Barrow
Neurological Foundation
2023

You Fuel Lifesaving Innovation

Cover: (top) Chinami Michaels with Barrow Neuroscience Publications Department intern Maya Green (bottom) Barrow Neurological Institute President and CEO Michael T. Lawton, MD

Since 1962, Barrow Neurological Institute has been at the forefront of treatment for neurological diseases through groundbreaking research and innovation. Under the leadership of President and CEO Michael T. Lawton, MD, Barrow continues to advance research and treatment that will change the course of medicine.

It is your dedicated support that allows our physicians and scientists to transform these novel ideas into breakthrough studies. That is why it is such a pleasure to report back to you on the difference your generous philanthropy is making in research, patient care, and medical education at Barrow. Because it is you who fuels life-saving innovation.

In the pages of this report, you'll read about Barrow neurosurgery resident Dr. Brandon Fox, who developed a novel stimulation device that measures a coma patient's level of consciousness electronically, rather than through manual pain stimulation. Dr. Fox was able to take this device from concept to reality with funding from our Board of Trustees and the Flinn Foundation.

Of course, that's just one example of how you revolutionize the future of neuroscience. Your generosity also drives innovation in deep brain stimulation (DBS) for chronic pain, neuroimaging for nerve trauma in veterans, and research into brain-based solutions for diabetes.

You'll read about Jim Weatherly, an adventure-loving father who went from running marathons to barely being able to stand due to debilitating back pain. With the expertise of spine surgeon Dr. Laura Snyder, and a technique Barrow pioneered—minimally invasive spine surgery—Jim is now back to living each day to the fullest. You gave him his life back.

You'll read about groundbreaking studies, including one that aims to uncover the link between COVID-19 and Alzheimer's disease, funded through a most significant grant from the Office of the Arizona Governor. There's also a study by Dr. Tomoki Hashimoto, the inaugural Sam and Rita Garvin Aneurysm Research Chair, which seeks to develop a medication-based approach to preventing aneurysm ruptures caused by aging cells. And scientists in the Caroline Hoeye Pituitary Research Program successfully developed a "tumor-in-a-dish" model that replicates a Cushing's disease-causing pituitary tumor. You drive these scientific breakthroughs.

You also accelerate the Ivy Brain Tumor Center's search for a cure through innovative Phase 0 clinical trials. This includes its newest trial, superselective intra-arterial infusion (SSIAI), which aims to deliver a drug directly to the patient's tumor, bypassing the blood-brain barrier and minimizing side effects.

The Franke Global Neuroscience Education Center has made exciting progress, welcoming its inaugural Franke Global Neurosurgery Fellow and inaugural International Sonntag Spine Center Research Fellow. And The Steele Foundation is helping us meet a critical need in Alzheimer's care through the Dan Cracchiolo and Pam Grant Behavioral Neurology and Neuropsychiatry Fellowship, which trains the next generation of dementia specialists. You pave the way for these trailblazers in neuroscience.

You'll read about the Henderson-Liebman ALS Expanded Access Program, which provides ALS patients with increased access to clinical trials. This incredible program was made possible by a generous gift from Autumn and Bobby Henderson. The Bob & Renee Parsons Foundation made a gift to launch the Legacy Caregiver Program, which provides additional resources to caregivers of patients with advanced Parkinson's. You transform care for all through programs like these.

And, you'll read about the exciting areas in which Barrow is investing in future growth, including new research space in the Phoenix Medical Quarter and the final stages of construction on the Ivy Brain Tumor Center headquarters.

Each aspect of this report highlights how your generosity and dedicated support of Barrow is helping shape the future of medicine, leading to cures for some of the most devastating neurological diseases. After all, you fuel life-saving innovation.

With tremendous gratitude,

Katie Cobb, President
Barrow Neurological Foundation

BARROW BY THE NUMBERS

117,704+
total number of patient visits

8
new patent applications filed by Thurston Innovation Center

$12
million in new federal research grant support

14
Centers of Excellence

327
active research studies

20
states reached through Alzheimer's outreach program

200+
scientific journal publications

5,817
brain and spine surgeries

36
combined total of neurosurgery residents and fellows

10th
ranked specialized hospitals by *Newsweek*

1st
Patient Choice for Brain Surgery, Arizona WebMD

51
U.S. and international students completed summer internships

397
patients enrolled in clinical trials

513
inpatient/outpatient neuroscience nurses

$10
million American Rescue Plan Act Grant

41
combined total of neurology residents and fellows

41,777
individuals impacted by the Ali Legacy Care Program

58,078
individual patients treated

59
international research fellows/visiting scholars

1st
Provider Choice for Neurology, Arizona WebMD and Medscape

DONOR IMPACT

FY2023

$44,000,000
TOTAL DISTRIBUTED TO BARROW NEUROLOGICAL INSTITUTE

$25,400,000
DESIGNATED TO IVY BRAIN TUMOR CENTER

$5,300,000
DESIGNATED TO CENTERS/PROGRAMS

$11,900,000
BASIC, CLINICAL, AND TRANSLATIONAL RESEARCH

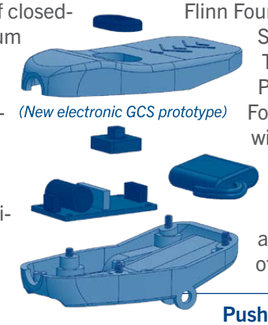
$1,000,000
ENDOWMENTS

3,898
TOTAL DONORS

You Forge the Future of Neuroscience.

Redefining the Glasgow Coma Scale

The Glasgow Coma Scale (GCS) is the standard for measuring patients' level of consciousness when they are in a coma. However, it relies on painful stimulation in the form of closed-fist rubbing on the sternum and pressure on the nail bed of a finger. This can result in significant bruising, and even the loss of fingernails.



(New electronic GCS prototype)

Barrow neurosurgery resident Brandon Fox, MD, has been investigating whether an electronic stimulation device that measures patients' level of consciousness would provide more consistency in exams and limit injuries. Dr. Fox developed his novel stimulation device in the Thurston Innovation Center and received funding from the Barrow Neurological Foundation Board of Trustees to expand his work into clinical studies. He was also awarded a $100,000 grant from the Flinn Foundation as a part of its Seed Grants to Promote Translational Research Program. Ultimately, Dr. Fox hopes that this device will replace manual pain stimulation for GCS exams, providing a safer and more accurate way of assessing a patient's level of consciousness.

Pushing Boundaries in Deep Brain Stimulation

Deep brain stimulation (DBS) is changing patients' lives by correcting abnormal electrical activity in the brain. With generous support from Curt and Jean Feuer, the Barrow Center for Neuromodulation, led by Francisco Ponce, MD, continues to revolutionize the use of DBS to treat a wide range of neurological conditions.

> "Dr. Ponce's groundbreaking work in deep brain stimulation is restoring hope for people with epilepsy, Parkinson's disease, and essential tremor. He is determined to unlock the potential of DBS and we are glad to support his efforts.
>
> – Curt and Jean Feuer

One of Dr. Ponce's initiatives is training up-and-coming leaders in DBS, such as Barrow neurosurgery resident Baltazar Zavala, MD, PhD. Dr. Zavala is working to refine DBS treatment for chronic pain by analyzing recordings of electrical activity deep inside the brain as patients experience exacerbations and relief of pain. This will allow him to ascertain the optimal stimulation parameters to provide patients with the most relief.

Ultimately, Dr. Zavala hopes to not only deliver better pain relief, but also increase the number of individuals with chronic pain who are candidates for DBS, providing a safer alternative to opioid medication.

Brandon Fox, MD, with Dakota Graham in the Thurston Innovation Center with a prototype model of Dr. Fox's electronic stimulation device.

Neuroimaging Solutions for Nerve Trauma in Veterans

Modern body armor saves lives, but it also puts military service members at a greater risk of sustaining peripheral nerve damage. This can result in chronic pain, loss of sensation, and permanent paralysis. Many surgeries to repair nerve damage fail, however, due to doctors' limited ability to monitor nerve health after surgery.

Barrow neuroimaging scientist Richard Dortch, PhD, is utilizing diffusion MRI, which uses water molecules to reveal microscopic details of nerve tissue, as a biomarker of nerve damage and regeneration. Through the generous support of Arte and Carole Moreno, Dr. Dortch has been able to upgrade imaging equipment and launch a program focused on providing veterans suffering from nerve damage with a better quality of life.

> "Arte, a proud Vietnam Veteran, and I support Veterans Research at Barrow, which involves nerve transplants in hand surgeries. Giving a Veteran back the use of his/her hands is life-changing to say the least.
>
> – Carole Moreno

Dr. Dortch will be collaborating with Barrow neurosurgeon Rory Murphy, MD, on a trial to evaluate whether diffusion MRI can identify failed nerve repairs earlier than existing methods. They recently received a grant from the United States Department of Defense (DoD) to further this work, which could ultimately reverse paralysis in veterans with nerve damage.

> "With a strong family history of type 1 diabetes, I am a committed supporter and advocate of Dr. Zaman Mirzadeh's research. Watching this critical work unfold is heartening to those who are affected by this disease.
>
> – Nancy Hanley Eriksson

Shifting the Treatment Paradigm for Diabetes

It's widely believed that blood sugar control is entirely based on insulin. However, at least half of the body's ability to maintain normal blood sugar levels is brain-based. And the half that's dependent on insulin is still regulated by the brain. Barrow neurosurgeon Zaman Mirzadeh, MD, PhD, is paving the way for brain-based solutions for controlling blood sugar in patients with both type 1 and type 2 diabetes.

In type 1 diabetes, Dr. Mirzadeh is studying the role of leptin, a hormone naturally occurring in the body, in its ability to regulate blood sugar levels and provide a more effective alternative to insulin therapy. In type 2 diabetes, he is implanting a spinal cord stimulator in patients with both back pain and diabetes. The stimulator injects a growth factor protein into the brain to regulate blood glucose levels while simultaneously disrupting pain pathways.

In support of this cutting-edge research, Nancy Hanley Eriksson made a generous $2.5 million gift to endow the Nancy Hanley Eriksson Chair of Neuromodulation, with Dr. Mirzadeh serving as the inaugural chair. With funds from this endowment, Dr. Mirzadeh can continue his groundbreaking research with the potential to revolutionize the treatment of diabetes and improve the lives of countless patients worldwide.

Improving Rehabilitation with Robotics

The Barrow Neuro-Rehabilitation Center is a leader in the use of neurorobotics and one of the only facilities to utilize this technology across the entire continuum of care. Barrow therapists gather and analyze data from the robotic devices to identify trends that will deliver the best results for each patient's specific injury. Many of these vital studies are funded by philanthropy.

Nancy Hanley Eriksson with Zaman Mirzadeh, MD, PhD.

You Helped An Extreme Athlete Gain His Life Back.

For Jim Weatherly, the sky's always been the limit. The Milwaukee native approached everything he did in life with passion and enthusiasm – and he was always ready for the next adventure. Activities like cross-country skiing, marathons, and triathlons were all part of Jim's active lifestyle, and he had no intention of ever slowing down. Until he did.

When Jim was in his mid-50s, he started experiencing some degeneration of the vertebrae in his spine. At first, it caused mostly stiffness and discomfort. As the years went by, however, Jim's condition deteriorated to the point where he was experiencing severe, chronic pain in his back. Because of the added pressure on his spine, Jim also suffered from nerve damage. He went from running marathons to not even being able to stand for more than a few minutes. He recalls, "By that time, I could hardly walk any kind of distance. As someone who had always lived an active lifestyle, it made this all the more frustrating."

Soon, Jim's back pain began to affect the quality of time he spent with his family. One of the most heartbreaking moments came when he realized he could no longer participate in a beloved family tradition.

Accompanied by his parachuting instructor, Jim Weatherly celebrates his 73rd birthday skydiving.

"Every year around the holidays, my family goes on a ski trip to Colorado. But the last time we went, my back was so bad that I didn't feel comfortable getting on the slopes and had to wait for them back in the lodge," he says. "That's just not me – I've never been the guy who hangs back."

Things became even worse when he retired. Jim and his wife decided to spend the winter months in Arizona, but instead of taking advantage of the warmer weather, he found himself indoors at home most of the time. That's when Jim reached his breaking point. He knew he couldn't continue on this way.

He searched near and far for the right spine surgeon, looking at hospitals in major cities like Los Angeles, Chicago, and New York. "Finally, a neighbor of mine whose wife had brain surgery at Barrow Neurological Institute recommended it for my back surgery, and that's how I found Dr. Laura Snyder," says Jim. With her extensive experience in both complex and minimally invasive spine surgery, Jim knew immediately that Dr. Snyder was the right surgeon for him.

In December 2021, Jim took a leap of faith and went through with the surgery. It lasted almost eight hours, with Dr. Snyder doing multiple spinal fusions to relieve the pressure on his nerves. The rehabilitation process was long and arduous, but Jim persevered. "Everyone at Barrow, from Dr. Snyder, to the nurses, to the Neuro-Rehabilitation team, was just phenomenal. I couldn't have done it without them," he says. When Jim finally began outpatient rehabilitation, he set two goals for himself: climb to the top of Camelback Mountain and go skydiving.

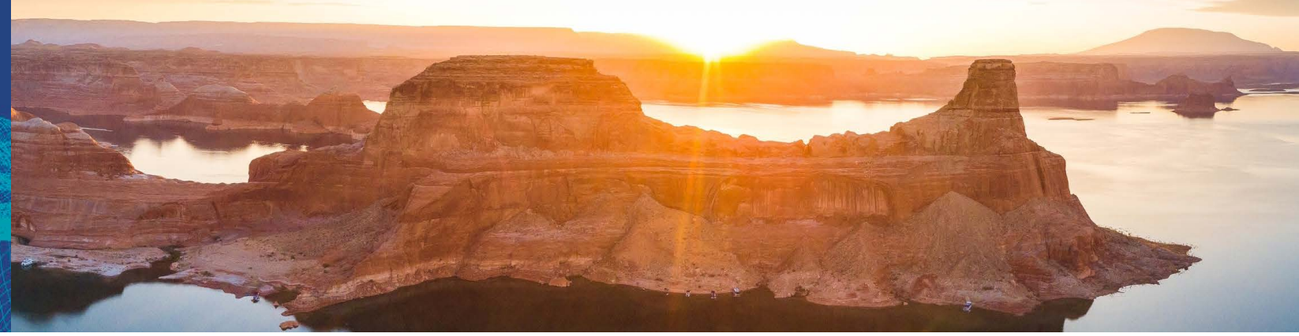
> "Looking back, it's really amazing just how far I've come. I remember when I couldn't even walk my dog, and now I'm skydiving for my 73rd birthday.
> – Jim Weatherly

One year after his surgery, Jim had accomplished both of those goals.

Jim looks forward to continuing his progress and getting back to doing the things he loves, such as skiing with his family, joining a golf club, traveling to Europe, and much more. "I remember asking Dr. Snyder why she liked being a spine surgeon, and she told me that she liked seeing people get their lives back. I can proudly say that I've done that to the fullest," he says. Thanks to Barrow, Jim's future is once again open to endless possibilities and adventures – and not even the sky's the limit.

Jim Weatherly at the summit of Camelback Mountain.

In Her Own Words, a Mother's Epilepsy Journey.



I remember the day I had my very first seizure. I was on a plane and we had just landed at the airport. My four-year-old daughter was holding my hand and my 14-month-old son was balanced on my hip as we waited to exit. Suddenly, I was overcome with an intense wave of dizziness. I handed my son over to my husband, scared that I would drop him as the world spun around me. Then everything went black.

When I came to, I was lying on the ground in the airport terminal surrounded by paramedics. I couldn't see my husband or children anywhere and started to panic. That's when paramedics told me that I had experienced a seizure. Specifically, I had a tonic-clonic seizure, complete with loss of consciousness and violent convulsions. I didn't recall any of it, but the seizure must have been bad because I could clearly see the fear in my husband's eyes when he reached me.

The days following my seizure were a whirlwind of tests and scans, all of which came back inconclusive. This led my doctors to believe that it was a one-time anomaly. That was not the case, and I had two more seizures within the next couple of years. Finally, I found a neurologist who put me on a medication that stopped the tonic-clonic seizures.

Then, I started humming. I was completely unaware I was doing this until my husband mentioned it. I went to see my neurologist, and it turned out that these "humming episodes" were actually focal seizures. My neurologist started me on a new medication to get the focal seizures under control before they caused any damage.

After 19 different medications and a vagal nerve stimulation surgery, my seizures still wouldn't stop. Even worse were the terrible side effects I experienced from the all the medications. From brain fog, to extreme exhaustion, to deep depression, I went through it all to no avail.

Sara Eeds undergoing electroencephalography (EEG) at Barrow.

> "From day one, Dr. Smith walked through everything step-by-step with me, answered all my questions, and never pressured me to make a decision on the spot. I felt like he really cared about me as a person and had my best interests in mind.
> — Sara Eeds

That's when my neurologist told me that there was nothing more he could do, but he would refer me to Barrow Neurological Institute. At that point, I lost hope of ever getting my epilepsy under control and almost gave up trying. Then, I remembered my husband, who had been my rock this whole time, and my children, who needed their mother as they grew up. I resolved to keep fighting and took the referral to Barrow. It was the best decision I ever made.

I met with epilepsy neurologist Susan Herman, MD, and was shown kindness and compassion like I had never experienced before from a medical professional. She worked hard to expedite all of the advanced diagnostic testing that was needed to figure out the best course of treatment. It was decided that I would need to undergo deep brain stimulation (DBS) surgery, which is like getting a pacemaker for the brain.

> "I resolved to keep fighting and took the referral to Barrow. It was the best decision I ever made.
> — Sara Eeds

I was apprehensive about doing the surgery, but when I met my neurosurgeon, Kris Smith, MD, I knew I was in the best hands possible. From day one, Dr. Smith walked through everything step-by-step with me, answered all my questions, and never pressured me to make a decision on the spot. I felt like he really cared about me as a person and had my best interests in mind.

I had the DBS surgery with Dr. Smith and it completely changed my life. I very rarely have seizures now and can spend time with my husband, play with my children, travel, and do all the things I love without fear or medication side effects. I have my life back and it's all thanks to Dr. Herman, Dr. Smith, and everyone at Barrow who went above and beyond to care for me.

Sara Eeds wakesurfing at Lake Powell in Arizona.

Andrew Yang, MD, Neurosurgeon

Barrow Neurological Foundation Donors Advance Epilepsy Research.

Approximately 3.4 million Americans are living with epilepsy, with more than 30% experiencing drug-resistant epilepsy. Thanks to the generous support of donors like Diane Might, the 2022–2023 Women's Board Chairman, the epilepsy research program has been able to expand significantly, with new equipment acquired for advanced studies into drug-resistant epilepsy. For example, Barrow epilepsy surgeon-scientist Andrew Yang, MD, focuses on designing next-generation deep brain stimulation (DBS) therapies for patients with drug-resistant epilepsy. He is currently working on a study that explores changes in the interactions between the thalamus (where DBS is delivered) and the cortical regions of the brain, from which seizures arise. Ultimately, Dr. Yang hopes to identify specific changes that are associated with an increased risk of seizures, as well as understand how DBS may reverse these pro-seizure interactions.

You Drive Scientific Breakthroughs.

Uncovering the Link between COVID-19 and Alzheimer's

The COVID-19 pandemic resulted in a devastating 15% greater mortality rate for Alzheimer's patients compared to the general aging population. Thanks to a transformational $10 million grant from the Office of the Arizona Governor through the American Rescue Plan Act (ARPA), Barrow can now begin work to understand the link between COVID-19 and Alzheimer's disease.

Marwan Sabbagh, MD, FAAN, Vice Chair of Neurology Research, and Rita Sattler, PhD, Professor of Translational Neuroscience, are leading the clinical branch of this comprehensive study. The clinical studies will involve Alzheimer's patients who had COVID-19 and non-Alzheimer's patients who experienced cognitive deficits as a result of COVID-19. This will help scientists uncover disease-relevant biomarkers and determine whether the virus triggers dementia-associated disease mechanisms.

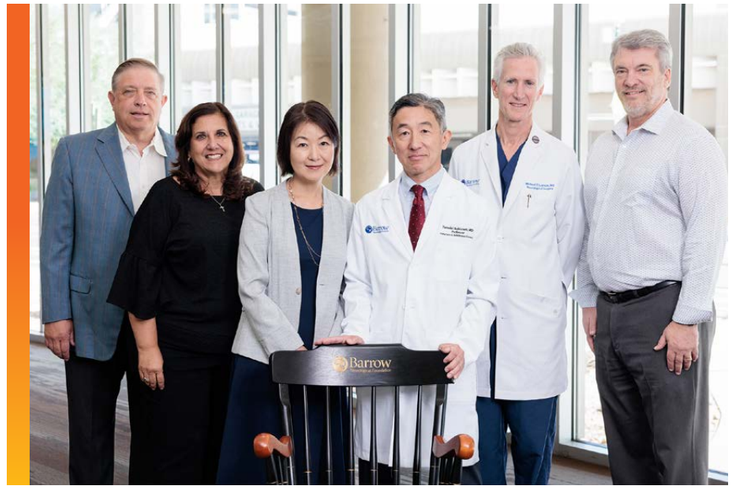
Brad A. Racette, MD, FAAN, Barrow Senior Vice President and Chair of Neurology, is leading the epidemiological branch of the study, analyzing robust data on the health outcomes of Alzheimer's patients before, during, and after the pandemic. The study also evaluates socioeconomic variables associated with these health outcomes to identify patterns in vulnerable patient populations. This is critical to informing public policy and the delivery of health care in future health emergencies.

Investigating Aging, Inflammation, and Aneurysm Rupture

Approximately 35% of aneurysm ruptures are fatal. The Barrow Aneurysm and AVM Research Center, led by Barrow President and CEO Michael T. Lawton, MD, is dedicated to pushing boundaries in research to develop more effective treatments for patients worldwide. Tomoki Hashimoto, MD, a scientist in the Center, conducts novel research aimed at developing a medication-based approach to preventing aneurysm ruptures. Thanks to a generous $2.5 million endowment gift from Sam and Rita Garvin, Dr. Hashimoto has been named the inaugural Sam and Rita Garvin Aneurysm Research Chair. "I've seen firsthand how dangerous aneurysms can be. My wife, Rita, suffered from a ruptured aneurysm, but we were able to get her to Barrow Neurological Institute in time for surgery. I credit Barrow for saving her life," says Sam Garvin, Vice Chairman of the Phoenix Suns.

> "We endowed the Sam and Rita Garvin Aneurysm Research Chair in support of Dr. Hashimoto's work to develop better aneurysm detection and treatment methods for patients.
> — Sam Garvin

Shortly after his chair appointment, Dr. Hashimoto received a significant grant from the National Institutes of Health (NIH) to continue his innovative research into cell senescence, when cells stop dividing due to aging. This causes inflammation and damage to blood vessels, which can trigger an aneurysm rupture. Dr. Hashimoto aims to develop an effective drug target to remove these senescent cells and prevent an aneurysm rupture.



(L-R) Sam and Rita Garvin; Yuka Hashimoto; Tomoki Hashimoto, MD; Barrow President and CEO Michael T. Lawton, MD; and Barrow Chief Scientific Officer Robert Bowser, PhD.

Unlocking the Molecular Mysteries of Cushing's Disease

Because pituitary disorders present with such a wide range of symptoms, patients often suffer for years before receiving a correct diagnosis. Thanks to a generous $1.5 million gift from Caroline Hoeye to create the Caroline Hoeye Pituitary Research Program, Barrow pituitary specialists can conduct critical research to improve diagnosis and treatment.

> "The innovative work that the Barrow pituitary team is doing has the potential to change the lives of patients suffering from this condition. I wanted to use my own personal experience to support them in advancing this research and helping patients.
> — Caroline Hoeye

One of the Program's current studies focuses on developing more effective therapies for Cushing's disease. A significant barrier to advancing therapies for this disease is the absence of preclinical models that replicate the type of pituitary tumor that causes it. Last year, Barrow pituitary specialists successfully developed an organoid model that replicates much of the cellular complexity of a Cushing's disease–causing pituitary tumor. These "tumors-in-a-dish" have the potential to lead to more effective and personalized treatment for pituitary patients.

Treating Parkinson's Disease with Gene Therapy

In ongoing studies, Barrow scientist Fredric Manfredsson, PhD, and postdoctoral fellow Kimberley Meyers, PhD, discovered that the kynurenine metabolic pathway may be dysfunctional in Parkinson's disease. The scientists are now utilizing gene therapy to deliver the protein ACMSD to this pathway in order to reduce brain inflammation and prevent the loss of neurons. Preliminary results have been promising, and the Pat Simone Charitable Foundation, Inc., recently awarded a two-year, $624,000 grant to support this work in further investigating ACMSD gene therapy.

Applying Gene Therapy to ALS Treatment

Barrow scientist David Medina, PhD, is developing a novel gene therapy approach to protecting motor neurons in amyotrophic lateral sclerosis (ALS) by activating the retinoid signaling pathway. At first, he created nanoparticle formulations (tiny containers) to deliver retinoids to this particular pathway, but they encountered significant delivery problems. With support from Barrow Neurological Foundation donors, he was able to collaborate with scientist Fredric Manfredsson, PhD, and shift to a gene therapy approach to deliver the retinoids.

The U.S. Department of Defense continues to support Barrow Research.

This new approach appealed to the United States Department of Defense (DoD), which awarded Dr. Medina a grant to further his work. In the past fiscal year alone, Barrow scientists have received more than $2.1 million in DoD grants for ALS research.

Caroline Hoeye with Andrew S. Little, MD, Co-Director of the Barrow Pituitary Center.

You Accelerate the Search for a Cure.

The Ivy Brain Tumor Center is focused on finding a cure for brain cancer. Thanks to the generosity of Barrow Neurological Foundation donors, it is fast approaching this goal. Here are just some of the Ivy Center's accomplishments from the last fiscal year.

Ivy Brain Tumor Center Headquarters

Construction is complete on the outer shell of the new Ivy Center headquarters, and crews are now moving on to the interior of the building. The Ivy Center headquarters will be the world's largest translational research center dedicated to brain tumor drug development and treatment. It will house Ivy Center clinicians, scientists, investigators, and staff under one roof, creating more efficiency and accelerating the clinical trials process for patients.

Dr. Yoshie Umemura Joins the Ivy Center and Barrow

Yoshie Umemura, MD, is the new Chief Medical Officer of the Ivy Brain Tumor Center and the Division Chief of Neuro-Oncology and William and Joan Shapiro Chair of Neuro-Oncology at Barrow Neurological Institute. As a leading neuro-oncologist with research interests in experimental therapies for brain cancer, Dr. Umemura is uniquely suited for the Ivy Center's cutting-edge clinical trials program.

2023 Neurosurgical Oncology Fellow

The Ivy Center welcomed Nasser Yaghi, MD, as its 2023 neurosurgical oncology fellow. Dr. Yaghi will focus on developing his expertise in brain tumor surgery and preparing for his career as a clinical trials specialist in neuro-oncology. Funds from the Francis and Dionne Najafi Endowed Chair for Neurosurgical Oncology were used to support this fellowship.

Yoshie Umemura, MD, Division Chief of Neuro-Oncology and Chief Medical Officer of the Ivy Center.

Liquid Biopsy Program

The Ivy Center initiated a new liquid biopsy program to obtain real-time insights into how a patient's brain tumor is responding to experimental treatment. Ivy Center physicians access a biologically inert reservoir hidden under a patient's scalp and safely extract a small quantity of cerebrospinal fluid (CSF). Tumor-specific genetic material from the CSF is then analyzed to identify potential mechanisms of drug resistance evolving within the tumor cells.

Scan for video.

Superselective Intra-Arterial Infusion Trial

In an effort to discover unique, new ways to treat brain tumors, the Ivy Center is pioneering an innovative Phase 0 clinical trial to test an experimental drug-delivery method called superselective intra-arterial infusion, or SSIAI. This technique aims to deliver a drug directly to the tumor, bypassing the blood-brain barrier and minimizing side effects. The success of the study could lead to a revolutionary new method to treat brain tumors.

> "Drug delivery is arguably the most significant problem in brain tumor treatment today.
>
> – Nader Sanai, MD

Recurrent Glioblastoma Clinical Trial

The Ivy Center has enrolled patients in a Phase 0/1b clinical trial to evaluate AZD1390, which blocks the repair of DNA breaks caused by radiation treatment, in recurrent WHO grade 4 glioma. The goal of the Phase 0 clinical trial is to confirm that AZD1390 is capable of crossing the blood-brain barrier. Patients with positive results may advance to the 1b expansion phase of the trial.

Sonodynamic Therapy Expansion Study

The Ivy Center is conducting a Phase 2 dose-escalation and expansion study of sonodynamic therapy in patients with recurrent glioblastoma.The primary objectives of this study are to evaluate safety and efficacy in patients with recurrent or progressive glioblastoma, as well as recommend a Phase 2 schedule.

Nader Sanai, MD, Chief of Neurosurgical Oncology and Director of the Ivy Brain Tumor Center.

The continued growth and success of the Ivy Center is made possible through the unwavering leadership, support and vision of the Ben and Catherine Ivy Foundation, and from the generosity of Barrow Neurological Foundation donors.

A pre-visualization of the lobby in the new Ivy Brain Tumor Center headquarters.

You Pave the Way for Trailblazers in Neuroscience.

Bringing Advanced Neurosurgical Education to East Africa

Barrow Global was created in 2019 to address the health care needs of underserved populations around the world. Through a transformational endowment gift from the Franke family in 2021, Barrow created the Franke Global Neuroscience Education Center to serve as a platform for building neuroscience education and training programs in developing countries. In 2023, Barrow welcomed Kerry Vaughan, MD, as the inaugural Franke Global Neurosurgery Fellow. Dr. Vaughan spent three months training at Barrow before travelling to Tanzania to begin her nine-month program at Barrow's first international partner site, Kilimanjaro Christian Medical Centre (KCMC). During her time in Tanzania, Dr. Vaughan has not only been providing advanced training to established neurosurgeons, but she also has been working to establish a sustainable neurosurgery education system and residency program at KCMC.

An International Spine Research Opportunity

In 2023, Barrow welcomed Temesgen G. Assefa, MD, as the inaugural International Sonntag Spine Center Research Fellow. Dr. Assefa is the first-ever Ethiopian neurosurgeon to come to the United States for fellowship training. At Barrow, he is working on cervical spine biomechanics research while receiving training in advanced endoscopic surgical techniques. Dr. Assefa hopes to use this fellowship experience to advance minimally invasive spine surgery and research back in his home country.

Temesgen G. Assefa, MD, International Sonntag Spine Center Research Fellow.

Kerry Vaughan, MD, with Kilimanjaro Christian Medical Centre staff.

Inspiring Students Across the Globe

The 2023 Franke Global Undergraduate Interns share about their their 12-week internship experience at Barrow.

> "Coming from a country that still has sparse funding for international training, I would not have had this opportunity if it wasn't for the Franke scholarship.
>
> – Gabriela Morales Lima, Federal University of ABC, São Paulo, Brazil

"Where I come from, there are not many opportunities for young scholars to reach their full potential. Thanks to this experience, I can now pursue the next steps in becoming a biomedical researcher."

– Andres Santiago Martinez Hernandez, University of the Andes, Colombia

Educating Future Leaders

The High School Research Program and Summer Undergraduate Internship Program provide a rewarding educational experience through valuable hands-on work and direct access to leading neuroscience specialists. With support from the Garcia Family Foundation, Barrow has the privilege of teaching and training talented young leaders, regardless of their socioeconomic status.

In 2023, Barrow welcomed 13 high school students from 10 high schools and 38 undergraduate students from 20 colleges. They share about their experiences.

> "Through this internship, I have been exposed to a level of scientific work that my classmates at college may not encounter until graduate school.
>
> – Noah Frazier, University of Arizona

"I got to see how patients presented both pre-operatively and post-operatively, and it really showed me the effect of these surgeries and how much patients' lives have improved after them. It really got me thinking about my future."

– Jackie Vogel, Xavier College Preparatory

Barrow Summer Undergraduate Internship Program, Class of 2023.

Training Future Dementia Specialists

In the United States, the current number of dementia specialists can support only 10% of the care needed for patients and their families. Recognizing the critical need for more dementia specialists, The Steele Foundation made a $1.5 million gift to endow the Dan Cracchiolo and Pam Grant Behavioral Neurology and Neuropsychiatry Fellowship through the 2023 Women's Board Barrow Grand Ball.

"The Steele Foundation is thrilled to partner with Dr. Anna Burke, Barrow Neurological Institute, and the Women's Board of Barrow Neurological Foundation to establish this fellowship in honor of my late father, Daniel Cracchiolo, and his incredible wife, Pam Grant," says Marianne Cracchiolo Mago, President and CEO of The Steele Foundation. "Since the early '90s, Steele and Barrow have partnered to recruit physicians from across the world to Phoenix. This fellowship will capitalize on Barrow's achievements in dementia care and research, inspiring new doctors joining the field of dementia-related diseases to serve patients in desperate need."

The fellowship provides physicians with the unique opportunity to work in clinics with both behavioral neurologists and neuropsychiatrists, as well as participate in groundbreaking dementia research.

Anna D. Burke, MD, Karsten Solheim Chair for Dementia

You Transform Care For All.

Expanding Access to ALS Trials

Amyotrophic lateral sclerosis (ALS) gradually robs patients of their ability to move, speak, eat, and eventually breathe, on their own. It is a terrifying disease for those diagnosed and a heartbreaking one for their family and friends. Unfortunately, less than 50% of ALS patients qualify for traditional clinical trials based on rigid participation criteria. Autumn and Bobby Henderson aim to change that with their generous $2.5 million gift to launch the Henderson-Liebman ALS Expanded Access Program in the Gregory W. Fulton ALS and Neuromuscular Disease Center at Barrow.

"My childhood friend's father was diagnosed with ALS in 2020. I had grown up with her family, so it was devastating watching him suffer through this terrible disease. I made this gift to honor my dear friend's father and the work of Dr. Shafeeq Ladha, who provided him with exceptional care," says Autumn Henderson.

The Henderson-Liebman ALS Expanded Access Program will offer ALS patients the opportunity to gain access to experimental therapies, even when they don't qualify for traditional clinical trials. It also has the potential to become a flagship platform for ALS expanded access, attracting partnerships with pharmaceutical companies for the most promising drugs as they become available. This will bring hope to patients and families all over who are living with this devastating disease and feel stuck in terms of accessing new therapies.

> "My hope is that the Henderson-Liebman ALS Expanded Access Program will help more ALS patients gain access to new therapies that they desperately need.
>
> — Autumn Henderson

Chaplain Nash Pwol consults with patients

Supporting Parkinson's Patients and Caregivers

Seeing a loved one suffer from a debilitating disease like Parkinson's is devastating. The toll becomes even greater when a family member also is the patient's caregiver. As the disease progresses, caregivers begin to face significant responsibilities and challenges, and they are more susceptible to burnout.

> "The new Legacy Caregiver Program will further leverage Barrow's top-notch service model by extending support and relief to family members who quietly bear so much of the burden.
>
> — Bob Parsons

To provide additional resources for caregivers, The Bob & Renee Parsons Foundation continued its dedicated support of the Muhammad Ali Parkinson Center with a $1 million gift to launch the Legacy Caregiver Program. This will be an extension of the Lonnie and Muhammad Ali Legacy Care Program, which was created through a $4 million grant from The Bob & Renee Parsons Foundation in 2017. "The level of care at the Muhammad Ali Parkinson Center at Barrow Neurological Institute is second to none," said Bob Parsons, Co-Founder, The Bob & Renee Parsons Foundation. "The new Legacy Caregiver Program will further leverage Barrow's top-notch service model by extending support and relief to family members who quietly bear so much of the burden."

President and CEO Michael T. Lawton, MD, withLonnie Ali at the Muhammad Ali Parkinson Center.

Through this program, Barrow Parkinson's specialists will implement comprehensive interventions to reduce caregiver burden, including Movement Cafés and an online Parkinson's care training program for informal and professional caregivers.

A Holistic Approach to Headache Care

At the Lewis Headache Center, created by a generous gift from Jan and Tom Lewis, headache specialists utilize a holistic approach to care to help patients gain their lives back. While successfully applying traditional therapies such as BOTOX, occipital blocks, and nerve blocks, the Center also offers a comprehensive wellness program. One of the main highlights of the wellness program is headache-focused physical therapy and yoga, which helps patients with postural deficits, muscle strength, and the mind-body connection. The wellness program also includes mindfulness, dietary consultations, psychological services, and social work. Combined, all of these strategies create a holistic approach to treating headache pain. The Lewis Headache Center Plans to continue enhancing its wellness services to provide even more headache patients with a better quality of life.

Expanding Stroke Care with Telemedicine.

The Petznick Stroke Center is dedicated to the philosophy that every patient who suspects they are having a stroke deserves to be evaluated and treated by a vascular neurologist, regardless of their location when the stroke occurs. Thanks to the generous support of the Petznick family and the Kendrick family, the Stroke Center has made strides in achieving this goal by expanding care outside of the physical clinic space, so patients can receive the best treatment possible when they need it most.

One example of this is the Telestroke Program, which connects Barrow vascular neurologists with community hospitals across Arizona in real time, allowing them to read scans, diagnose patients, and recommend a course of treatment – all virtually. The Telestroke Program currently has contracts with 17 health care sites across Arizona and fields more than 70 calls per month. In addition, the Stroke Center offers continuous training for all Telestroke sites, providing on-site education to paramedics, air medics, nurses, EMTs, firefighters, and pre-hospital physicians.

Philanthropic Events

Barrow Neurological Institute President and CEO Michael T. Lawton, MD, with 2023 Barrow Grand Ball Co-Chairs Amy Cohn and Erin Gogolak and Women's Board Chairman Diane Might.

Women's Board Reaches Lifetime Fundraising Milestone for Barrow

The Women's Board of Barrow Neurological Foundation raised over $7 million for the Institute through the 2023 Barrow Grand Ball, reaching a lifetime milestone of $100 million raised since their 1965 inaugural Ball. The 2023 Women's Board Chairman, Diane Might, and this year's Ball Co-Chairs, Amy Cohn and Erin Gogolak, galvanized members' and donors' passion for supporting the research and programs of Barrow's world-renowned physicians and scientists. The Co-Chairs selected the Barrow Aneurysm and AVM Research Center, led by Barrow President and CEO Michael T. Lawton, MD, as the special project for the 2023 Ball.

Donors Create a Lasting Legacy at Barrow with Planned Giving

Generous Foundation donors and supporters gathered at Paradise Valley Country Club on April 27, 2023, for a special Legacy Society Luncheon to learn more about supporting the Institute through a planned gift.

The Luncheon opened with a special welcome from Robert F. Spetzler, MD, Emeritus Chair of Neurosurgery at Barrow, followed by a presentation from Marwan Sabbagh, MD, FAAN, Alzheimer's specialist and Vice Chair of Research for the Department of Neurology at Barrow, highlighting the importance of planned giving to the future of neuroscience research and patient care.

Local Organizations Hold Third-Party Events Benefiting Barrow

In the past year, third-party events included Croquet for a Cure, Miles for Migraine, Bryan Lester's 8th Annual Charity Golf Tournament, Head for the Cure, Students Supporting Brain Tumor Research, the Arizona Diamondbacks' Brain Tumor Awareness Night, and more.

In addition, Lou Grubb Friends Fore Golf, Barrow's longest-running third-party event, celebrated 50 years of supporting world-class research and care. The April 2023 golf tournament raised $400,000 benefiting both Barrow Neurological Institute and St. Joseph's Hospital and Medical Center. Since its founding in 1973, Lou Grubb Friends Fore Golf has raised $8 million to support critical areas of need throughout Barrow and St. Joseph's Hospital.

Dan Grubb at the Lou Grubb Friends Fore Golf 50-year celebration.

Gail Rosseau, MD, Volker K.H. Sonntag, MD, at the Barrow Global Symposium reception.

The Barrow Neuroplex lobby features artwork by Nicholas Kontaxis, Charles Gaines, and Studio Drift.

Inaugural Barrow Global Symposium

In January 2023, the Institute and Foundation hosted the inaugural Barrow Global Symposium, An Evening with Barrow Global. With more than 150 virtual and in-person attendees, the symposium provided updates on the progress of the Franke Global Neuroscience Education Center and the actions that Barrow Global is taking to improve access to safe, timely, and affordable global neurosurgical care.

Foundation Art Council Advances Barrow's Healing Mission

Barrow believes in the healing power of art and its potential to improve recovery and reduce pain, anxiety, and stress. Through the leadership of the Barrow Neurological Foundation Art Council, the Barrow Neuroplex gained four additional works that embody this healing mission. Adjacent to the outside entrance is a poppy-red sculpture by Phoenix-based global visual artist Rotraut Klein-Moquay that exhibits the life, energy, and motion of nature. Inside the Barrow Neuroplex lobby is a vibrant abstract painting by artist and grateful Barrow patient Nicholas Kontaxis. Only a few feet away, a colorful multimedia work by Charles Gaines depicts the various stages of a cottonwood tree. On the second floor, a triptych painting titled "Bayou" by award-winning actress, artist, Foundation Board member, and grateful Barrow patient Sharon Stone exudes the calm tranquility of this slow-moving body of water. All art featured at the Barrow Neuroplex has been generously sponsored or donated to Barrow.

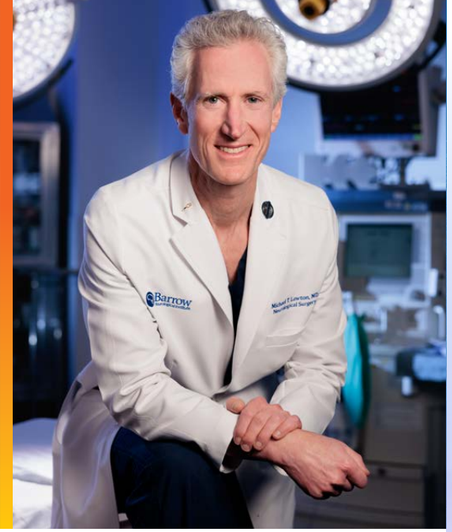
Neuro Night 2023 Raises Funds for Neuroscience Research and Care

Barrow Neurological Foundation raised more than $3 million through its largest philanthropic event, Neuro Night, in support of life-saving brain and spine research at Barrow Neurological Institute. The event had more than 300 attendees and featured world-class talent such as Mark McGrath and Sugar Ray, along with interactive art installations and a thrilling live auction. Chaired by Jordan Rose, Jacqui Firestone, and Lauri Termansen, Neuro Night was a celebration of medical innovation and advancement like no other.

Mark McGrath and Sugar Ray perform at the Clayton House in Scottsdale for Neuro Night 2023.

The Next Frontier in Neuroscience

Barrow President and CEO Michael T. Lawton, MD, Discusses Plans for the Mind Exploratorium



The brain is the most complex system in the known universe.

To put that into perspective, the Milky Way Galaxy has hundreds of billions of stars, which is just a small fraction of the 100 trillion connections in the human brain.

Even with the significant advancements made in technology, innovation, and research, we have only scratched the surface of understanding how the brain really functions.

Barrow Neurological Institute President and CEO Michael T. Lawton, MD, is leading the way to the next frontier in neuroscience: exploring the mysteries of the mind. He aims to delve into how the brain functions as the mind by collaborating with institutions around the world, as well as harnessing the incredible breadth of expertise found right here at Barrow.

Dr. Lawton's vision is centered on the creation of the Mind Exploratorium, a research center where neuroscientists, engineers, and entrepreneurs will collaborate with neurosurgeons, neurologists, and clinicians to discover how the brain functions as the mind.

The Mind Exploratorium will comprise six cognitive disciplines: movement and perception, emotion, neural plasticity, intelligence, memory, and consciousness. Within these disciplines, a diverse set of research platforms will be utilized to understand diseases that affect both the mind and the brain. These platforms include translational neuroscience, data science, neuro-engineering, neuroimaging, clinical studies, public health, and health care delivery. Creating such a robust ecosystem of academic and medical professionals, industry partners, and students can lead to the development of revolutionary devices and therapies to treat the most complex neurological diseases.

> "Our mind is what makes us who we are. It's where dreams come from, where reason lives, and where memories are stored. A brain or spine condition can change all of that. That's why we push the boundaries of neuroscience and medicine, to help our patients hold onto their dreams, their memories, and themselves.
>
> – Michael T. Lawton, MD

The Mind Exploratorium will ultimately position Barrow as the place where mankind will finally understand the mysteries of the mind for the betterment of health care and humanity.

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