinary delivery models are required to deliver on quality, cost, and risk-based metrics. Since the development of ANII, we have been able to establish a care model that has incorporated technology, many first-in-man procedures, such as Robotically Operated Video Optical Telescopic (ROVOT-m) surgery, and have shared the work hosting over a 100 surgeons for training to date. Our model for innovating and incorporating technology has been of financial responsibility and purpose-built development geared to measurable outcomes and scale.

As organizations are now trying to formulate their concepts of clinical service lines, Aurora has made the successful transformation and is leading the way nationally in integrating the neurosciences health care delivery and is embodying the principle of the patient as the primary shareholder in a meritocratic-based delivery system. The foundational components have been established and we are now scaling the next generation tech-enabled integrated services model that will delivered improved outcomes at further cost reduction through iteration. We look forward to cross-institutional partnerships where we collectively have to deliver care in a combined goods and services model that functions and thrives in the new realities while staying true to the core mission:

- Patient-centric care and the practice of clinical medicine
- Scholarly activity for innovation and discovery
- Educating and seeding the next generation

We welcome the new health care economy and its predictability as a path to sustainable growth. Despite our rapid growth, we have great faith in the patient who has and will always remain as ANII's chairman of the board.





The Neuroscience Service Line embodies integration in that many of the services and providers have matrix relationships and dual-reporting to other departments and service lines, leading to effective collaboration for patients.

# 3-VERTICAL MODEL

#### VARIANCE

Controlling variance within delivery system to ensure stable processes, which can be systematically improved upon using proper management techniques

#### INTEGRATION

Improving inter-connections and related processes across the system while removing typical care silos in delivery Patient KEY SHAREHOLDER

#### SCALE

Establishing venue-appropriate scale mapped to proper service locations, effectively maximizing quality outcomes and optimizing resources while mitigating clinical and enterprise risk

#### BRAND

Utilizing non-traditional methods to engage stakeholders directly through immersive digital channels for awareness of patient care and emerging technologies

CLINICAL DELIVER

#### IMAGING

Creating a DICOM hierarchical, searchable data management system that creates a pathway toward predictable, non-variant care delivery

# INNOVATION CREATE

EDUCATION SCALE

#### INNOVATION

Developing the next set of commodities for
clinical care, which includes procedural advancements as well as cellular precision therapies and basic science research



# Meet Dr. Kassam

At the Aurora Neuroscience Innovation Institute, Dr. Amin Kassam leads a multidisciplinary team dedicated to advancing the field of neuroscience with defining research and advanced procedures. Aurora Neuroscience strives to provide the best possible care today while defining the best care for tomorrow.

## A Leader in Innovation

As Vice President of Neurosciences and Chairman of the Department of Neurosurgery at Aurora Health Care, Dr. Kassam is a board-certified, world-renowned neurosurgeon whose accomplishments have advanced the field of neurosurgery. He was the driving force behind the establishment of the Aurora Neuroscience Innovation Institute (ANII), where he collaborates with an experienced team of scientists, engineers, clinicians, and cell biologists. These neuroscience specialists work together to provide comprehensive clinical care and emerging research for the next wave of neurological innovation.

### **Shaping Tomorrow's Care**

Dr. Kassam has been recognized globally as a defining neurosurgeon and has contributed to profound advancements in skull base surgery and minimally invasive approaches. During the first decade of his surgical innovation, he was one of the key international figures in redefining anatomical and surgical approaches to skull base surgery. During his second decade of innovation, he has applied the same discipline to focus on diseases of the white matter and deep subcortical spaces. This time, not only has the focus been surgical and defining technology, but on understanding the cellular development of underlying diseases, such as cancers of the brain. An equally important focus has been building service line care delivery models.

His neurosurgical breakthroughs have made medical history. The innovations that have marked Dr. Kassam's career as a neurosurgical specialist are now helping improve the quality of life for patients with brain cancer and other subcortical abnormalities. His most notable accomplishments include the following:

## **SKULL BASE INNOVATIONS**

 The Expanded Endonasal Approach (EEA), a term he coined to describe a minimally invasive technique that uses the nose as a passageway to treat deep-seated tumors and lesions at the base of the skull and under the brain. It's also used to repair aneurysms in major blood vessels in the brain

## **MEDICAL FIRSTS**

Dr. Kassam has played a key role in making medical history by being the neurosurgeon that successfully performed the first-in-man of several procedures through the nose:

- The Transpalate Approach: Dr. Kassam used this modified version of EEA to successfully remove a large teratoma tumor from the skull base of a newborn baby
- Repaired a vertebral artery aneurysm through the nose using EEA
- With ENT colleagues in Argentina, reconstructed a skull base using EEA
- Removed an arteriovenous malformation in a child through the nose
- Performed surgery to remove a patient's second spinal vertebra through the nose using the EEA approach
- Was the first to describe the ability to transpose the pituitary gland through the nose to remove complex tumors located behind it

# **DEEP SUBCORTICAL INNOVATIONS**

• The Deep Subcortical MIS Approach: Dr. Kassam developed an innovative way to treat deep subcortical brain tumors that were once considered inaccessible by many

# **ADVANCING EDUCATION**

In addition to having written more than 300 peer-reviewed articles and two textbooks, Dr. Kassam is sought after to speak all over the world about neurological innovation—not just about what's happening today, but also about what he envisions for the future. He has also taught countless instructional courses and been keynote lecturer at symposiums around the world. He encourages fellow doctors to think critically about the kind of care they give to each patient and to pay attention to the clinical and economic value of each new procedure.



#### **Redefining Patient Care**

At Aurora, Dr. Kassam has pioneered a patient care model that integrates multiple specialties for complex treatment plans – all the while prioritizing the patient's comfort and authority. This innovative model is geared towards empowering the patient and removing any other agenda. Implementing this model has allowed him to partner with several exceptional physicians. As a patient, you can feel comfortable knowing that all of the neurosurgical specialists on your team are absolutely committed to providing the best care possible. Everyone on your team has the same goal, and that's getting you well soon.



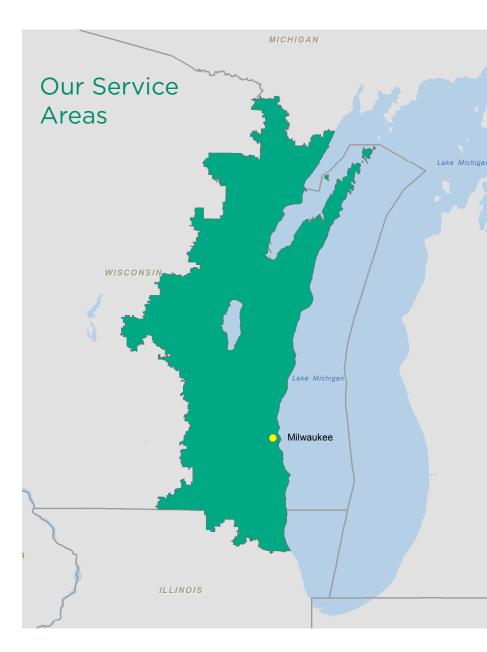
# Aurora Health Care

Aurora Health Care is an integrated, not-for-profit, all-for-people health care provider serving communities throughout eastern Wisconsin and northern Illinois. Our approach keeps people in our minds and at the heart of everything we do. We treat each person as a person, not as a patient, an illness, or an appointment.

Aurora got its start in 1984 when two established Milwaukee hospitals, St. Luke's Medical Center and Good Samaritan Medical Center, came together to form Aurora Health Care. Over the years, our organization grew, allowing us to help more people and communities.

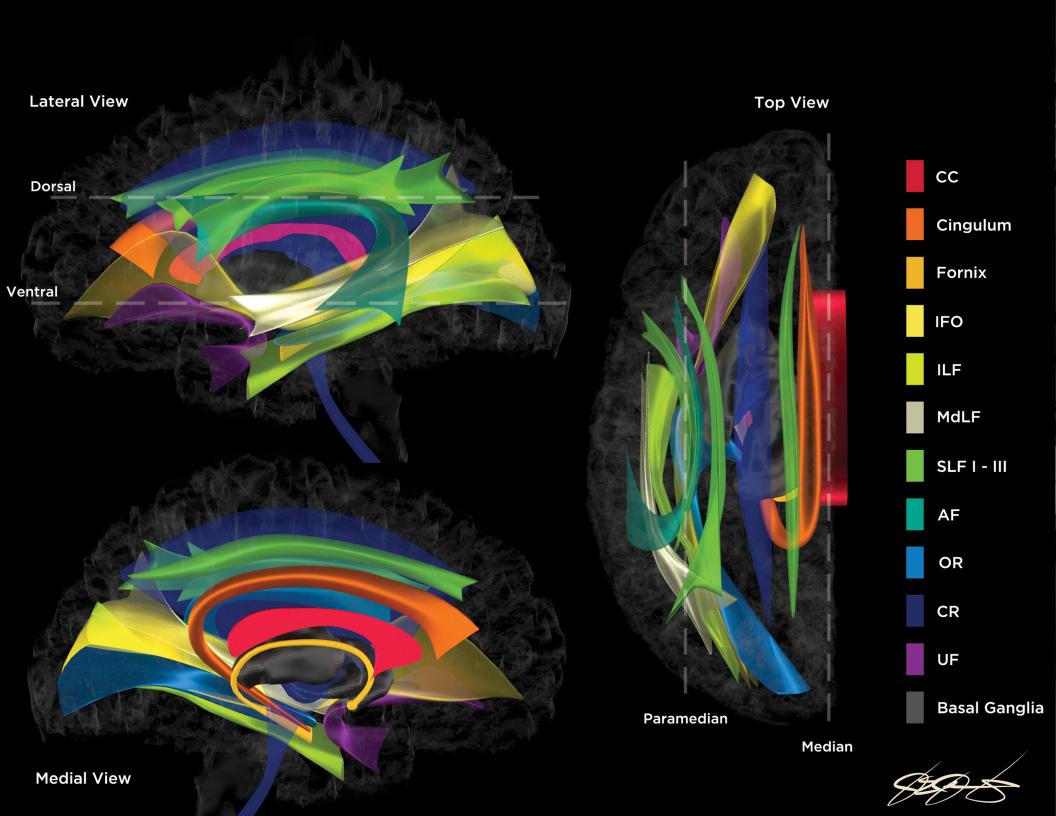
Today we serve communities throughout eastern Wisconsin and northern Illinois with 15 hospitals, more than 150 clinics, and 70 pharmacies in 30 communities. We strive to offer services that are close to home and help make the whole community healthier.

Aurora Health Care is a not-for-profit health care system serving Wisconsin and Northern Illinois with **15 hospitals**, more than **150 clinics**, and **30,000 employees**. Aurora has been experiencing significant growth over the past decade, and is now a fully integrated system comprising more than 1,500 employed physicians.











# Innovative and Integrated Care Delivery Model ANII Neuroscience Service Line

Our difference isn't just our innovations, but our multidisciplinary teams working together to develop a comprehensive plan specifically designed just for you. This includes a collaborative group of caregivers committed to providing precision medicine that is adapted specifically for your unique needs.

Your nervous system carries complex messages to and from your brain, so if this is disrupted, you need an equally elaborate and complex team to understand and restore these messages. Your team at Aurora can identify the source of your symptoms, treat it with the latest procedures, and guide you on your path to an individualized recovery.

From advanced diagnostic testing through treatment and recovery, trust Aurora to provide you with a personalized neurological care plan. We'll identify the best possible remedy for your circumstances and provide the follow-up care you need to get you back to living an active, healthy life. We treat our patients as empowered leaders of the care team, keeping them actively involved in all decision-making to ensure all questions and concerns are evaluated and taken into account. When it comes to treating neuroscience conditions and disorders, we believe the patient is the most important shareholder in the decision-making treatment process.

Our multidisciplinary team treats a wide variety of conditions using state-of-theart technology and facilities. If you have a neurological disorder—like Alzheimer's, Parkinson's, a tumor, or a condition that stems from trauma—you can expect innovative, comprehensive medical care with a compassionate touch.

You can trust Aurora's team of experienced neurological experts to offer the most advanced treatment options for a variety of conditions. We combine minimally invasive procedures and individual treatment plans with exceptional patient care to deliver the best possible outcomes. A core commitment to providing minimally invasive surgical options for neurological diseases and disorders makes Aurora Neuroscience one of the most advanced and truly one of the few completely integrated service lines of its kind. We continuously strive to provide the best care available today while defining the best possible care for tomorrow.



# NEUROSCIENCE

Surgeries/Procedures	12,180
Hospital Admissions	7,636
Clinic Visits	87,407

# NEURODIAGNOSTICS

VEP	<b>52</b>
SSEP	13
EEG Continuous	349
EEG Ambulatory	1,168

EEG Sleep Deprived	71
EEG Routine	3,551
EEG Video	1,828
EMG	11,356

# NEURO IMAGING

51,382	MRI Spine	21,564
12,728	Nuclear Medicine	233
7,340	US Carotid Duplex	11,144
3,254	Nerve Conduction	8,006
19,344		
	12,728 7,340 3,254	12,728Nuclear Medicine7,340US Carotid Duplex3,254Nerve Conduction

# **Quality & Patient** Satisfaction

# High quality care for your life

# WHAT MAKES "HIGH QUALITY"?

For Aurora, it's about offering care for your life, not just for your health. We do this by:

- Promoting health care innovation, and staying up on the latest advances
- Setting high goals for ourselves
- Keeping track of our progress as we reach those goals

You have a right to expect high quality wherever you go for health care. But how do you define it?

At Aurora Health Care, quality is the degree to which we give our patients better results than they can get anywhere else.

That means we need to:

- Update our knowledge through continuous research on "best practices"—that is, how medical and nursing science prove to be the best possible ways to prevent or treat specific problems
- Set goals for ourselves based on medical science and on what health care systems with the best results in the country are doing
- Keep track of our progress and continually set higher goals

# HOW WE DELIVER QUALITY

We continually strive to give high quality care and results. It is a promise we take very seriously. In order to deliver high quality, we have a step-by-step approach that is carried out across our entire organization.

Our main approach to delivering high quality is Care Management.

Care Management is a coordinated, patient-centered approach to finding better ways of preventing and treating health problems. The Care Management approach to quality means that we work together to:

- Define the health care needs of the people we serve
- Research the best ways to meet those needs
- Design a plan of action that can be carried out by all of our health professionals
- Measure our results (against national standards)

# Risk-Adjusted Quality/Cost Outcomes

Our multidisciplinary approach is able to demonstrate a significant reduction on key metrics in comparison to risk-adjusted populations across the nation. Key products chosen reflect trends in health care changes as outlined by SG2<sup>®</sup> data and analytics reporting.

	Lengt	<b>h of Stay</b> (Days)	Mortal	ity Rate	Readm	nission Rate	Cost/Ca	ase
	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected
Seizures and Epilepsy	3.83	3.39	0.32%	0.73%	6.99%	6.57%	\$9,030	\$9,370
Headaches and Migraines	2.90	2.66	0.00%	0.23%	6.17%	8.15%	\$5,830	\$7,690
Degenerative Disorders	9.51	9.69	0.02%	1.12%	7.81%	10.56%	\$14,383	\$15,046
Multiple Sclerosis	7.98	5.44	0.00%	0.28%	5.19%	8.01%	\$11,269	\$9,778
Peripheral/Cranial Nerve Disorders	4.21	3.93	0.89%	0.60%	22.28%	20.45%	\$8,327	\$10,777
Concussion	2.82	2.74	0.00%	0.53%	4.55%	4.93%	\$7,138	\$10,277
Cranial Surgery	3.66	5.08	2.92%	8.68%	8.43%	9.97%	\$19,883	\$24,421
Neurotrauma	4.79	4.04	4.72%	6.66%	7.40%	10.00%	\$9,082	\$11,748
Stroke (Ischemic and Hemorrhagic)	4.13	4.48	6.47%	7.55%	7.17%	8.82%	\$13,027	\$13,737
Other Neurological Disorders	4.52	4.31	3.94%	3.95%	8.17%	10.82%	\$8,851	\$10,398
Spine	2.96	3.01	0.24%	0.47%	5.60%	5.98%	\$17,331	\$24,895





# **NEUROSCIENCE** SERVICE LINE

	Actual	Expected
LOS (Days)	4.16	4.27
Mortality Rate	2.97	3.52
<b>Readmission Rate</b>	7.48	9.13
Cost/Case	\$14,610	\$15,807

# Patient Satisfaction

Of over **100,000** Neuroscience admissions and visits, Aurora Neuroscience has only **658** deaths, a rate of just **0.66%** 

Overall provider rating for neurosurgery, **99<sup>th</sup> percentile** 

Access to care rating for neurology, **73<sup>rd</sup> percentile** 

Office environment for neurology and neurosurgery, **92<sup>nd</sup> percentile** 

\*Data reflects percentile rankings as compared to Press Ganey database

\*Data reflects medical and surgical admissions

# Awards and Recognitions





WISCONSIN COVERDELL STROKE PROGRAM









The Joint Commission

American Heart Association American Stroke Association

CERTIFICATION Meets standards for

Comprehensive Stroke Center





# BRAIN TUMORS & NEURO-ONCOLOGY

With 480 new primary tumors and another 1,200 cases of metastatic brain cancer expected in the state of Wisconsin every year—including 926 new deaths from the disease—Aurora Health Care has made a commitment to the early diagnosis and innovative treatment strategies of primary and metastatic brain tumors of all kinds.

Based on American Cancer Society registry data, 7.4 people out of every 100,000 will be diagnosed with brain cancer next year in Wisconsin, which is more than the 6.6 expected across the United States. It's also more than the incidence expected of liver, myeloma, stomach, and testicular cancers, as well as some forms of esophageal, Hodgkin's lymphoma, laryngeal, oral, and thyroid cancers.

A distinctive feature of the Aurora Neuroscience program is the truly multidisciplinary approach to brain tumor management used at every stage of treatment and diagnosis. Our specialized team of neurosurgeons, neuroradiologists, neuro-oncologists, and radiation oncologists work collaboratively with the added expertise of medical oncology, neuropsychology, head and neck oncology, neurology, pathology, and many others, including cancer nurse navigators, neuroscience advanced practice nurses, and physician assistants. We treat our patients as members of the care team, keeping them actively involved in all decision-making to ensure all questions and concerns are evaluated and taken into account. When it comes to treating neuroscience conditions and disorders, we believe the patient is the most important shareholder in the decision-making treatment process.

Our model puts you, the patient, at the center. We see you collectively so you can ask us while we are all in the clinic room at the same time any questions you may have. This is not only convenient, but also avoids the confusion of trying to interpret what different specialists may have said to you at different times. We also endeavor to have the person with the right expertise in the room at the right time. For example, we provide a neuroradiologist reviews your imaging with you as opposed to a surgeon or non-radiological specialist, whenever possible.

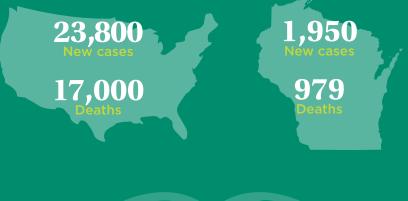
Complex access and treatment algorithms have been developed to ensure that all patients, primary and metastatic, are reviewed and considered by the Neuro-Oncology tumor conference team with comprehensive development of care plans. Through innovative approaches to care, the management of brain tumors at Aurora Health Care has evolved beyond just length of life, and has become fully invested in a patient's quality of life. We offer the best of the proven current treatment available today, while bringing the next generation of innovative chemo and surgical treatment applications to our commitment to precision medicine with innovative techniques that adapt to the individual patient.

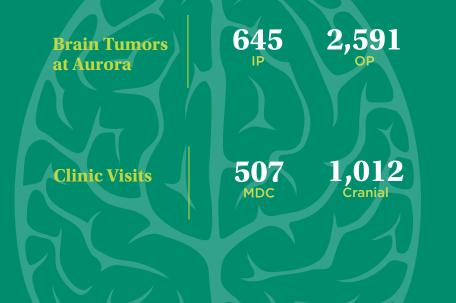
# AT A Glance

# **2017** ESTIMATES

Brain and other nervous system

Source: American Cancer Society® Cancer Statistics Center





# EXPANDED ENDONASAL APPROACH (EEA)

# Revolutionizing the way brain surgeons access the skull base and upper cervical spine in a less invasive way.

During endoscopic endonasal surgery, a neurosurgeon and an otolaryngologist work together to enter the skull base through the nose. This minimally invasive technique eliminates the need for external incisions and brain retraction. By removing the back half of the nasal septum and the bone in front of the sphenoid sinus, surgeons can reach the skull base.

Tumors are then removed with the help of high-definition optics and an endoscope. Finally, the skull base is reconstructed using a flap of the septal membrane—which seals off the brain from the nose—helping prevent complications.

The Expanded Endonasal Approach allows access to skull base tumors minimizing the complications that can be seen with open skull base surgery, which include infections associated with large scalp incisions and the side effects seen with brain retraction.

Many patients undergoing EEA spend only one to two days in the hospital, and recovery time at home can be much shorter than for open skull base surgery. In addition, there are many scenarios in which EEA causes less disruption of critical nerves during skull base surgery.

The Expanded Endonasal Approach is used to perform minimally invasive brain surgery for these conditions:

- Brain tumors
- Cancers of the sinus (squamous cell, sphenoid sinus carcinomas, adenocystic and metastatic)
- Meningiomas of the skull base
- Pituitary tumors (including pituitary adenomas, acromegaly, prolactinomas, and pituitary apoplexy)

- Olfactory neuroblastomas
- Rathke's cleft cysts
- Skull base tumors and cysts
- Chordomas and chondrosarcomas
- Orbital tumors and Graves' disease

# MINIMALLY INVASIVE ROBOTIC TECHNIQUES

Deep brain tumors (subcortical), areas of bleeding, and cysts that were once considered too risky to operate on by many are now often removed through a precise and patient-specific corridor with our unique, integrated surgical techniques. This minimally invasive technique offers patients hope for better surgical results, as well as improved long-term health outcomes. It also allows our patients to reach the goa of zero footprint, or no long-term complications as a result of their tumor or surgery.

### Mapping

An invaluable tool for Aurora's neurosurgeons, brain mapping depicts aspects of a tumor and surrounding healthy tissue with enhanced clarity rendered in a three-dimensional space. This imaging technology allows surgeons to preplan a patient-specific, real-time surgical pathway before a brain surgery procedure even begins—which translates into improved outcomes in the operating room and a faster recovery.

### **Dynamic Navigation**

Neurosurgeons use a GPS-like system that gives them real-time guidance deep within the brain. Patients can see their brain tumor removal on the same computer screen that their surgeons use to track the movements of their surgical instruments.

### Safe Access

We use a specialized and innovative tool that minimizes damage to surrounding tissue by allowing neurosurgeons to safely displace the natural folds of the brain as they advance to the target site. This is a critical component of a minimally invasive treatment for brain tumors and other deep-seated neurological disorders.

### **High-Definition Optics**

This technology allows neurosurgeons to differentiate tissue types with unprecedented clarity from above the surgical site. Being able to separate diseased tissue from healthy tissue makes it possible to successfully remove what would otherwise be considered inaccessible brain tumors, cysts or other growths difficult to see.

### **Automated Resection**

Using a tool about the size of a pencil, neurosurgeons are able to remove tissue without injury to adjacent healthy brain matter. This technique is another reason Aurora can offer treatment options for conditions, such as brain tumors, that were previously deemed too risky by many.

### **Directed Therapy Options**

Neurosurgeons collect and preserve the brain tissue they remove in a sterile, closed-capture device for pathology, molecular, and genetic evaluation. These samples provide opportunities to develop personalized treatment regimens for every patient. This is a critical step in advancing treatment paradigms. The ability to capture, grow, and implant the tumor tissue into mice enables the team to study and develop new targets for treatment that are brought directly back to the patient in an individualized manner, epitomizing our commitment to precision medicine.

All of this patient and correlated cell data is then compiled into a novel image-driven data capture system with the goal of developing predicted informatics power. Aurora was the first institution in the world to install and implement this specific image-driven informatics system.



The culmination of all of these integrated technologies allows for many of our patients to have surgery while awake. However, this is different than the way awake procedures have been commonly done in the past. Our patients often have less anesthesia than even routine, non-neurosurgical procedures, like a colonoscopy. Also, many patients are interacting on their phones or smart devices during surgery, and many, go home the next morning.

We believe this has resulted in significant improvements in cognitive outcomes, particularly those that are otherwise difficult to monitor when patients are completely asleep during surgery. This philosophy of care has been paramount to our continued pursuit of zero footprint, or no long-term complications.

## **BRAIN MAPPING**

Advanced brain mapping technology lets our team of experts see the precise location of individual brain functions—speech, memory, and movement—in order to help determine the most appropriate treatment.

Brain mapping is a critical tool used by neuroscientists to diagnose long-term, chronic conditions, like Parkinson's disease; it is also used to plan surgeries for more acute conditions, such as brain tumors.

If surgery is needed, brain imaging technology may be used before and during a procedure to differentiate healthy brain matter from diseased tissue. It can also be used to define a surgical or navigational strategy to help avoid injury to portions of the brain needed for critical functions.

Diffusion tensor imaging with white matter tractography is one type of brain mapping. It uses state-of-the-art technology to create a 3D map of the brain, which shows the location of nerve fibers that control speech, memory, cognition and thought—all of the things that make you ... you!

It provides advanced assistance with:

- Determining the best surgical approach to remove a tumor
- Diagnosing and treating a traumatic brain injury
- Finding breaks in brain fibers that may cause the loss of certain body/memory functions
- Understanding which brain connections are intact and which are damaged
- Other types of brain imaging technology that works like a GPS system during surgery, giving neurosurgeons real-time guidance deep within the brain

Brain mapping is a fundamental element of our minimally invasive methodology for treating subcortical tumors and cysts that were often considered otherwise inaccessible.



**Aurora has performed** more optical robotic brain surgery than anyone in the world to date, **and ANII was the** first in the world to deploy a unique 3-D brain mapping platform **for patient care.** 

# The MDC team approach is progressive and is different from most multidisciplinary teams that exist today in that it functions as one fluid unit instead of operating in specialty silos.

## Neuroradiologist

Uses advanced technology to diagnose diseases of the nervous system

## Surgeons

•

- You will see one of our world-renowned neurosurgeons who will perform any necessary procedures
- Communicates regularly with other providers on your care team

## Financial Advocate

- Answers questions about insurance coverage
- Discusses any payment or financial concerns and options

# Primary Care Physician

- Views your progress via your health record
- Sees you during the full recovery process

# Care Coordinator

- Your most regular point of contact
- Assists with scheduling appointments
- Stays in touch with NP, PA, and surgeon
- Ensures you're comfortable and taking medications

# Cancer Nurse Navigator

- Makes sure you receive seamless care
- Schedules appointments with specialists
- Connects you with support groups

# Nurse Practitioner (NP) and Physician Assistant (PA)

- Specially trained advanced practice providers
- Performs daily physical exams, reviews tests, and medications
- Follows you in the hospital and clinic
- Will assist your surgeon during surgery

# Other Specialists

Communicate and collaborate with other care team members, including the following:

General neurologistNeuro-oncologist

Rehab specialist

Endocrinologist

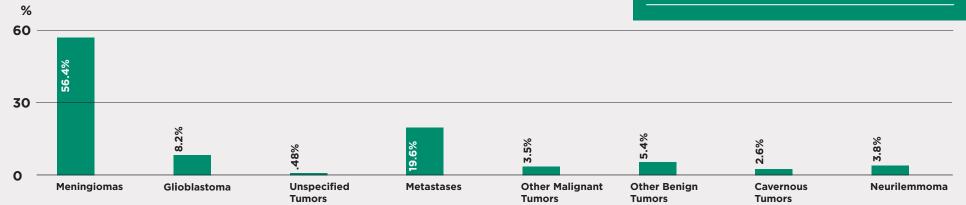
Otolaryngologist/ENT

- Spine physiatrist
  - Neuroendovascular specialist
  - Neuropsychologist
  - Neuro-ophthalmologist
  - Radiation oncologist
- Medical Oncologist

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# Brain Tumor Distribution





# COLLABORATION TAKES FLIGHT



Not everyone would compare a successful multidisciplinary neurosciences center to the airline industry.

# However, not everyone is world-renowned neurosurgeon Amin Kassam, MD, who sees parallels between commercial flight and a health care model built on value through risk reduction rather than volume.

"I wanted to build a health care service line that mitigates risk, and the airline industry has done that well," he says. "Flying is a safe event, when you look at the number of flights as opposed to the number of plane crashes. You can look at health care the same way."

With that in mind, Kassam spearheaded the creation of the Aurora Neurosciences Innovation Institute (ANII), a multidisciplinary program of the Aurora Health Care Medical Group in Milwaukee, Wis. The program's goal is to create a collaborative environment where neurosurgeons pilot through brain surgery with navigation from neuroradiologists—all working side-by-side in the OR. Each team member provides support for the competency for which they are best suited.

Typically, imaging would be done in a separate location and provided to neurosurgeons in preparation for surgery. By combining efforts in one location, Kassam says patients benefit from more immediate care.

According to Jonathan E. Jennings, MD, section chief of neuroradiology for Aurora Health Care Medical Group and a neuroradiologist with ANII, the overarching goal of the new program is improved outcomes, decreased patient morbidity, and reduced length of stay for patients. "In the two years since the program began, we've amassed a significant amount of data about the progress of this multidisciplinary approach," he says. "Now we're analyzing that information to help us drive better patient outcomes."

# **MODEL DESIGN**

In 2014, Kassam was recruited by Aurora Health Care Medical Group to build its multidisciplinary neurosciences program. Kassam has had extensive experience over the past two decades in building service lines focused on multidisciplinary collaboration and proposed the concept of integrating neuroradiology as a clinical component of neurosciences. He designed the ORs and clinics to contain reading spaces for radiology. This meant actually seeing patients in the clinic, in the operating room, and in postoperative acute and outpatient venues.

Radiologist Dale J. Lye, MD, who leads Aurora Imaging Services, was also

forward-thinking and supportive of establishing the ANII, not only because it provides a higher quality of patient care but because it is a natural progression in the evolution of how radiology will need to look in the future, particularly as health care moves from volume to value. This open-minded thinking led to a natural collaboration that broke down silos and made implementing the concept much easier.

During the design process, the imaging team analyzed the clinicians' workflow to see where having a radiologist on site could help improve efficiency. They realized neurosurgeons were spending time weeding through stacks of imaging reports in order to plan their next course of action. In response, they proposed that adding a neuroradiologist to the crew would provide the guidance necessary to complete a surgical flight plan.

"At ANII, neurosurgeons are pilots, radiologists are the navigators, and the OR is the cockpit," Jennings says.

# PLANNING AND WORKFLOW

The cockpit of this multidisciplinary clinic space comprises a state-of-the-art, four-room operating theater, with a dedicated planning room embedded within the semi-restricted area adjacent to the OR. Neuroradiologists work together with their neurosurgery colleagues within that space.

The need for efficiency in radiology is maintained on the OR floor. At ANII, reading rooms are located within the OR suite and allow neuroradiologists to read nonsurgical cases during down time. In addition, a network of video communication creates connectivity between the OR, the planning room, clinical offices, and the main radiology reading room-essentially creating air traffic control.

With this model, no one service line "owns" the patient. **"Just as** a plane doesn't have just one pilot, a patient doesn't

**have just one surgeon** taking care of him or her," Kassam says. "There are always two attending doctors with a patient, and we put the radiologist in the cockpit with us, reading images and providing our navigation in real time. In fact, the radiologist generates the flight plan before we even see the patient."



## Neuroradiologists also play a direct role with patients within the clinic setting, joining oncologists in discussions with patients about the benefits and

**risks of surgery**. For most complicated discussions, the neuroradiologist reviews the imaging directly with the patient and the rest of the team. Patients have the opportunity to ask questions while all the members of their treatment team are in one place. It's a unique role for radiologists, who historically don't have much patient contact.

Each member of the team brings a different strength to the case at hand, Kassam adds. "A surgeon can put information about a patient's case into the context of the disease, but a radiologist has the data and the ability to present the information at clinic in a way that the patient can understand," he explains.

"With this program, we break down the silos and form a collaborative unit," Jennings says. "As the silos break down between medical specialties everyone comes up with good ideas. We are fortunate to have been welcomed as integral members of the neurosurgical care team."

# THE PATIENT CARE CONTINUUM

Melanie Brown Fukui, MD, a neuroradiologist at ANII, embraces the opportunity to work side-by-side with neurosurgeons. In addition to providing her imaging expertise in the OR, she is in a position to bridge patients' imaging needs from their clinic visit through preoperative planning and into the operative and postoperative phases of their treatment.

"This is a window into neuroscience here that I believe doesn't exist anywhere else," she says. "We're a multidisciplinary unit in which radiology participates in planning and workflow. We are included in the overall work environment. Within this model, having a neuroradiologist immediately available at critical moments during anatomically complex procedures can decrease the potential for adverse outcomes."

According to Fukui, radiologists are involved with the pre-surgical planning along with the surgeons. They also stay in the OR during **"inflight cross checks"** when the surgeon is working in the brain, following the anatomy in imaging.

"We have come to speak a common language with our partnering neurosurgeons and advanced practice providers," Jennings says. "We directly observe the manner in which imaging is used for operative guidance, and have accordingly designed a set of pathology-specific MR protocols to fit the unique operative approaches and technologies our neurosurgeons use."

# **COLLABORATIVE IMPACT**

Jennings, Fukui, and Kassam agree that the collaboration among members of the ANII team strengthens the clinical environment and incrementally improves patient care.

In one instance, during surgery to remove a cluster of blood vessels from the brain of a 36-year-old man who suffered from seizures, imaging guidance in the OR suite provided Kassam with a map to the malformation.

It also helped that the patient was kept awake during surgery in order to regulate the effects of the surgery on his functionality.



The culmination of this collaborative process has yielded significant results in a short period of time. The neurosurgical oncology service has posted a 30 to 40 percent reduction in length of stay, mortality, and readmission rates as compared to national risk adjusted rates. This has also translated into a financial benefit, with a 10 percent reduction in cost per case, despite increasing the case complexity in comparison to the pre-ANII era.

The neuroradiologists also benefit from direct and immediate clinical-radiologic correlation, observing surgical procedures in real-time and working in sync with surgeons and other members of the team. This enables imagers to see how their navigation helps the surgeon, and where they can improve the process of providing the right map for surgeons to follow.

Jennings points out that participating physicians share information and learn from each other. "Now, the radiologist is involved at the point-of-care," he says. "We interact with each other in a more natural way, with amore open flow of communication."

# **NEXT STEPS**

- Look for opportunities across the health care continuum where the radiologist can come into more direct patient contact.
- Seek out the clinicians in your practice or facility who use and value imaging the most, and work to form alliances between them and your radiologists.
- **Develop collaborative models** that overcome silos in budgeting by valuing risk reduction for the patient rather than volume delivery by the provider.

# KEY **Take-aways**

**1** A team of neuro-oncology specialists **breaks down silos** and provides patients with a multifaceted approach to neurological issues.

**2** Neuroradiologists join the clinical side of medicine by providing **real-time** image guidance within the OR and playing a direct role with patients in the clinic setting.

**3** The neurosurgical oncology service has posted a **30**to **40% reduction** in length of stay, mortality, and readmission rates, as well as a **10% reduction in cost** per case.

# SURGICAL INNOVATION

Recent innovation in the field of neuroscience has created dramatic advancements in neurosurgery through the engagement and collaboration of several unrelated disciplines joining forces, particularly the safety principles of the aeronautics industry. Neuroscience is now realizing this same value of integration and unification based on diverse stakeholders like health care providers, technology, and even our patients.

Aurora's neurosurgical operating room of the future is a space in which one of its mains goals is to gather information in the OR in real time in order to serve patients and surgeons on a global scale. At Aurora, we've adopted the theory that the state of information overload can be resolved by a simple understanding of the power of visualization and collection of data in real time.

The foundational architecture of aerospace industry and innovation continues to provide guidance for the operating room of the future. Aviation safety experts measure air traffic routes for safety using quality metrics. Our new software allows us to map millions of previously unseen white matter tracts in real time, rendering them in a three-dimensional modeling system. Like air traffic routes, we are now able to apply principles of aviation safety to the white matter tracts of the brain.

ANII has been an international leader in this effort, recently presenting a unique three-dimensional patient-specific atlas of the human brain. This means that each patient can have their individual case planned and simulated just like a flight plan-this is a critical step towards precision medicine.

The planning of each surgical case begins with precise, detailed, and advanced imaging. The complex imaging data is thoroughly evaluated by a computer algorithm that determines whether or not it is ideally suited for surgical planning. Once the surgical plan is generated, it is transferred directly to a robotically-operated video optical telescopic microscope (ROVOT-m) with a built-in navigation system. Aurora and the team at ANII were the first in the world to deploy this integrated system for direct patient care.

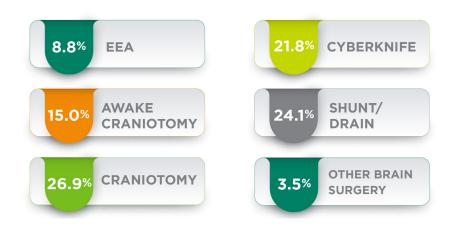
This system represents a single, integrated intraoperative solution to allow surgeons to accurately reach their target while protecting sensitive brain matter. The plan is displayed onto a high-definition monitor and merged with imaging confirming alignment for a precise trajectory in order to develop an individualized corridor of entry for each patient.

The ANII care delivery model is equally unique and innovative as the technology. The system is designed so the neuro radiologists (navigators) design the flight plans in the OR (on the runways) and are actually present

during the critical portion of the procedure to provide input when needed. In addition, every effort is made to ensure that two experienced surgeons (pilot & co-pilot) are performing the key portions of the procedure together, whenever possible. Very few commercial flights operate with just one pilot to avoid errors and maximize quality assurance; we are committed to patient safety in the same manner. This has led to creating innovative models that overcome financial barriers.

Aurora neurosurgeons are now able to see the "flight plan" on this imaging platform to prepare themselves to navigate the complex anatomy of each individual patient in advance. They are able to take off and fly through the surgical space with autopilot functionality as well as have the freedom to adjust the plan while in flight if obstacles arise and if deviation is necessary. Information is being acquired in an intelligent, user-friendly manner with ability to record, capture, and share in real time, giving rise to an iterative loop.

# PROCEDURES







# MOVEMENT DISORDERS

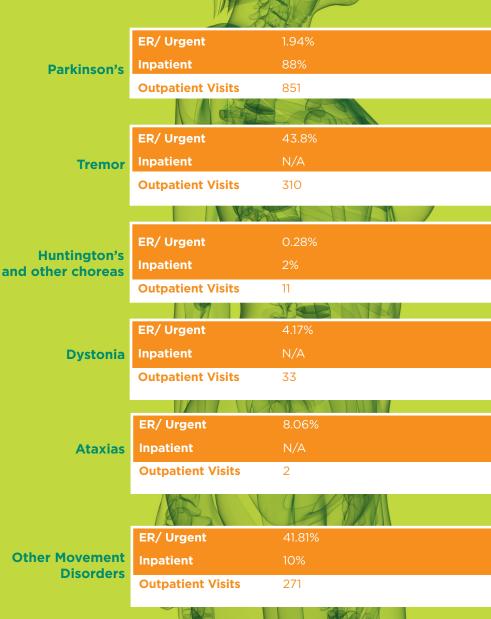
## Parkinson's disease may be part of your life, but it shouldn't define it.

Eating breakfast. Writing your grocery list. Walking to the car. Driving to the store. Most of us do these activities without a second thought. But for a person with a movement disorder like Parkinson's disease, these simple things can be challenging—or even dangerous.

Parkinson's disease is a brain disorder that leads to shaking (tremors) and difficulty with walking, movement, and coordination. While there is no cure, treatments can reduce the symptoms and improve your quality of life. Diagnosing Parkinson's disease can be difficult, particularly in the early stages of the disease. Our team uses neurological exams, SPECT scans, and MRI to assist in diagnosis.

We also offer DaTscan to help confirm a diagnosis, which is an imaging technology that uses small amounts of a radioactive drug to help determine health of the dopamine system in a person's brain. A SPECT (single photon emission computed tomography) scanner measures the amount and location of the drug in the brain.

# BY THE **NUMBERS**





"You all made a difficult time easier for me. I came away with a better attitude and more hope."

- Jerry D., Big and Loud program participant

## EASY STREET

Easy Street is a one-of-a-kind therapy environment and facility that provides a variety of real-world experiences to aid in the recovery of our patients, specifically those suffering from neurological and movement disorders. This facility includes a grocery store, barber shop, movie theater, bus, driving range, and apartments so our patients have a unique opportunity to be challenged both mentally and physically over curbs, ramps, and uneven surfaces before they face those obstacles in the communities we serve. Easy Street allows for a truly multidisciplinary approach to care by creating an environment where physician, therapist, and other medical professionals come together to focus on one priority, helping your patient regain their highest functional level and re-enter the community.

## PARKINSON'S SUPPORT

#### LSVT Big and Loud Clinic®

For People Living with Parkinson's Disease

- Evidence-based exercise program that follows an intensive and specific protocol to provide maximal results
- Specialized treatment from certified therapists for Parkinson's disease
- This treatment has been linked with better outcomes compared to traditional therapy
- Patients learn how to move BIG and speak LOUD on a consistent basis
- Recalibrates the senses for automatic use of normal movement and voice
- Uses high effort and intensive treatment to improve everyday function

#### Mobile and Fit Parkinson's Class

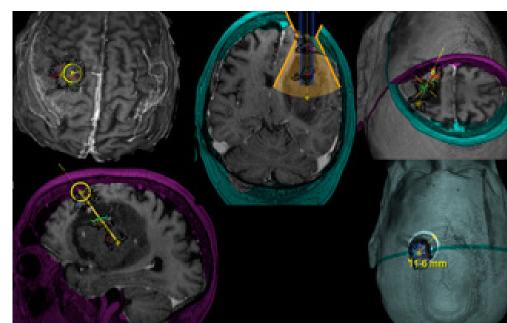
This exercise class is designed so that people with Parkinson's disease can get better and stay better through exercise. The class targets movement deficits caused by Parkinson's disease with the goal of reducing falls, improving function, and improving quality of life.

#### **Health Counseling**

Many patients experience anxiety and depression after their diagnosis. Specialized therapy sessions can help them learn to cope with the emotional changes.

## FUNCTIONAL NEUROSURGERY LAUNCH

Aurora Health Care recently saw the launch of its functional neurosurgery program with capabilities in both epilepsy and movement disorders surgery led by a specialist from one of the best functional training programs in the country. Our program focuses to not only surgically treat epilepsy and movement disorder patients (Parkinson's disease, essential tremor, dystonia, etc.) who have exhausted other options, but also do it in a manner that has the highest level of safety with the least invasive approach, including laser ablation for epilepsy and asleep deep brain stimulator (DBS) placement.



# NEUROLOGICAL DISORDERS

Our neurology team is part of a family of services that includes the latest diagnostic technology and proven physical rehabilitation services. Our neurologists lead and participate in clinical trials to bring our patients the next generation of treatments.

Chronic headaches. Degenerative neurological disorders. Persistent muscle pain. At Aurora, we understand that medical issues like these require experienced, compassionate care. Our multidisciplinary team will identify the source of your neurological condition with state-of-theart diagnostic services and provide treatment tailored to your needs and goals.

Neurologists at Aurora Health Care will partner with you to create a treatment plan for your brain injury or disorder. Our neurologists will help you deal with existing symptoms, treat your symptoms, and monitor your health to ensure you enjoy the best quality of life possible.

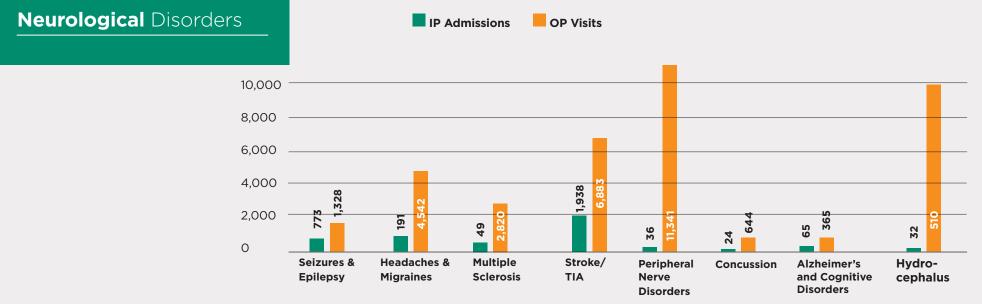
## Our team works to diagnosis and treat the following neurological disorders:

- Alzheimer's disease and other cognitive disorders
- Epilepsy and seizures
- Multiple sclerosis
- Parkinson's disease and movement disorders
- Stroke
- Headaches and migraines
- Neuromuscular disorders
- Neurodegenerative diseases

## AT A Glance

Average rate for readmissions to the hospital was **7.5%**, however expected return was **9.2%** showing the advanced treatment of Aurora's neurology care leading to longer term outcomes and improvement.





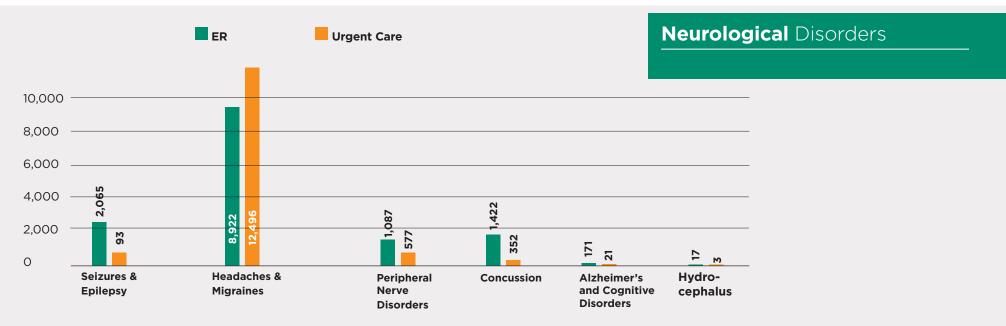


## CONCUSSION

According to the Centers for Disease Control (CDC), an estimated 300,000 people under the age of 19 were treated in hospital emergency rooms for concussions related to sports and recreation activities alone last year. This number is doubled over reports 10 years prior, due in large part to the increased focus on the identification of and need for immediate treatment for concussion. This is good news, considering 90% of most diagnosed concussions do not involve a loss of consciousness (LOC). Prior to recent awareness, this lack of LOC led many parents and coaches to brush off any substantial hits or collisions as requiring medical attention.

Research presented to the American Academy of Pediatrics' annual meeting concluded that school and sports teams with athletic trainers on site have higher rates of concussion than those that don't due to their expertise in identifying the injury and its oft-subtle signs immediately.

Aurora takes concussion care seriously and has been a proven leader in concussion assessment, treatment, education and prevention. Aurora is the top employer of athletic trainers in the state of Wisconsin. By providing these front-line prevention resources, Aurora's athletic trainers ensure baseline tests are administered properly, contact techniques are being safely instructed, and student athletes and parents are appropriately educated to assure that all safeguard elements are in place for all high-risk activities.



In the event of a head injury, athletic trainers have certification and state licensure that assures evidence-based practice of proper concussion management. Over 70 Aurora athletic trainers across the state provide on-field assessment using researched protocols and follow the National Athletic Trainers Association position statement on management of sport concussion.

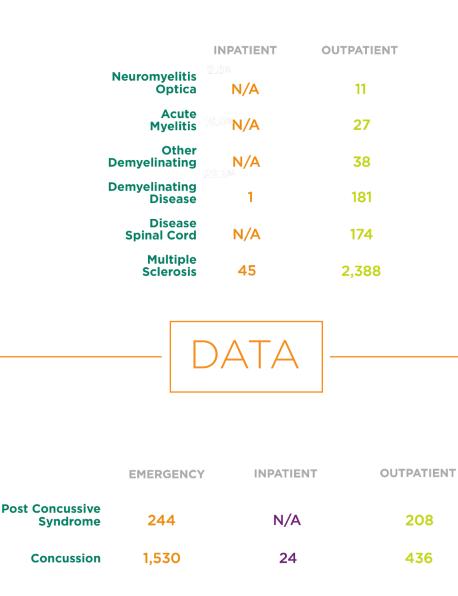
Aurora's athletic trainers work with a complete team of dedicated health professionals, including pediatricians, orthopedic surgeons, neuropsychologists, neurologists, family practice physicians, and physical therapists to reassure proper return to play.

## AT A Glance

Aurora performs nearly **7,000** baseline concussion tests to student athletes throughout the state of WI annually.

There are between an estimated **1.6** and **3.8 million** sports-related concussions in the U.S. every year, leading the CDC to conclude that sportsconcussions have reached an epidemic level.

The CDC reports that of college football players, **34%** have reported experiencing concussion, and as many as **20%** have experienced more than one.



## **MULTIPLE SCLEROSIS**

### **Comprehensive care clinic associated with the National MS Society**

Multiple Sclerosis (MS) affects women more than men and most commonly begins between the ages of 20 and 40. Doctors aren't sure what causes multiple sclerosis, but it is an immune-mediated illness.

Genetic factors and exposure to certain viruses are thought to be involved in the development of multiple sclerosis. No two people have the exact same effects, which can make diagnosing MS difficult at times.

Aurora's expert neurologists work with patients to determine the best way to slow or stop the destruction of the nerves' protective coating. The right treatment can significantly reduce symptoms and prevent them from becoming disabling. We'll help you cope by giving you access to the latest in MS research and treatment options.

#### **Collaboration with:**

- Neurology
- Neuropsychology
- Occupational Therapy
- Physical Therapy
- Speech and Language Pathology

We believe in comprehensive care that treats the whole patient, including your spiritual, physical, and emotional medical needs. In addition, we can help you manage symptoms like cognitive deficits, swallowing and speech issues, bladder or bowel difficulties, spasticity, fatigue, depression, stress, tremors, and weakness. National standards show a **0.28%** rate of mortality for those suffering from MS; in 2016, Aurora's mortality rate was **0.00%**.

Return trips to the hospital occurred at a rate of **5.19%**, while risk-adjusted expectations were much higher at **8.01%**.

599 EMU Admissions

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A

## EPILEPSY

According to the Epilepsy Foundation, epilepsy is the 4th most common neurological condition. Every year, 48 new people of every 100,000 will be diagnosed with epilepsy, which means that 1 in every 26 people will develop epilepsy sometime throughout their life. Current statistics show that in the United States, there are roughly 2.2 million people diagnosed with and being treated for epilepsy and seizures.



At Aurora, a seizure evaluation consists of a detailed discussion of your symptoms, a comprehensive neurologic examination and diagnostic testing. Basic testing includes an EEG, or brainwave test, to see if we can capture a seizure or see footprints of seizure activity. We may also get an MRI of your brain to see if there is an abnormalit or malformation that can cause seizures. Our expert neurologists can help you manage these debilitating occurrences regardless of their source—so you can lead an independent, productive life. We'll start by determining whether you have generalized-onset or partial-onset seizures and then develop a seizure treatment and management plan that's right for you.

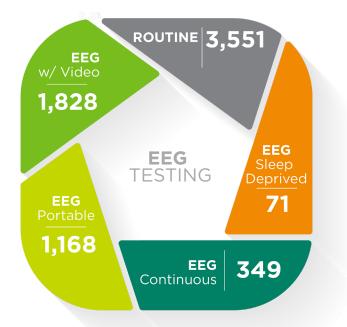
## EPILEPSY MONITORING UNIT

Patients whose seizures can't be controlled with medications and those who may be candidates for epilepsy surgery are often scheduled for long-term epilepsy monitoring in one of our Epilepsy Monitoring Units. Information from the study is used to determine if surgery is a viable treatment or if other options should be considered. This information helps to do the following:

- Establish an epilepsy diagnosis. In most epilepsy centers, about 1 in 4 patients who have seizure-like events do not have epilepsy
- Identify the seizure type. Some seizure medications are designed to treat certain types of seizures
- Locate the source. Monitoring can help identify the brain area where your seizures begin. Lateralization and localization (finding the side and area) of your seizures is a critical first step in planning any epilepsy surgery. Seizures are videotaped because your behavior during seizures can also help to locate the source
- Determine seizure frequency. Video EEG monitoring can identify how often you are having seizures. Frequently patients have seizures and don't know unless someone tells them

## ABRET LAB ACCREDITATION

The Laboratory Accreditation Board of ABRET has granted the EEG Laboratory at Aurora St. Luke's Medical Center a five-year accreditation. This award is based on an evaluation of the technical quality of the EEGs performed in this lab and on a review of specific policies from the Policy and Procedure Manual. The lab has been commended on their desire to promote excellence and competency in the department which has had a positive influence. There are only 156 accredited labs in the country.



In **2016**, Aurora saw over **20,000** visits to the emergency department or urgent cares for headaches and migraine.

### NEUROMUSCULAR

#### Dysautonomia

Dysautonomia occurs when there's a malfunction in the autonomic nervous system (ANS), potentially affecting heart rate, blood pressure, digestion, sweating and other automatic processes in the body. Doctors can't always pinpoint what causes dysautonomia. It may be secondary to a multitude of other medical conditions, such as diabetes, multiple sclerosis, rheumatoid arthritis, celiac disease, Sjögren's syndrome, lupus, Parkinson's disease and many others. Sometimes it develops after a trauma or a virus. It may also happen to adolescents after a growth spurt. Dysautonomia can be a mild and temporary condition or a serious long-term illness.

Dysautonomia is not rare. Recent National Institute of Neurological Disorders and Stroke data reports that over 70 million people worldwide have been diagnosed with varying forms of dysautonomia and confirms that it affects any age, gender or race. Although there usually is no cure, advanced treatments are being used every day to help patients better combat the dysfunction of their ANS. The largest issue that physicians face is the difficulty associated with actually diagnosing the condition, as it can mask itself as a number of other neurological disorders.

> Over **1 million** Americans are impacted with a primary autonomic nervous system disorder.

#### **Dysautonomia Center**

The Dysautonomia Center at Aurora Health Care is one of only two centers in Wisconsin offering specialized diagnostic testing and treatment for people with complex ANS disorders. Our multidisciplinary team approach includes medical experts in neurology, cardiac electro-physiology, psychology, gastroenterology, rehabilitation, nutrition, integrative medicine, genetics and more. Our team focuses on identifying the root causes of dysautonomia and participates in clinical trials to determine the most effective treatments and improve the quality of life for patients with this condition.

#### **Autonomic Function Testing**

There are number of tests that can help to diagnose and quantify the severity of autonomic dysfunctions. Some tests use deep breathing techniques to quantify heart rate and blood pressure responses to evaluate the function of autonomic nerves. A tilt table test can quantify blood pressure and heart rate responses to the stimulus of moving a person from a supine to an upright position. An advanced form of diagnosis for dysautonomia is testing of sweat function. This can be done by the quantitative sudomotor axon reflex test (QSART) that quantifies the sweat that occurs by activation of small nerves controlling sweat glands in the skin on select confined areas on the limbs. This test evaluates the peripheral component of the ANS controlling sweat function. The thermoregulatory sweat test, where patients are covered in a reactive powder that turns color when the body sweats, assesses both the central and peripheral ANS. This test shows the pattern of sweat a patient experiences, helping physicians diagnosis a number of different autonomic disorders. These two tests of sweat function in combination can help doctors localize and more precisely diagnose the type of autonomic dysfunction. The Dysautonomia Center Autonomic Laboratory is specifically designed to evaluate, quantify the severity of, and help lead to the treatment of ANS disorders.

### **HEADACHES AND MIGRAINES**

Headache is our most common form of pain and a major reason cited for days missed at work or school as well as visits to the doctor. The International Classification of Headache Disorders, published by the International Headache Society, is used to classify more than 150 types of primary and secondary headache disorders. Primary headaches occur independently and are not caused by another medical condition. Migraine, cluster, and tension-type headache are the more familiar types of primary headache.

Secondary headaches are symptoms of another health disorder that causes pain-sensitive nerve endings to be pressed on or pulled or pushed out of place. They may result from underlying conditions including fever, infection medication overuse, stress or emotional conflict, high blood pressure, psychiatric disorders, head injury or trauma, stroke, tumors, and nerve disorders (particularly trigeminal neuralgia, a chronic pain condition that typically affects a major nerve on one side of the jaw or cheek).

Headaches can range in frequency and severity of pain. Some individuals may experience headaches once or twice a year, while others may experience headaches more than 15 days a month. Pain can range from mild to disabling and may be accompanied by symptoms such as nausea or increased sensitivity to noise or light, depending on the type of headache.

#### Treatment

When headaches occur three or more times a month, preventive treatment is usually recommended. Migraine treatment is aimed at relieving symptoms and preventing additional attacks. Drug therapy, biofeedback training, stress reduction, and elimination of certain foods from the diet are the most common methods of preventing and controlling migraine and other vascular headaches. Drug therapy for migraine is often combined with biofeedback and relaxation training. The first step in caring for a tension-type headache involves treating any specific disorder or disease that may be causing it. A physician may suggest using analgesics, nonsteroidal anti-inflammatory drugs, or antidepressants to treat a tension-type headache that is not associated with a disease. Treatment options for cluster headaches include medication, non-invasive vagus nerve stimulation (which uses a hand-held device to transmit a mild electrical stimulation to the vagus nerve through the skin), and oxygen therapy (in which pure oxygen is breathed through a mask to reduce blood flow to the brain). Certain antipsychotic drugs, calcium-channel blockers, and anticonvulsants can reduce pain severity and frequency of cluster headache attacks.

#### Prognosis

Not all headaches require medical attention. But some types of headache are signals of more serious disorders and call for prompt medical care. These include: sudden, severe headache or sudden headache associated with a stiff neck; headaches associated with fever, convulsions, or accompanied by confusion or loss of consciousness; headaches following a blow to the head, or associated with pain in the eye or ear; persistent headache in a person who was previously headache free; and recurring headache in children. Migraine headaches may last a day or more and can strike as often as several times a week or as rarely as once every few years.

With a headache-certified physician leading the program, Aurora is committed to the multidisciplinary and collaborative treatment approach to headaches and migraines.

Information provided by the National Institute for Neurological Disorders and Stroke



## PATIENT STORY: Annette Wick



## Seizure Control Means Quality of Life for One Young Woman

A visit with an epilepsy specialist at Aurora BayCare has vastly improved one young woman's quality of life.

Annette Wick is a 24-year-old with both epilepsy and an undiagnosed genetic syndrome. She started having seizures at age seven and has been seeing neurologists ever since. She's had atonic seizures (also known as drop attacks), convulsive seizures, and complex partial seizures.



For years her condition was manageable, but then the seizures started picking up. By her early 20s, Annette was having frequent drop attacks, suddenly losing consciousness and falling to the floor. Eventually the drop attacks became near daily occurrences, and she began wearing a helmet to prevent brain damage. At one point, she fell on a heat register and cut her face. "She could have lost an eye," said Annette's mom, Donna Wick.

DR. WHITTON

Then, in fall of 2016, Annette was seen by Dr. Shawn Whitton, the new epileptologist at Aurora BayCare.

Donna noticed right away how Dr. Whitton interacted with Annette. "Some doctors are scared of her, but he was so welcoming," Donna said. Donna also appreciated being sought out as an active player in Annette's care, whereas previous providers were often content to communicate with the staff at Annette's group home.

"It was the first time we had a doctor who said, 'I want to talk to the mother.' He was one of the first ones who's done that for me," Donna said. "He wanted to find out what drugs had been tried and with what success. He was truly open to listening to what I had to say." Dr. Whitton changed Annette's meds, weening her off some that could actually worsen her epilepsy and shifting toward others more targeted to her particular condition. "He wanted the RIGHT prescription cocktail, not just A prescription cocktail," said Donna.

Although Annette still has around two seizures daily, life is a lot better, "This is a very hard epilepsy to manage. It is very unlikely that she is going to be seizure free, but we try our best to limit the more dangerous ones," said Dr. Whitton.

Donna was grateful, "He's had the most success, I would say, with treating Annette."

"You know, you can't bubble wrap the girl. We're seeing that this is the best quality of life that she's had for quite a while," said Donna. "She isn't falling anymore."

> " New therapies and surgical techniques make it possible to control seizure disorders once thought to be untreatable."

# NEURO OPHTHALMOLOGY

## American Academy of Ophthalmology Achievement Award physician department that specializes in neurosurgical and orbital disorders.

Partnering with neurosurgeons and otolaryngologists, our neuro-ophthalmology specialists treat neurosurgical/orbital disorders that require a multidisciplinary approach. They provide their patients with the best medical evaluation available by thoroughly discussing with them their options and helping them make the best possible treatment decisions for their health care goals and quality of life.

Our team treats the full spectrum of oculoplastic and neuroophthalmic disorders including surgery for eyelid abnormalities and skin cancers, eye socket tumors, reconstruction, and treatments for tearing or dry eye problems.

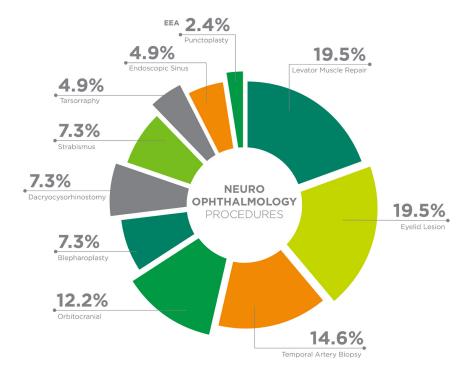
### **Treatments for neuro-ophthalmic disorders include:**

- Eye muscle surgery
   Optic nerve fenestration
- BOTOX<sup>®</sup> for eyelid spasms
   Eyelid surgery

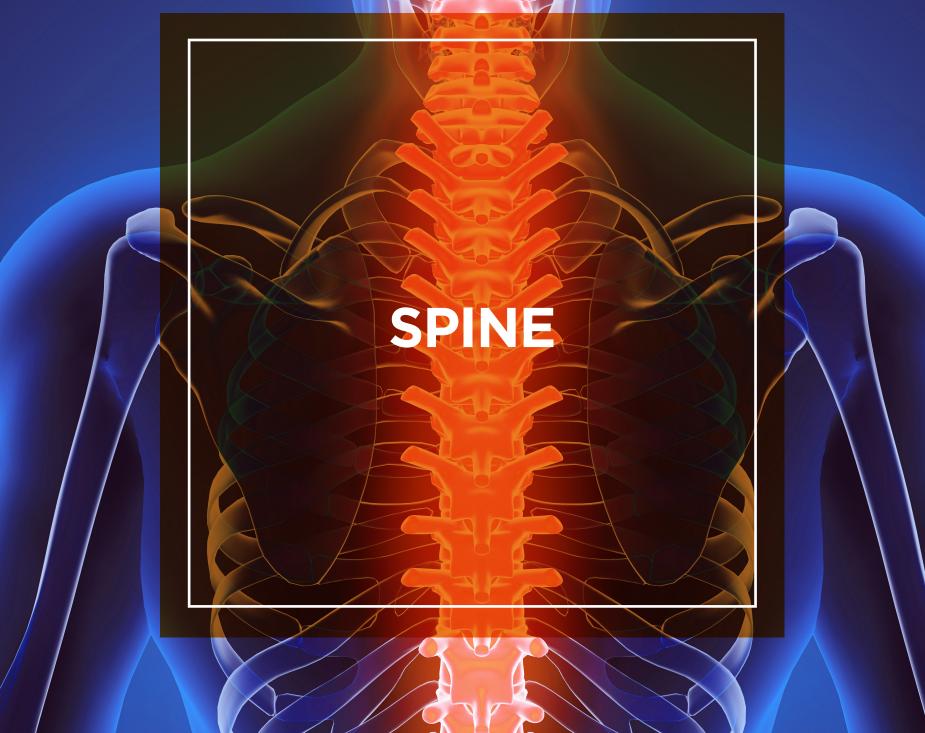
Partnering with neurosurgeons and otolaryngologists, our **neuro-ophthalmology specialists** treat neurosurgical/orbital disorders that require a multidisciplinary approach



Anisocoria	Migraine
Anterior Ischemic	Myasthenia Gravis
Optic Neuropathy (AION)	Optic Nerve
Double Vision	Sheath Meningioma
Drusen	Optic Neuritis
Eyelid Myokymia	Photophobia
Hemifacial Spasm	Pituitary Tumor
Horner Syndrome	Progressive Supranuclear Palsy
Homonymous Hemianopia	Tearing
Idiopathic Intracranial Hypertension	Thyroid Eye Disease
	Transient Visual Loss
Microvascular Cranial Nerve	
Palsy	







## Complete management for spine conditions

Four out of every five Americans struggle with neck or back pain due to an accident, injury, or just everyday wear and tear. This is pain that often makes it hard to enjoy work and hobbies.

Aurora spine care is a comprehensive approach for a full range of spinal conditions, including injuries, degenerative conditions, spinal fractures, and tumors.

We offer the most advanced spine care available for back pain and neck problems, and are recognized as innovators in the region. We were the first to use minimally invasive spinal fusion and artificial disc replacement to treat degenerative disc disease. In addition, we offer complete management for spine conditions—everything from common low back pain and disc problems to spinal injuries and tumors. Our treatments include minimally invasive surgery, spinal reconstruction, and fusion procedures.

Aurora's comprehensive back and spine programs make it easier for you to get back to the things that matter most. With a care coordinator to guide your care, you'll be connected to an integrated team of specialists all working together on your personalized treatment plan.

Aurora saw over **22,000** emergency room and urgent care visits related to neck and back pain in 2016.

## AT A Glance

Did you know that **80% of people experience back pain** at some point in their lives?

In its first year, the Aurora Back and Spine program saw about **800 new patients**; that number more than **tripled last year to 2,415**.

If you're suffering from a spinal disease or have developed back pain as a result of a tumor or an injury, our talented team of specialists can help you **regain mobility and return to your daily activities**.

Risk-adjusted cost per case for spine patients in 2016 was **\$17,331** with an expected cost of almost **\$25,000**, **proving our team's efficiency in surgical technique**.

## COMPLETE MANAGEMENT FOR SPINE CONDITIONS

In most cases, back pain can be managed conservatively and without surgery. The Aurora Back and Spine program provides treatments that will help provide a solution to back pain and get patients back to an active life.

With one call you'll be connected to our team of experts led by a spine nurse navigator that guides patients through every step of the diagnosis and treatment process.

Aurora Back and Spine is part of an integrated health system that treats not just the spine, but the patient as a whole person. Combining medical history, lifestyle, and patient desire, we seek treatment options that work best for each individual patient.

#### Treatment options might include the following:

- Physical therapy
- Behavioral health
- Orthopedics
- Neurosurgery
- Pain management
- Integrative therapy
- Chiropractic

### Certified Spine Center AURORA **SHEBOYGAN MEMORIAL MEDICAL CENTER**

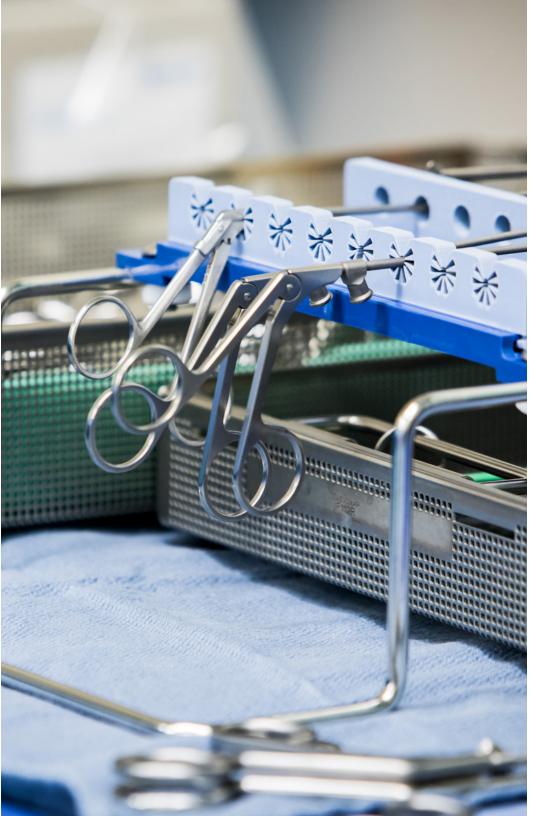
### SPINE CERTIFICATION

## Meeting higher standards to support better outcomes for spine care

Joint Commission Spine Center Certification confirms that a spinal surgery program is in compliance with consensus-based national standards, has an effective and consistent use of appropriate, evidence-based clinical practice guidelines for the discectomy, laminectomy and spinal fusion patient populations, and performs a collection and analysis of spinal-specific performance measures.

# Aurora performed more optical robotic spine surgeries in 2016 **than anyone else in the world**.

	URGENT/ EMERGENCY	INPATIENT ADMISSIONS	OUTPATIENT VISITS
Deformities/ Curvature of the Spine	235	21	967
Degenerative Spine and Disc Injury	132	1,637	24,553
Nonspecific Neck and Back Pain	25,304	488	49,814
Spinal Fracture and Trauma	62	200	1,541



## BCBS BLUE DISTINCTION® Blue Distinction®

## **Evaluating what matters**

Blue Distinction Center designations are awarded to health care facilities based on a thorough, objective evaluation of their performance in the areas that matter the most—quality care, treatment expertise, and overall patient results, just to name a few. The criteria are established with the help of expert physicians and medical organizations. Blue Distinction Centers have a proven history of delivering better quality and results than healthcare facilities without these recognitions.

Blue Distinction Centers for Spine Surgery provide comprehensive inpatient spine surgery services, including discectomy, fusion, and decompression procedures. Research confirms that designated health care facilities in this area have lower readmission rates and fewer reoperations than non-designated facilities.

**BCBS Blue Distinction Centers:** 

## AURORA BAYCARE MEDICAL CENTER

## AURORA MEDICAL CENTER GRAFTON

AURORA ST. LUKE'S MEDICAL CENTER

## STROKE & CEREBROVASCULAR

The American Stroke Association reports that as of 2016, stroke is the 5th leading cause of death in the United States, killing almost 133,000 people every year and accounting for 1 in every 20 deaths. Fortunately, though, due to advanced treatment options and the early recognition of stroke symptoms, the past 10 years have seen a decline in the death rate from stroke by about 29%. Still, almost 800,000 people have a stroke every year, which averages to about one stroke every 40 seconds.

The decreased rate of stroke mortality over the past decade is a major improvement in population health seen in both sexes across all age groups and races, and is largely contributed to significant improvements with cardiovascular risk factors and their control. Better management of diabetes and high cholesterol, along with smoking cessation and advanced hypertension treatments, also appear to have led to the decline in the number of stroke deaths.

Despite the decline in deaths, the incidence of stroke is still on the rise and continues to be the leading cause of long-term disability in the United States. Furthermore, the prevalence of stroke in younger adults and even children has increased, leading to focused efforts on not only the management of stroke risk factors, but also the education of the population to identify stroke symptoms and seek treatment sooner.

In order to maintain our status as a leader in cutting-edge stroke treatments and protocols, Aurora Health Care has established evidence-based care guidelines at all sites for all types of stroke patients to ensure that best clinical practice is followed to maximize recovery, manage complications, and prevent long-term deficits for our patients. In addition to that, highly functional and specialty-trained teams have been constructed to guide the stroke patient through every step of the diagnosis and treatment process including neuroscience nurse practitioners, physician assistants, nurse navigators, and trained stroke responders. Coupled with an extensive team of stroke, cerebrovascular, endovascular and critical care neurologists, stroke patients at Aurora are cared for by the highest level of medical professionals available.

## AT A GLANCE

## COST OF STROKE IN THE U.S.



## **PREVALENCE OF STROKE**

	AGE	%
Men	20-39	0.20
Women		0.70
Men	40-59	1.90
Women		2.20
Men	60-79	6.10
Women		5.20
Men	201	15.80
Women	80+	14

## 11,221 strokes

2016 State of Wisconsir

Stroke kills someone in the US **every 4 minutes** 



## Stroke is the leading cause of long-term disability

## STROKE CERTIFICATION

## Meeting the highest standards to support better outcomes from stroke care

#### **Primary Stroke Certification**

Primary Stroke Certification recognizes hospitals for going above and beyond the standard of care to ensure ischemic stroke patients receive the highest level of treatment options and quality measures. Eligibility standards set by the American Heart Association/American Stroke Association include:

- A dedicated stroke-focused program and stroke unit
- Staffing by qualified medical professionals trained in stroke care
- Individualized care to meet stroke patients' needs
- Coordination of best practice care of stroke patients across the continuum
- Participation in stroke care databases to continually assess improve quality of care

#### **Comprehensive Stroke Certification**

In addition to this, some hospitals may also qualify for Comprehensive Stroke Certification, which meets all of the primary requirements, as well as sets the highest standards for the care of hemorrhagic patients and the most complex stroke patients eligible for surgical or endovascular intervention. Comprehensive eligibility standards include the following:

- Availability of advanced imaging techniques, including MRI/MRA, CTA, DSA, and TCD
- Availability of personnel trained in vascular neurology, neurosurgery, and endovascular procedures
- 24/7 availability of personnel, imaging, operating room, and endovascular facilities

- ICU/neuroscience ICU facilities and capabilities
- Experience and expertise treating patients with large ischemic strokes, intracerebral hemorrhage, and subarachnoid hemorrhage

According to the Joint Commission, the governing body currently certifying the Primary and Comprehensive Stroke Centers at Aurora Health Care, the benefits of certification reach far beyond the accolades of the accomplishment. Certification signifies that our organization has established a consistent approach to stroke care, reducing the risk of error, and has maintained a consistently high level of quality using effective data-driven performance improvement.

#### Get With the Guidelines®

Aurora Health Care is proud to be a participating member in the American Heart Association's (AHA) Get With The Guidelines® (GWTG) program, an in-hospital database that promotes consistent adherence to the latest scientific treatment guidelines for stroke. Participation with GWTG allows our stroke care teams to have constant access to the most up-to-date research and scientific publication, gives us a competitive advantage in the healthcare marketplace, and provides performance feedback reporting for continuous quality improvement.

Target Stroke Awards

- **Target: Stroke Honor Roll:** Time to therapy within 60 minutes in 50% or more of acute ischemic stroke patients treated with IV tPA
- Target: Stroke Honor Roll-Elite: Time to therapy within 60 minutes in 75% or more of acute ischemic stroke patients treated with IV tPA
- **Target: Stroke Honor Roll-Elite Plus:** Time to therapy within 60 minutes in 75% or more of acute ischemic stroke patients treated with IV tPA & DTN, within 45 minutes in 50% of acute ischemic stroke patients treated with IV tPA

### **PRIMARY STROKE CENTERS:**

Aurora BayCare Medical Center	<b>Gold Plus,</b> TARGET Stroke Honor Roll-Elite Plus
Aurora Medical Center Manitowoc County	
Aurora Medical Center Oshkosh	Gold Plus
Aurora Sheboygan Memorial Medical Center	<b>Gold Plus,</b> TARGET Stroke Honor Roll-Elite
Aurora Medical Center Summit	<b>Gold Plus,</b> TARGET Stroke Honor Roll-Elite Plus
Aurora Medical Center Grafton	<b>Gold Plus,</b> TARGET Stroke Honor Roll-Elite
Aurora St. Luke's Southshore	Gold Plus
Aurora Sinai Medical Center	<b>Gold Plus,</b> Target Stroke Honor Roll
Aurora West Allis Medical Center	Gold Plus
Aurora Memorial Hospital of Burlington	Gold Plus
Aurora Medical Center Kenosha	Gold Plus
Aurora Lakeland Medical Center	Gold Plus

### **COMPREHENSIVE STROKE CENTERS:**

Aurora St. Luke's Medical Center	Gold Plus,
	TARGET Stroke
	Honor Roll-Elite Plus

Of the 44 certified stroke centers in the state of Wisconsin, Aurora Health Care locations are 13 of them, representing about **30% of the entire state.** 







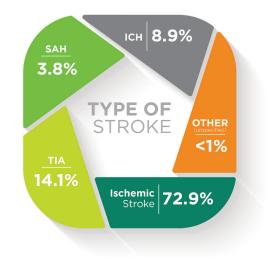




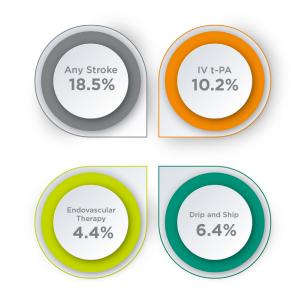
## BY THE NUMBERS

## **OUTPATIENT** STROKE VISITS





## THROMBOLYTIC THERAPY

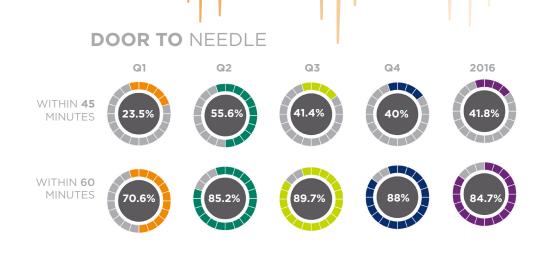




## MEDIAN TIME DOOR TO NEEDLE

00 05 10 15 20 25 30 35 40 45 50





## **NEUROENDOVASCULAR INTERVENTION**

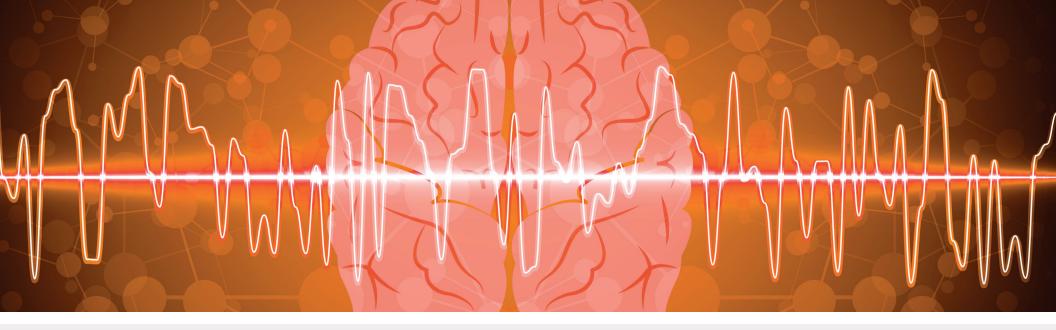
Neuroendovascular conditions are complex conditions of the central nervous system—the brain, spine, and peripheral nerves. In the past, no treatment may have existed. Today, the neuroendovascular subspecialty makes it possible for highly trained physicians to diagnose and treat these conditions, including strokes, aneurysms, and arteriovenous malformations, in addition to a variety of other diseases.

Our expert physicians at Aurora St. Luke's Medical Center and Aurora BayCare Medical Center perform the very latest procedures using first-in-class minimally invasive technology. Also known as endovascular surgical interventional neurology or neurointerventional surgery, neuroendovascular care allows physicians to use high-tech radiology to view, isolate, and treat the source of a wide variety of central nervous symptom conditions.

Our innovative treatments are designed to save lives and minimize disability. High-tech, less-invasive procedures also have the benefit of shorter hospital stays and easier recovery periods.

Time matters after a stroke. After a certain window of time has passed, patients who have had an ischemic stroke are no longer suitable to receive medication designed to break up the clot. With 24/7 access to neurointervention care, stroke patients at Aurora can be treated by a team that specializes in stroke care. For specific cases, a specially trained physician can use minimally invasive procedures to enter the affected brain vessels and break up or pull out the blood clot.





## Comprehensive Core Measures

AHC vs. All CSC % AHC All CSC 100 CSTK-7: Median Time to Revascularization 118 50 mins CSTK-9: 69.6 Median Time 98.0 92.5 9.96 90.1 91.3 3 8 80 8 to Skin Puncture N 6 62.5 0 mins CSTK-1: CSTK-5: CSTK-2: CSTK-3: CSTK-3a: CSTK-3b: CSTK-4: CSTK-5a: CSTK-5b: CSTK-6: CSTK-8: mRs at 90-days NIHSS Severity Hunt/Hess ICH Score Reversal No No Hem Trans No Hem Trans Nimodipine TICI Post for IV t-PA Measurement for SAH Initiation ICH Hemorrhagic for IA t-PA Administered Treatment Grade



SAH/ICH

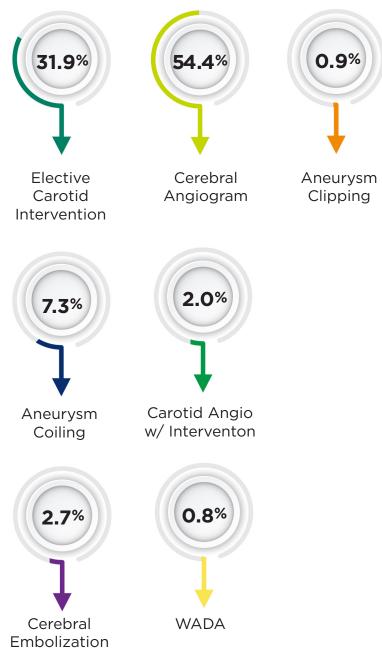
## BY THE NUMBERS

Mortality of hemorrhagic stroke was **6.47%**, with risk-adjusted expectation at **7.55%** 

Overall readmission rate for stroke was **7.17%**, with risk-adjusted expectation at **8.82%** 



## **INTERVENTIONAL** PROCEDURES



In a recent study by the American Heart Association and the American Stroke Association, the FAST (Face Arms Speech Time) stroke recognition tool identified anywhere from 69% to 90% of strokes. However, FAST missed up to 40% of those with posterior circulation events and also does not include the cardinal sign of hemorrhagic strokes—a sudden onset of the worst headache of someone's life. Further, it was found the use of BE FAST (Balance Eyes Face Arms Speech Terrible headache) could reduce the missed stroke diagnoses to as low as 4.4%. For these reasons, in October of 2016, Aurora adopted the more inclusive BE FAST stroke recognition tool. This change will be used in the foreseeable future to more comprehensively educate our communities on the signs, symptoms, and response to stroke.

## A stroke is an emergency. Every minute counts.

## B.E. F.A.S.T

**BALANCE:** Sudden loss of balance or coordination

**EYES:** Sudden change in vision; loss of vision, blurry vision or double vision

FACE: Facial droop , uneven smile

**ARMS:** Arm or leg weakness or numbness

**SPEECH:** Slurred speech, trouble speaking , trouble understanding speech

**TERRIBLE HEADACHE:** Sudden onset of a terrible headache

## NEURO CRITICAL CARE



## Inside our Neuro ICU, our patients receive care around the clock and are closely monitored by expertly-trained specialists.

Our neuro critical care team is unique in that they actively treat and oversee an entire patient population instead of simply performing consultative work. In addition, they work in day-to-day collaboration with our neurology, neurosurgery, and endovascular teams for a truly comprehensive approach to critical patient care.

Our neuro critical care team features:

- 27-bed Neuro ICU
- Significant neuro monitoring
  - 24 hr. EEG, ICP, EVD
  - 24 hr. IN-HOUSE intensivist coverage
  - Fellowship-trained neurocritical care physicians
- All Neuro ICU nurses are NIH-certified and specially neuro-trained
- 24/7 Neurosurgery coverage with backup
- 24/7 Endovascular neurology/interventional neuroradiology coverage

## **3,956** transfers were made in **2016** through the TAP system

## 848 were neuroscience-related (21.4%)

## TERTIARY ACCESS PROGRAM

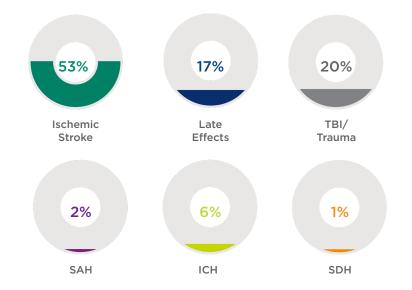
### Connecting physicians to physicians to expedite patient transfer

Our goal is to find better treatment options that result in better patient outcomes. Aurora Health Care can facilitate admission of patients who need immediate attention for stroke or cerebral hemorrhage, including connection to our Neuro Intensive Care Units.

The Tertiary Access Program connects experts by phone, internet, and mobile technologies. It allows physicians to work with real people (hospitalists, intensivists, or specialists), exchange information, access e-ICU care, and expedite patient transfers.

The TAP's dedicated critical care-trained nurses connect physicians directly to the appropriate clinical personnel, creating a streamlined transfer process that results in superior quality and service for our patients. TAP connects transferring physicians to admitting physicians for direct communication, contacts appropriate ancillary hospital staff to expedite admitting processes, and follows up with the transferring physician on admission status and closes communication loop by sending discharge summary to referring physician.

## Neuro ICU Admissions - 707 Average LOS - 5.75 days



In 2016, our Neuro ICU team took our Foley catheter infection rate from 16% to 2%.

# NEURO PSYCHOLOGY

Evidence-based, holistic, and therapeutic approaches to neuropsychological evaluation that is individually-centered and culturally sensitive. Our team strives to create a supportive, collaborative assessment process whereby patients and their families learn about cognitive functioning and strategies to manage cognitive/cognitive-behavioral difficulties in everyday living.

Neuropsychology is a division of Aurora Health Care that focuses on understanding patients' cognitive and functional abilities as they relate to the brain. Common abilities assessed include general intellect, attention, memory, language, visual spatial skills, and executive functions. A patient's emotional, behavioral, social, and when relevant, academic functioning is also assessed. Neuropsychologists diagnose a range of brain-based disorders across the life span, from preschool-aged children with developmental disabilities to adults with question of dementia. Evaluations can also help to determine how neurological conditions such as concussion, epilepsy, brain tumor, and multiple sclerosis are affecting daily functioning. Following an evaluation, neuropsychologists provide education to the patient and family, and generate recommendations to help improve the patient's quality of life.

In addition to outpatient services, neuropsychology serves as part of the ANII multidisciplinary team to provide comprehensive clinical care in a hospital based setting. Neuropsychologists perform pre- and post-surgical evaluations, help determine prognosis and risk for cognitive morbidity following a range of medical interventions, conduct intracortid sodium amytal procedures (Wada tests) to determine language and memory lateralization prior to surgery, and assist with intraoperative cognitive monitoring. Neuropsychologists often follow patients with hydrocephalus, brain tumors, and other neurological conditions as they undergo prolonged treatment (i.e., spinal taps, shunting, radiation, chemotherapy) to assess for possible change over time.

Neuropsychology at Aurora Health Care has seen rapid growth over the last 10 years. There are currently 5 neuropsychologists, with 2 more joining in fall 2017 (5 focused on adults and 2 focused on children and adolescents). In addition to keeping up with the most advanced, evidence-based practices, our neuropsychologists conduct original grant-funded research and participate in interdisciplinary clinical research headed by the Aurora Research Institute and the Aurora Neurosciences Innovation Institute.

### We specialize in:

- Neuropsychological evaluation
- Cognitive rehabilitatio
- Psychotherapy
- Inpatient consultation
- Liaison services with adult populations

### Areas of treatment include:

- Neuro-oncology
- TBI
- Stroke
- Dementia
- Parkinson's disease
- MS
- Epilepsy
- Medical and mental health conditions that may impact cognition, performance validity testing, rehabilitation psychology/neuropsychology, and psychotherapy



## Neuropsychology Visits

1951

# NEURO REHAB

Within Aurora Health Care's network of rehabilitation clinics, 30 sites feature specialists skilled in treating neurological disorders and injuries. Site-specific offerings range from physical, occupational, and/or speech therapy to a comprehensive team approach for effectively caring for individuals diagnosed with high-level neurological impairments. A number of our clinics have received specialty

accreditation for stroke rehabilitation from the

Commission on Accreditation of

Rehabilitation Facilities (CARF). To help restore and improve function needed for activities of daily living, including: mobility, strength, balance, swallowing, speech, memory, thinking, and coping. By returning patients to activity following a life-altering event, we help to preserve their independence.

#### Specialized clinical staffing includes:

- Occupational therapist
- Physiatrist
- Physical therapist
- Psychologist
- Recreational therapist
- Specialists
  - Nursing
  - Social work
  - Integrative medicine



- Speech pathologist
- Vocational therapist

#### Conditions/diagnoses addressed through outpatient neuro therapy:

- Parkinson's disease
- Speech
  - Communication disorders
  - Cognition disorders
  - Swallowing
- Spinal cord injury
- Stroke
- Amyotrophic lateral sclerosis (ALS)
- Bell's palsy, neuromuscular facial retraining
- Brain injury, concussion
- Balance, vestibular
- Fall risk
- Gait
- Multiple sclerosis
- Neurological conditions



IP rehab programs in SE Wisconsin, one of them is the largest in state

### TREATMENT

To gauge improvement from therapy, a patient baseline is created using a Functional Independence Measure. This measurement defines how much help the patient needs to complete certain tasks associated with activities of daily living (ADL). At the time of discharge, nearly 100 percent of patients have shown documented improvement.

Appointment length and number of visits depend on the severity of the neurological disorder or impairment. Treatment may also involve advanced rehab technology:

- Nintendo Wii system
- Video Stroboscopy
- VitalStim therapy
- Bioness NESS, LiteGait mobility devices
- DynaVox
- Kay Digital Swallowing Workstation

Additionally, the following specialty programs, classes and support group sessions are offered at various clinic locations:

- Cognitive Rehabilitation and Activities Program
  - Designed for patients in early stages of dementia and cognitive decline.
  - Speech therapy components: Memory, language, social interaction, reasoning, and problem solving.
  - Occupational therapy components: Visual perception, acuity, activities of daily living, medication management, financial management, home safety, and cognitive skills related to driving.
- Brain Workout Class
- Driver Readiness Program
- Stroke at Mid-life Support Group
- Parkinson's Disease Skills Class
- Stepping On: Fall prevention, strength, balance
- Big & Loud Therapy Program: Parkinson's disease patients

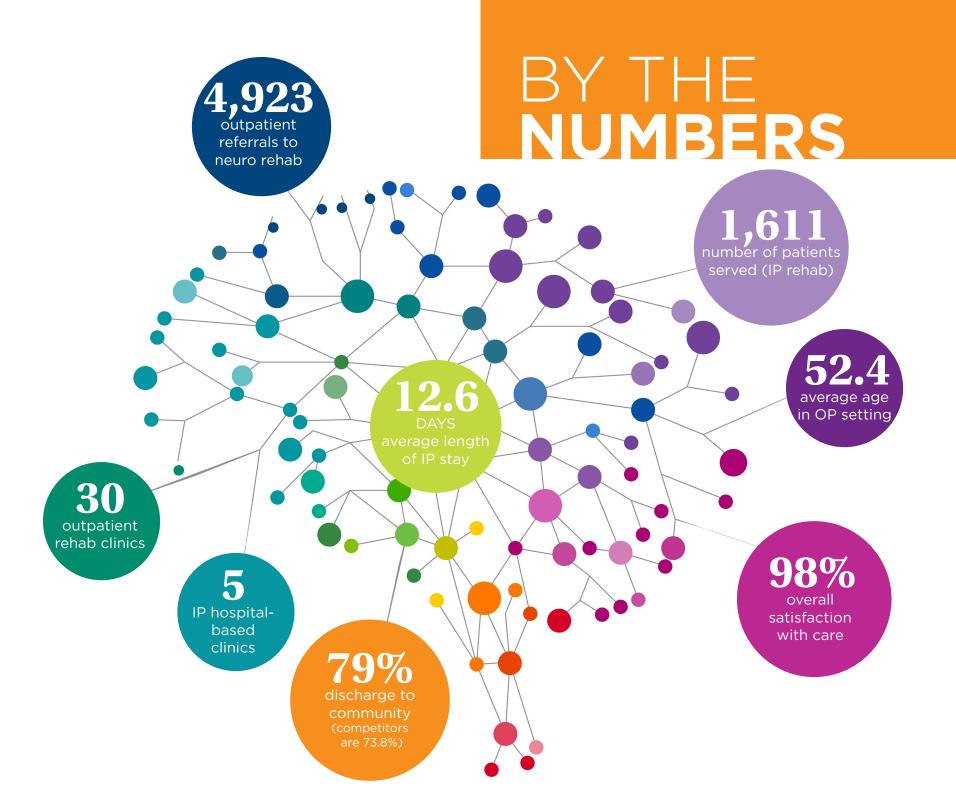
As treatment is driven by doctor referral, sharing additional education and documented outcome statistics with physicians could have a definite impact on patient levels.

Average treatment length resulted in a 51.5% restoration of function at the completion of therapy and nearly 100% had documented improvement

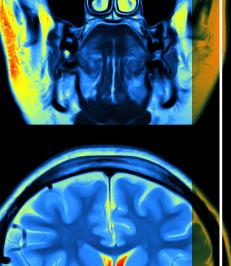
# IP Neuro Rehab Patients

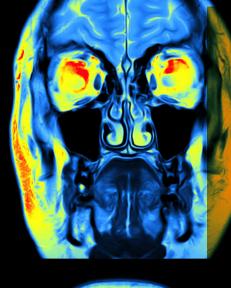
Stroke	488
Brain	276
Neurologic (MS, PD, GB, neuropathy, etc.)	102
Spinal Cord	116











Deep brain tumors, areas of bleeding, and cysts that were **once considered too risky to operate** on by many **are now often removed** through a precise and patient-specific corridor with **Aurora Neuroscience Innovation Institute** (ANII)'s unique, integrated surgical techniques.

Led by neurosurgeon Amin Kassam, MD, ANII includes a multidisciplinary clinic, education suite, neuroanatomical laboratory, and four neurosurgical operating suites featuring first-in-the-world technology at Aurora St. Luke's Medical Center.

### **Surgical** Techniques

A bedrock of innovative research combined with collaboration among the neuro-oncology multidisciplinary team translates into increased access to innovative minimally invasive techniques. These techniques offer patients hope for better surgical results and improved long-term health outcomes. They also minimize long-term complications as a result of their tumor or surgery.

AMIN KASSAM, MD VICE PRESIDENT, AURORA NEUROSCIENCES

#### **Directed Therapy Options**

Neurosurgeons collect and preserve the brain tissue they remove for pathology, molecular, and genetic evaluation. These samples provide

opportunities to study new treatments for patients. The ability to capture, grow, and use the tumor tissue in research enables the team to study new targets for treatment that can be brought back to the patient in an individualized manner, epitomizing Aurora's commitment to precision medicine.

All of this patient and correlated cell data is then compiled into a novel image-driven database with the goal of capturing enough data to predict outcomes. Aurora was the first institution in the world to install and implement this specific image-driven informatics system.

#### Mapping

An invaluable tool for Aurora's neurosurgeons, brain mapping depicts aspects of a tumor and surrounding healthy tissue with enhanced clarity rendered in a three-dimensional space. This imaging technology allows surgeons to plan a patient-specific, real-time

# BY THE NUMBERS 129

new subjects enrolled in 2016 neurosciences cllinical trials

> 25 neurosciences publications and abstracts in 2016

published manuscripts or book chapters

neurosciences research studies as of December 31, 2016

published abstracts

surgical pathway before a brain surgery procedure begins, which may translate into improved outcomes and a faster recovery.

#### **Dynamic Navigation**

Neurosurgeons use a GPS-like system that gives them real-time guidance deep within the brain. Patients can see their brain tumor removal on the same computer screen that their surgeons use to track the movements of their surgical instruments.

#### Safe Access

Aurora uses a specialized and innovative tool that minimizes damage to surrounding tissue by allowing neurosurgeons to safely displace the natural folds of the brain as they advance to the target site.

### **High-Definition Optics**

This technology allows neurosurgeons to differentiate tissue types with unprecedented clarity. Being able to separate diseased tissue from healthy tissue makes it possible to successfully remove what would otherwise be considered inaccessible brain tumors, cysts, or other difficult-to-see growths. The robotically-operated video telescopic-microscopy system (ROVOT-m) is a novel optical tool that consists of an optical system connected to a robotic arm that has the ability to maneuver along the surgical field in a hands-free, command-prompted interface.

The culmination of these integrated technologies allows for many patients to have surgery while awake. Many patients interact on their phones or smart devices during surgery, and many go home the next morning. Having patients awake permits detailed neurocognitive evaluation throughout the procedure. This intensive monitoring provides a margin of safety difficult to achieve when the patient is asleep.

### INNOVATIVE IMAGING TECHNIQUES DRIVE SURGICAL STRATEGIES

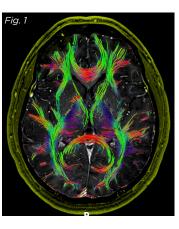
Minimally invasive brain surgery requires detailed planning to avoid white matter tracts and areas of the brain that control function. Neurosurgeons and neuroradiologists at Aurora Neuroscience Innovation Institute (ANII) use advanced magnetic resonance imaging (MRI) techniques called diffusion tensor imaging (DTI) and functional MRI (fMRI) to devise patient-centered strategies.

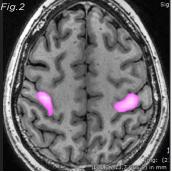
White matter pathways connect one area of the brain to another and DTI allows those connections to be visualized (Figure 1).

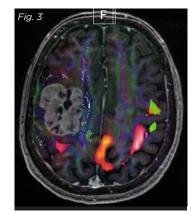
Locating areas of the brain activated during language and motor tasks are possible noninvasively with fMRI. This technique relies on changes in blood flow to specific areas of the brain caused by active neurons. Changes in blood flow are elicited by having the patient conduct motor, sensory, visual, auditory, and

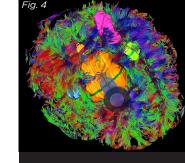
language tasks. fMRI maps of functional activation correlating with specific areas of the brain are created using statistical processing (Figure 2).

The DTI and fMRI maps are then carefully aligned so that the relationship between, for example, the tumor, white matter tracts, and areas of the brain that control function, can be visualized simultaneously. Based on this information, a route to the tumor is designed to minimize impact of the surgery.









"The combination of DTI, fMRI and anatomic MRI provides a road map for surgery and helps determine the safety and feasibility of operating on the lesion," said Richard Rovin, MD, medical research director.

This innovative imaging technique proved useful in a patient with a tremor and weakness in her left arm. After finding a large metastatic tumor adjacent to a part of the brain controlling motor function, the team used DTI and fMRI to identify the white matter tracts at risk with surgery (Figure 3). Functional areas at risk included the left hand, face and area that contributes to movement and sensation (Figure 4).

A precise trajectory was designed to avoid the tracts and functional areas. With this plan, the patient underwent surgery while awake to have the tumor removed. After surgery, the patient's left arm strength improved.

The ANII team is studying the technique of fusing DTI and fMRI images. Preliminary data released in 2016 show that the technique is

highly reliable in allowing to more fully remove tumors adjacent to functional areas of the brain with very low complication rates. The team is further validating the approach using technologically advanced methods of testing the patient's speech, cognition and motor systems during the awake surgeries. Neuroradiologist Jonathon E. Jennings, MD, is the principal investigator for the study.



#### Monitoring cardiac rhythms in stroke

Development of atrial fibrillation, an abnormal heart rhythm, is a risk for people who have had an ischemic stroke. Led locally by principal investigator Rehan Sajjad, MD, researchers are comparing the incidence of atrial fibrillation documented with an implantable continuous cardiac rhythm monitoring device versus standard of care monitoring. Medtronic Inc. is sponsoring the Phase IV trial (clinicaltrials.gov identifier: NCT02700945). Kate McPolin, BSN, and Lynda Yanny, BSN, are serving as coordinators at Aurora St. Luke's Medical Center.

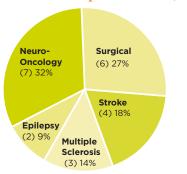
#### Studying outcomes after stroke

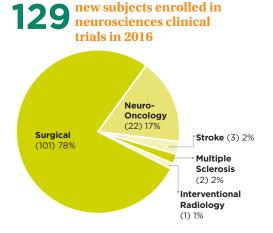
Open at three Aurora sites, the Mild and Rapidly Improving Stroke Study (MaRISS) is tracking outcomes of subjects who have suffered mild and rapidly improving stroke (clinicaltrials.gov identifier: NCT02072681). Through this American Heart Association study, sponsored by the University of Miami, researchers will track the proportion of subjects not independent at 90 days after a stroke. The study is supported by investigators/coordinators at each site:

- Aurora BayCare Medical Center: James Napier, MD/Laura Thoreson and Taylor Romdenne
- Aurora Medical Center in Grafton: Rose Dotson, MD/Sue Truchan, BSN, and Stacie Bishop
- Aurora St. Luke's Medical Center: Rehan Sajjad, MD/Carol Halliday, RN, and Lynda Yanny, BSN

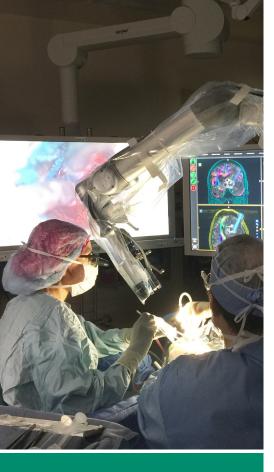
#### **Targeting MS**

In multiple sclerosis, immune cells attack nerve fibers in the central nervous system, interfering with signals between the brain and the spinal cord. An approved leukemia treatment called ofatumumab reduces their ability to damage the central nervous system. Led by principal investigators Akram Dastagir, MD, at Aurora St. Luke's Medical Center and James Napier, MD at Aurora BayCare Medical Center, researchers are comparing the effectiveness and safety of ofatumumab versus the standard treatment teriflunomide in patients with relapsing multiple sclerosis (clinicaltrials.gov identifier: NCT02792218). Sponsored by Novartis Pharmaceuticals, the Phase III study tests whether clinical trial participants treated with ofatumumab experience fewer multiple sclerosis relapses. Carol Halliday, RN, is serving as research coordinator at Aurora St. Luke's and Alex Albers and Laura Thoreson at Aurora BayCare. 22 neurosciences clinical trials open to accrual and follow-up as of Dec. 31, 2016





Neurosciences clinical trial research at Aurora Health Care provides patients with ACCESS to investigational therapies for brain cancer, stroke, multiple sclerosis and <u>epilepsy.</u>



# **Translational** highlights

### A new way to generate multiple tumor specimens that display a patient's characteristics

#### Growing tumors for testing

The spread of cancer to the brain from other primary tumors, such as breast cancer, is occurring more frequently, creating an urgent need to identify the underlying molecular factors and test drugs against those targets.

To find these molecular targets, researchers need to understand how cancer grows and spreads. One model to test this involves growing the tumors in scientifically engineered mouse avatars from human tumor cells. This can be challenging because sometimes the tumors fail to grow.

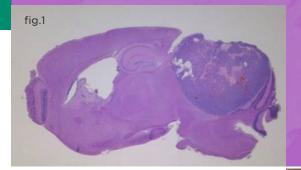
Postdoctoral fellow Amber LaCrosse, PhD, and a team at Aurora Research Institute determined a potential new way to generate multiple tumor specimens that display patient characteristics. They implant tumor cells through the cerebral aqueduct, part of the brain's ventricular system, rather than the traditional method that utilizes the striatum, located toward the center of the brain.

"Patient-derived tumor models are difficult to generate; however, placing the tumor cells in a region that would facilitate their spread and allow cells to choose an appropriate growth niche may facilitate successful tumorigenicity," said Dr. LaCrosse.

Cells from the first-generation tumors were then used to grow second and third generations of tumors. Testing of the tumor masses confirmed that the third-generation cells retained key characteristics of the original patient tumor (Figure 1).

Using this unique implantation site to grow second- and third-generation tumors with distinct characteristics may help with the diagnosis and treatment of patients with brain metastases in the future.

Dr. LaCrosse's findings were made possible by a grant from the Vince Lombardi Cancer Foundation.



#### **Tissue collection studies**

were donated

in 2016

by Aurora

patients

Development of genetically targeted diagnostics and therapies has increased exponentially in the past 10 years, in many ways thanks to people who are willing to donate tissue after a medical procedure (see one patient's experience with tissue donation on page 6). To conduct neurosciences research, clinically sound and genetically diverse samples are required. Neuro-

> sciences researchers, in collaboration with Aurora Research Institute's Biorepository and Specimen Resource Center, have focused on screening patients for viability of samples, obtaining consent, and collecting these specimens for neurosciences research.

Patients are becoming more aware of the need for tissue donation to boost clinical research. A total of 82 brain tumor tissue samples were donated in 2016 by willing Aurora patients. The effort to

obtain these precious samples is substantial. Over 90% of patients who are approached for consent agree to participate. Of those consenting patients, tissue collection occurs from 60% of them because sometimes the tumors are too small and must all be used for clinical purposes.

# Physician highlight

#### Mapping a route toward wellness

A member of a collaborative multidisciplinary team at Aurora Health Care, neuroradiologist Melanie Fukui, MD, helps provide a highly detailed road map for neurosurgeons prior to brain surgery using some of the most advanced tools in imaging.

"We are fortunate at Aurora St. Luke's to have the capital and intellectual resources to make the most of advanced imaging techniques, such as magnetic resonance (MR) perfusion, MR spectroscopy and diffusion tensor imaging," said Dr. Fukui, who was named one of The Best Doctors in America. Dr. Fukui has been with Aurora for nearly three years and has 25 years of clinical experience.

Dr. Fukui and researchers at Aurora Neuroscience Innovation Institute are studying diffusion tensor imaging, a tool that provides detailed imaging of biological tissue (see page 48), and a three-dimensional modeling technique that can provide visualization of neural tracts when treating abnormal tissue in the brain, or lesions.

These state-of-the-art, advanced imaging techniques are routinely available to Aurora patients. This mapping technology is only one unique aspect to the patient-centered care plans that have made Aurora a national destination

for brain surgery (see page 53). Multidisciplinary collaboration for each patient occurs between neuroradiologists, such as Dr. Fukui, neurosurgeons, neuro-oncologists, radiation oncologists, medical oncologists, palliative care specialists, neuropsychiatrists, advanced practice providers, and care coordinators.

"We first consider the patient's treatment goals and functional priorities, as well as whether the surgical goal is complete resection, tissue diagnosis, decompression of a critical neural structure that is producing symptoms, or cyto-reduction, in order to make radiation and chemotherapy more effective options," Dr. Fukui said. "The challenge then becomes designing a plan to achieve the surgical goal with the least disruption of normal surrounding tissue and the greatest preservation of neurological function. Sometimes it is better to take the long way, rather than the shortest route, in order to maintain critical structures."

Dr. Fukui appreciates the face-to-face collaboration that she has experienced at Aurora. With the introduction of electronic images, such as picture archiving and communications systems, she maintains that, in other institutions, this face time has become less common. The combination of state-of-the art imaging with true collaboration ensures that the patient obtains the best possible care.

Dr. Fukui helps map treatments for some aggressive and challenging cases, necessitating a need for a bench-tobedside approach. Dr. Fukui says that, in the future, precision molecular imaging combined with tumor-specific agents may boost both neuroimaging and treatment.

"We are hopeful that applying new techniques to these patients' care will translate into treatment modifications that improve outcomes," Dr. Fukui said. **DR. FUKUI** helps provide a road map for neurosurgeons prior to brain surgery using some of the

. . . . . . .

MOST ADVANCED IMAGING TOOLS.



# **Researcher** highlight

#### Breaking down barriers in brain cancer

With almost 20 years in the laboratory, senior research scientist Santhi Konduri, PhD, is on the cusp of translating her research into a clinical trial, providing a new investigational option in the fight against brain cancer.

Since joining Aurora Research Institute in July 2013, Dr. Konduri has focused on combining existing chemotherapy drugs with drugs approved for other indications in an attempt that may synergistically increase survival and decrease toxic effects in hard-to-treat cancers.

With Aurora Cancer Care Research Awards made possible by gifts from Vince Lombardi Cancer Foundation, Dr. Konduri and her team evaluated the drug disulfiram as part of a combination therapy for breast and pancreatic cancers. The interest in disulfiram was sparked because it is an FDA-approved drug.

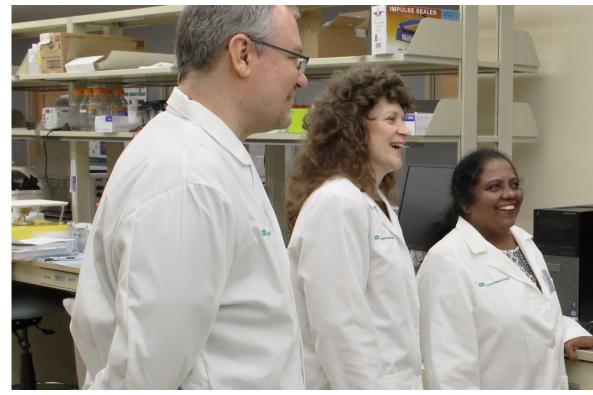
The combinations significantly decreased tumor cell growth in both pancreatic and breast cancers.

Applying these initial results, Dr. Konduri is testing combinations on brain cancer, specifically glioblastoma multiforme, a rapidly growing and aggressive brain tumor.

"Some of these patients are dying within six to nine months of their diagnosis," Dr. Konduri said. "It is too difficult for many drugs to penetrate the brain, which makes them ineffective."

Disulfiram can cross the blood-brain barrier. But it needs help.

"These cell membranes are tougher, but when we combined copper with the disulfiram, we were more easily able to kill the primary brain tumor cells," Dr. Konduri said. "Disulfiram combined with copper forms another compound that is able to kill the brain cancer cells effectively."



"If you are able to decrease the amount of this drug, you can also reduce the side effects of the chemotherapy drugs," Dr. Konduri said. "We want see if we can decrease side effects so that these people can lead better lives without as many complications."

# "Her **passion** for finding alternatives to current therapeutic options is evident in everything she does in the lab,"

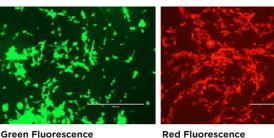


Dmitry Bosenko, Deb Donohoe and Santhi Konduri (left to right) work with neuro-oncologist George Bobustuc, who helps to develop ideas for clinically relevant projects and presentations. With the addition of copper, less disulfiram is needed; high levels of disulfiram may cause neurotoxicities, which destroys normal brain cells.

Taking the research further, Dr. Konduri added the chemotherapy drug temozolomide, which is approved for treatment of glioblastoma multiforme.

"Next we want to offer these potential therapies to consenting subjects in an ongoing clinical trial," Dr. Konduri said.

She is currently working with other researchers at Aurora



Red Fluorescence Protein - GBM Cells

in generating a database to determine what types of patients may be eligible and most appropriate for this type of therapy. Principal biostatistician, Maharaj Singh, PhD, is aiding with statistical analysis.

**Protein - GBM Cells** 

"Her passion for finding alternatives to current therapeutic options is evident in everything she does in the lab," said senior research technologist Deb Donohoe, who has worked with Dr. Konduri for almost two years. "Dr. Konduri is committed to improving the future of cancer treatments at Aurora."



# **PATIENT STORY:** Valerie Johnson



### What started as a headache led to a trip from **Texas** to **Wisconsin** for the latest in brain surgery.



### A DESTINATION FOR CARE

As a figure competitor, Valerie Johnson was in peak physical condition, but severe headaches caused her to take a break from training. After many tests, the 36-year-old Austin, Texas resident learned she was suffering from a life-threatening brain bleed.

Johnson's local doctor referred her to the Aurora Neuroscience Innovation Institute (ANII) team at Aurora St. Luke's Medical Center because of the leading-edge image-guided surgical techniques used there.

ANII researchers have been studying the combination of diffusion tensor imaging (DTI) and functional magnetic resonance imaging (fMRI) to avoid detrimental consequences in minimally invasive brain surgery like the one Johnson needed to control the brain bleed. This advanced imaging allows surgeons to access areas of the brain that control function while minimizing complication rates.

"I could not have done Valerie's surgery two years ago. That's how recent this revolutionary technology is," said Amin Kassam, MD, vice president of neurosciences at Aurora Health Care and founder of ANII.

#### No sleeping on the job

Neuroradiologists designed a three-dimensional map of Johnson's brain to plan the safest route for surgeons to take during surgery.

Johnson's bleed was located deep in the left side of her brain, surrounded by areas that control motor and memory function. At Aurora St. Luke's, the surgery to control a bleed like that is performed while the patient is awake, a strategy used at only a handful of hospitals throughout the United States. Prior to the operation, anesthesiologists deliver a specific dose of medicine so the patient is aware of what it is going on, but cannot feel pain.

"The neurosciences team at Aurora was great. They made me feel at ease with the surgery," Johnson said. "They assured me that being awake would be a great benefit to make sure they didn't do something that was detrimental to me."

At one point during the surgery Johnson appeared to be losing motor skills and she forgot who she was. At this point the doctors raised their voices to be sure Johnson could hear and respond.

"I was really sleepy from what I recall so in order to keep me awake they had to talk loudly," Johnson said.

The team used the 3D map for information regarding the safest way to proceed to preserve memory and motor function. Not long after making adjustments, Johnson's memory returned and she asked to call her mom.

"I do not remember most of it," Johnson said. "I remember going to questions on an iPad and talking on the phone with my parents. Even still, all of that is pretty hazy."

#### **Back to life**

After the surgery, Johnson could speak coherently and answer questions, and her motor skills were back to normal.

The next day, she left the hospital to have lunch with her family and, a month later, she is already planning to get back into shape. She wants to start a business of her own someday, but mostly plans to spend more time with her family in the years to come.

"I could not have done Valerie's surgery two years ago. That's how recent this **revolutionary technology** is,"

- Amin Kassam, MD

### NEUROSCIENCES RESEARCH COMMITTEE

Amy Beres, PhD George Bobustuc, MD Dmitry Bosenko, MS Juanita Celix, MD Srikant Chakravarthi, MD Denise Coley, MS Martin Corsten, MD Monica Cucciare Deb Donohoe Amin Kassam, MD (co-chair) Melanie Fukui, MD Nina Garlie, PhD Jennifer Hawes Timothy Heniadis Jonathan Jennings, MD Anne Kissack, MPH Nathan Kojis Santhi Konduri, PhD Amber Lacrosse, PhD Cassie Martin Paul Mintz, PhD Natalie Polinske, MS Richard Rovin, MD (co-chair) Maharaj Singh, PhD Bob Stoltz, MBA Sarika Walia, MD Thomas Wolfe, MD

### NEUROSCIENCES CLINICAL TRIALS RESEARCH COMMITTEE

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Tonya Hollrith Amin Kassam, MD (co-chair) Asadullah Khan, MD Kessarin Panichpisal, MD Richard Rovin, MD (co-chair)

Lori Schwingshakl, RN Carol Tutino, BSN, MS Paul Vilar Sarika Walia, MD Valerie Werner, BSN Thomas Wolfe, MD Lynda Yanny, BSN

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### Neurosciences volumes (systemwide)

Source: Aurora Smart Chart and Medipac	2014	2015	2016
CASES			
Epilepsy	3,210	4,317	3,991
Stroke	2,433	1,645	1,961
Ischemic	1,510	1,094	1,426
Transient ischemic attack	552	304	284
Hemorrhagic	371	247	251
Interventional radiology*	387	446	357

\*Number of patients

(For cancers of the brain and central nervous system, see table on page 44.)

# **Neurosciences** publications

### 2016 AURORA-AUTHORED, PEER-REVIEWED

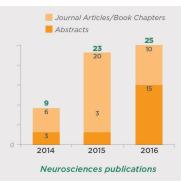
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Aurora Health Care is committed to making sure that all patients, regardless of income, have access to the best care possible. That includes health care for the un- and underinsured, services for survivors of sexual and domestic violence, substance abuse treatment and other supportive services for some of the most vulnerable people in our community. Donors to Aurora have the ability to have a major impact on these same issues through the programs Aurora provides, spanning the organization's service area and serving tens of thousands of people each year.

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> Your gifts transform care in our communities; you help make hope possible.

**Your gifts** help to advance clinical trials, investigator-initiated research and promote medical education and awareness reaching more than 100 countries all over the world.

**Your contributions** support cutting-edge research and helps to develop new therapies to treat and cure the most complex and life-threatening neurological diseases.



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OR of the Future. 26th Annual North American Skull Base Society Meeting (NASBS); Scottsdale, AZ February 12-15, 2016.

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360-Degree Minimally Invasive Brain Surgery: Concepts & Practical Approach, Ohio, State-ofthe-Art Endoscopic Skull Base Surgery Course, October 27, 2016.

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Minimally Invasive Subcortical Surgery. 2016 EndoChicago World Congress for Endoscopic Surgery of the Skull Base and Brain; Chicago, IL May 15-18, 2016 Technological Advancements in OR Integration. 2016 EndoChicago World Congress for Endoscopic Surgery of the Skull Base and Brain; Chicago, IL May 15-18, 2016

Kassam, A. Visiting Professorship, NorthShore University Health System, Evanston IL Hospital: "Anatomy and Physics the two Truths." May 27, 2016

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Endoscopic Endonasal Transclival Approach, Dissection/2016 EndoChicago World Congress for Endoscopic Surgery of the Skull Base and Brain; Chicago, IL. Amin Kassam, Martin Corsten, Sammy Khalili. May 15-18, 2016. (Cadaveric Dissection)

Endoscopic Skull Base Surgery. Lecture / McMaster University; Minimal Invasive Skull Base Surgery Course. Dr. Kesh Reddy, Dr. Almunder Algird, Dr. Doron Sommer, Dr. Justin Khetani, Dr. Smriti Nayan, Dr. Sarfaraz Banglawala, Dr. Amadeo Rodriguez; Guest Faculty: Dr. Amin Kassam. April 15 & 16, 2016.

Live Surgery: Rovotic Surgery. Aga Khan University, Karachi, Pakistan. Enam, Ather, Kassam, Amin. April 10-12, 2016.

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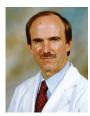
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