

Cedars - Sinai 2020 Annual Report

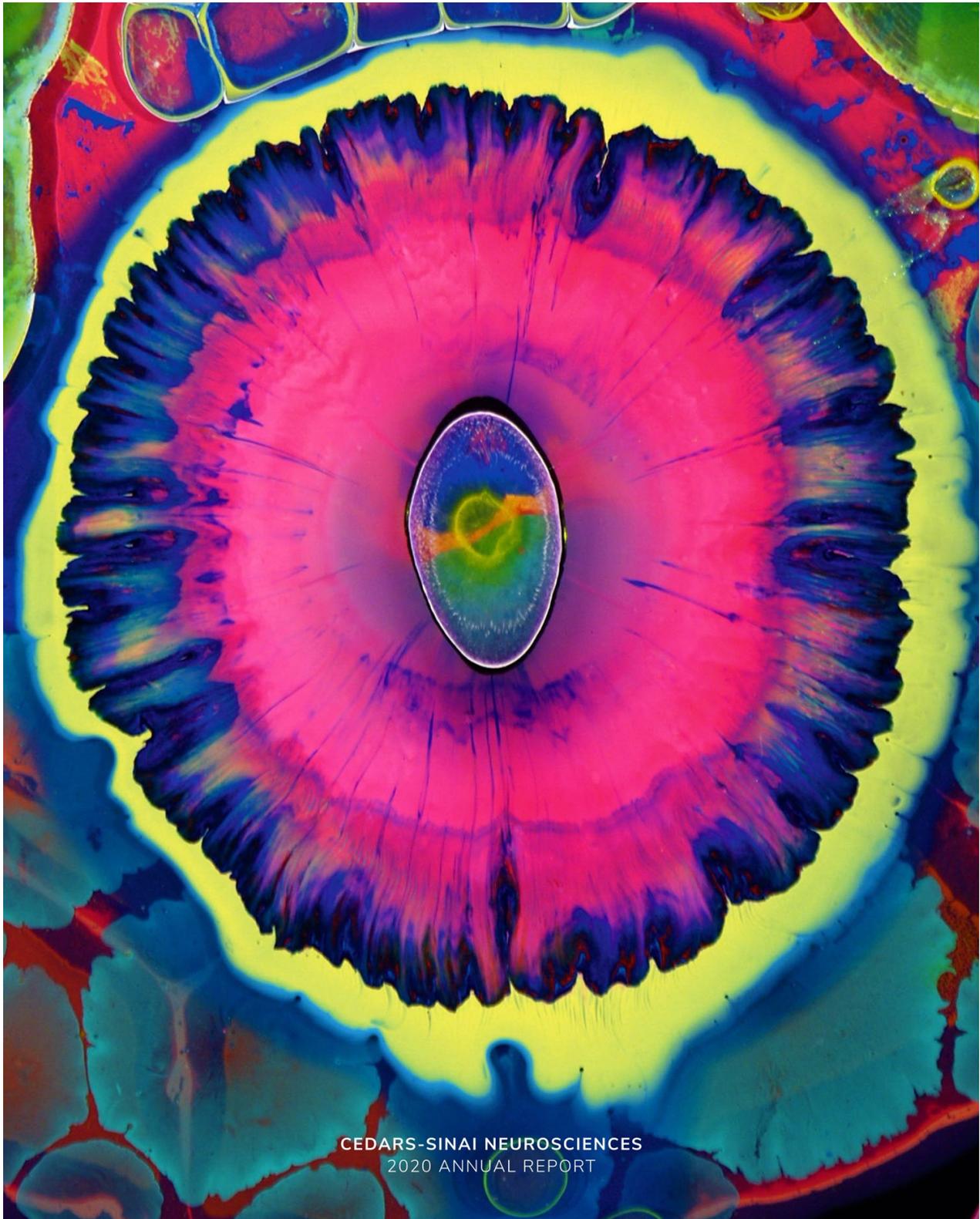
Below this introduction is the full report.

I am honored to have my images used in the Cedars-Sinai 2020 annual report. The hospital's enthusiastic embrace of my organic images is a radical shift from simply illustrating the content of an annual report. The hospital chose detail images and oversaw all the visuals in this report. In supplying the art I feel I collaborated in some small way with amazing people.

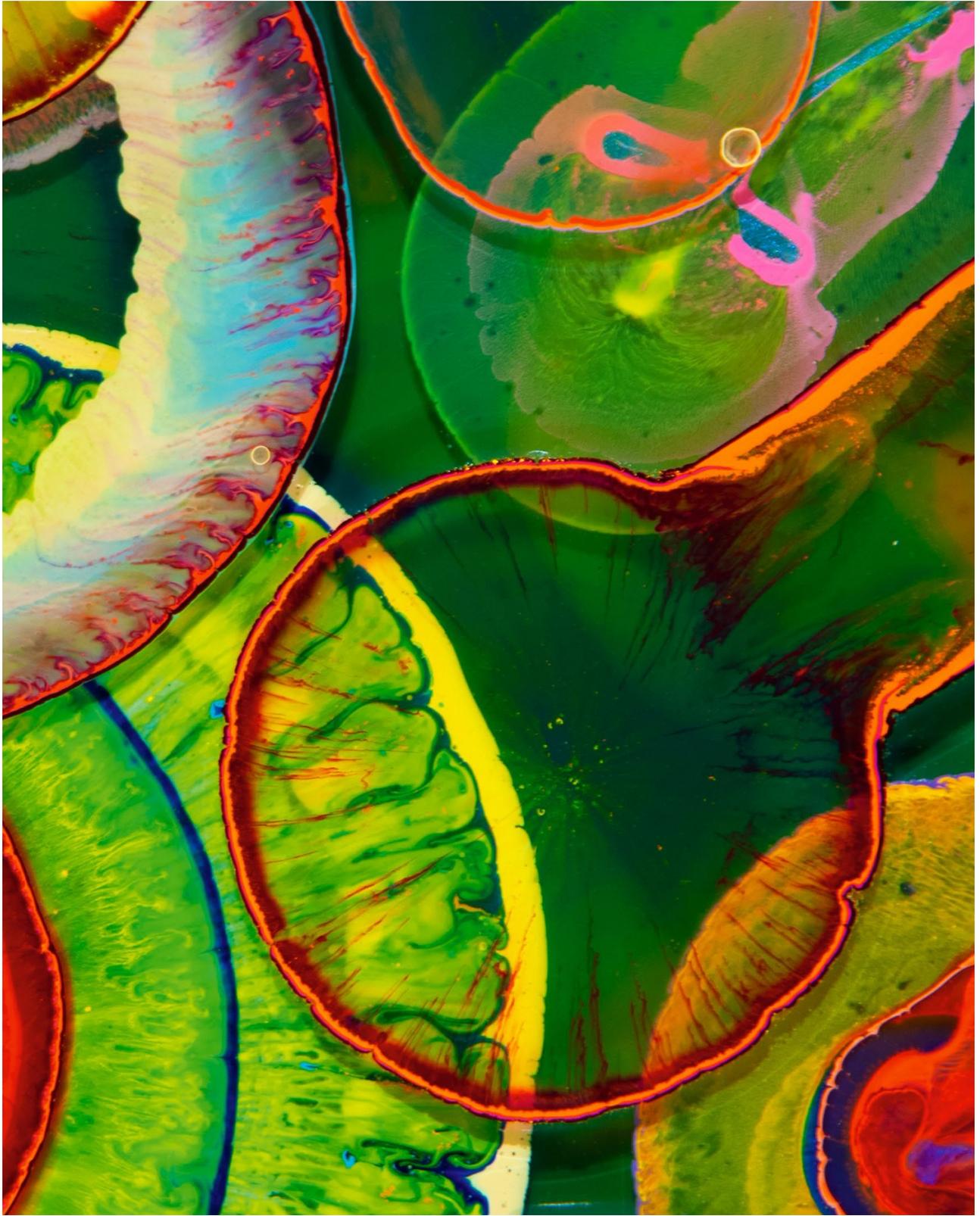
I do not pursue the use of my images outside a gallery or exhibition setting. I'm not sure how to do this. So I was really excited when the project was proposed to me.

My painting is an intuitively-driven process that focuses on the moments of its making. This approach brings a sense of life and evolution to my art that defies a simple definition while at the same time is recognized by people from all walks of life.

That these extraordinary medical professionals found a strong connection to my paintings is encouraging.



CEDARS-SINAI NEUROSCIENCES
2020 ANNUAL REPORT



Dear Colleague,

We are delighted to share our annual report with you. As our colleague and supporter, you play an essential role in our current success and ongoing efforts to combat neurological disease and disability. It's been an extraordinary year. Our departments have made great strides in research and patient care as well as in training the next generation of neurologists and neurosurgeons.

Every day, we see our clinicians, researchers and staff embody Cedars-Sinai's tradition of excellence and compassion. From personalized care to life-changing inventions and discoveries, they make a difference in the lives of thousands of patients who come to us from throughout the region, the nation and the world. Our commitment and achievements are reflected in the many accolades and awards garnered last year.

You can read about them in this report. You will also learn about the breakthroughs we made in every subspecialty of neurology and neurosurgery. We are honored to present these highlights.



Keith Black, MD
Chair, Department of
Neurosurgery
Ruth and Lawrence Harvey
Chair in Neuroscience



Nancy Sicotte, MD, FAAN
Chair, Department of
Neurology
Women's Guild Distinguished
Chair in Neurology

2019 HIGHLIGHTS

Neurosciences at a Glance



Cedars-Sinai expanded its telestroke program to help community hospitals provide advanced stroke care at the bedside within minutes. Emergency department physicians can access an on-call team of stroke experts 24 hours a day via videoconferencing to consult on urgent cases. This collaboration allows eligible stroke patients to receive recanalization treatment as soon as possible at the local hospital. Videoconferencing enables our experts to remotely view and examine patients in real time, ask questions, interpret imaging results and coordinate care with local hospital teams. For complex stroke cases, the Cedars-Sinai Transfer Center can help coordinate higher-level-of-care evaluations in our closed-method neurointensive care unit.

The Ray Charles Foundation provided a generous gift to establish the Ray Charles Foundation Scholars Fund in Neurosurgery, a scholarship that offers recipients opportunities for research, mentorship and career guidance under the leadership of Cedars-Sinai's neurosciences faculty.

Julia Ljubimova, MD, PhD, published a mouse study in the journal Nature Communications, showing the use of immunotherapy to fight some of the most deadly brain tumors using innovative nanomedicine to pass through the blood-brain barrier.

In June, a gift from the family of the late real estate developer Jona Goldrich founded the Jona Goldrich Center for Alzheimer's and Memory Disorders, where physician-scientists will work on developing new patient-care therapies that address the challenges of the rapidly growing population of patients with Alzheimer's disease and other memory disorders.

In September, Cedars-Sinai was named the coordinating center for a National Institutes of Health-funded, multicenter study that will assess the effectiveness of six potential stroke therapies. The study will also examine whether applying higher standards of rigor to early phases of research might produce results that are more likely to succeed in human clinical trials.

The Women's Guild Neurology Transformation Project launched in 2019 to support innovative research and education for the understanding and treatment of complex neurological disorders. This comprehensive project will support a Distinguished Chair for the Department of Neurology as well as a fund for programmatic expansion and enrichment of the department's clinical and research activities.

LATE-BREAKING RESEARCH

Parkinson's Disease

Investigators at Cedars-Sinai engineered induced pluripotent stem cells (iPSCs) from cells of patients with young-onset Parkinson's disease to produce dopamine neurons and analyze their functions. The team detected two key abnormalities: An accumulation of a protein called alpha-synuclein, which occurs in most forms of Parkinson's disease, and malfunctioning lysosomes—cell structures that allow the cell to break down and dispose of proteins. This malfunction could cause a buildup of alpha-synuclein.

The team also used the iPSC model to test a number of drugs that might reverse the abnormalities they had observed. They found that one of the drugs, PEP005—which is already approved by the Food and Drug Administration for treating

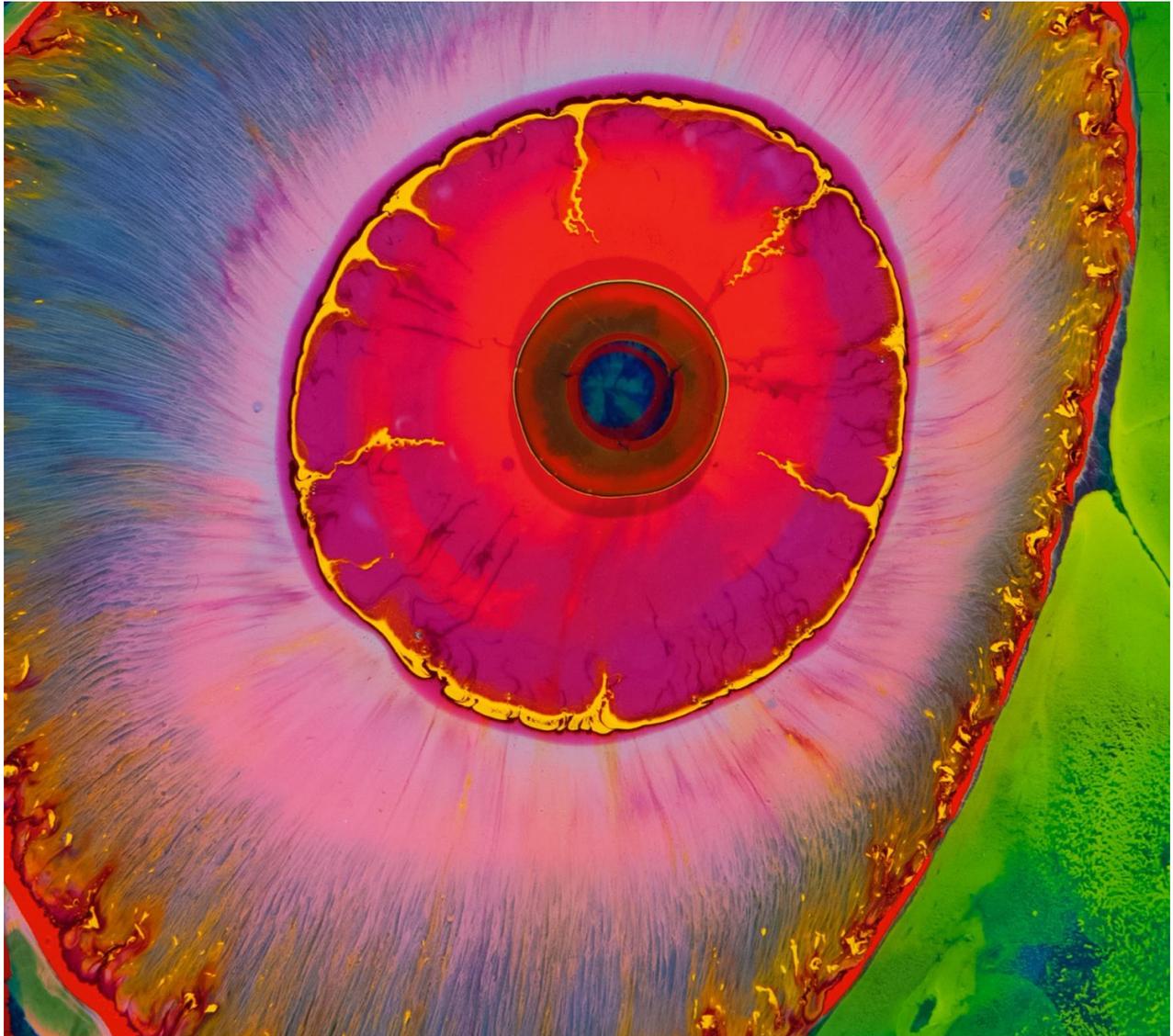
precancers of the skin—reduced the elevated levels of alpha-synuclein in both the dopamine neurons in the dish and in laboratory mice. The drug also countered another abnormality they found in the patients' dopamine neurons: elevated levels of an active version of protein kinase C—although the role of this enzyme version in Parkinson's is not clear.

The research, published in *Nature Medicine*, is being led by Clive Svendsen, PhD, director of the Cedars-Sinai Board of Governors Regenerative Medicine Institute and the Kerry and Simone Vickar Family Foundation Distinguished Chair in Regenerative Medicine, and Michele Tagliati, MD, professor and Vice Chair of Neurology at Cedars-Sinai and the Caron and Steven D. Broidy Chair in Movement Disorders.

Memory Disorders

The neuronal mechanisms that allow us to actively remember multiple items are referred to as working memory. A critical question for such memory is how we tell the different items apart we are holding in our mind—i.e., which number was first and which was second? A research team under the leadership of Ueli Rutishauser, PhD, Board of Governors chair in Neurosciences and director of Human Neurophysiology Research, discovered that a specific class of neurons in the human medial

temporal lobe employs a “phase code” to achieve this. The study (Kaminski et al. 2020, *Neuron*, in press) revealed that neurons become active at particular parts of an ongoing brain oscillation. This work provides critical new insights into the mechanisms of working memory and continues an earlier discovery of persistently active cells (Kaminski et al. 2017, *Nat Neurosci*). The new team studied the same type of cells, but in the context of how different items are simultaneously held in memory.



At age 39, **Albert Parisi** was coaching his son's tee-ball game when pain cracked through the back of his head. Eventually, an MRI revealed a brain tumor. Today, Parisi has been cancer-free for 23 years. He found inspiration in his illness and went on to write books, serve as a counselor and volunteer to support cancer sufferers. Parisi credits his longevity to three factors: his faith, his attitude and the skill of his doctor, Keith Black, MD.

BRAIN TUMOR

Keith L. Black, MD
*Ruth and Lawrence Harvey
 Chair in Neuroscience
 Chair, Department of
 Neurosurgery
 Director, Maxine Dunitz
 Neurosurgical Institute*

The Brain Tumor Center at Cedars-Sinai is internationally recognized for innovative treatments, including discoveries that enable anti-cancer drugs to be delivered directly into the brain. Our physicians are at the helm of new research being tested in clinical trials and adopted into new treatment options that directly benefit patients. When possible, we employ the latest in minimally invasive neurosurgery techniques and technology, including radiosurgery and Nico BrainPath. Cedars-Sinai was the first medical facility on the West Coast to offer the Radionics ConforMAX Mini-Multileaf Collimator (MMLC) and the first center in California to use Synaptive Medical's BrightMatter Guide exoscope system.

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The Cedars-Sinai Brain Tumor Center has 38 open clinical trials and three additional trials in development.

Investigators at Cedars-Sinai, led by neurosurgeon Adam Mamelak, MD, completed a Phase I trial in 2019 of a unique substance derived from scorpion venom, which, used in combination with a special high-sensitivity, near-infrared camera developed at Cedars-Sinai, allows neurosurgeons to better detect boundaries between brain tumor tissue and healthy brain. Technologies like this have the potential to help surgeons better remove some of the most deadly types of brain tumors.



Lisa Simmons was suffering from horrific headaches and began to have hearing loss. Specialists misdiagnosed her or said there was nothing they could do. She finally found Wouter I. Schievink, MD, and traveled from Seattle to see him. Schievink treated the problem with blood patches. It worked. Simmons felt instant relief from the crushing pain. Her hearing came back as well. "It was the most amazing moment of my life," she recalls. "I wish I lived closer so all my medical needs could be taken care of at Cedars-Sinai."

CSF LEAK

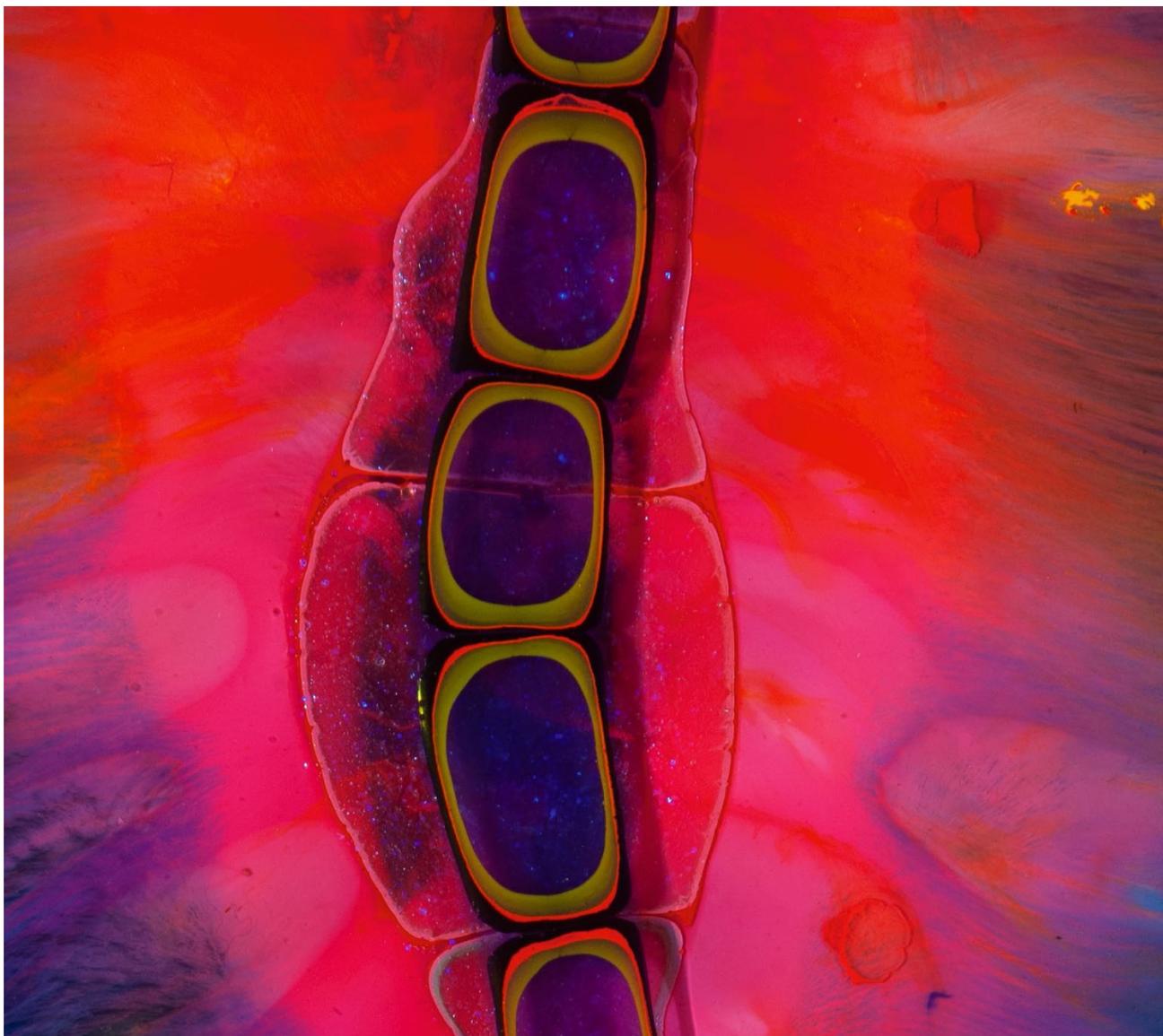
Wouter I. Schievink, MD
Director, Microvascular
Neurosurgery Program

A cerebrospinal fluid (CSF) leak is difficult to diagnose, and highly specialized care is paramount for patients whose condition does not resolve on its own. The dedicated CSF Leak Program at Cedars-Sinai focuses on advanced diagnostics and intervention to stop the debilitating pain and impediments associated with the illness. Our specialized team uses advanced imaging techniques to provide the best information for treatment planning, including cisternography and digital subtraction myelography to identify the location of a suspected CSF leak.

2,000

In the year 2000, Cedars-Sinai was the first hospital worldwide to establish a CSF leak program. Since then, more than 2,000 patients have been treated.

Wouter I. Schievink, MD, is one of the world's most renowned pioneers in intracranial hypotension and CSF leak. The author or co-author of over 180 research publications, Schievink has devised a sophisticated diagnostic protocol and is a leader in epidural blood patching and surgery for even the most complex cases. Patients are referred to Schievink's program from all over the nation and the world.



After experiencing atypical seizures for most of his life and trying a variety of unsuccessful treatments, retired CHP officer **Mark Odle** came to Cedars-Sinai to try a responsive neurostimulation (RNS) system. While the device didn't stop his seizures as hoped, it did provide hundreds of hours of data on how his brain was functioning. That allowed his doctors to pinpoint the trouble area: his right hippocampus. A brain function test revealed that even with a resection, he'd still be able to speak, form memories and control his body. With his right hippocampus gone, so were the seizures. The RNS system in his brain confirms that he's had no further seizures since.

EPILEPSY

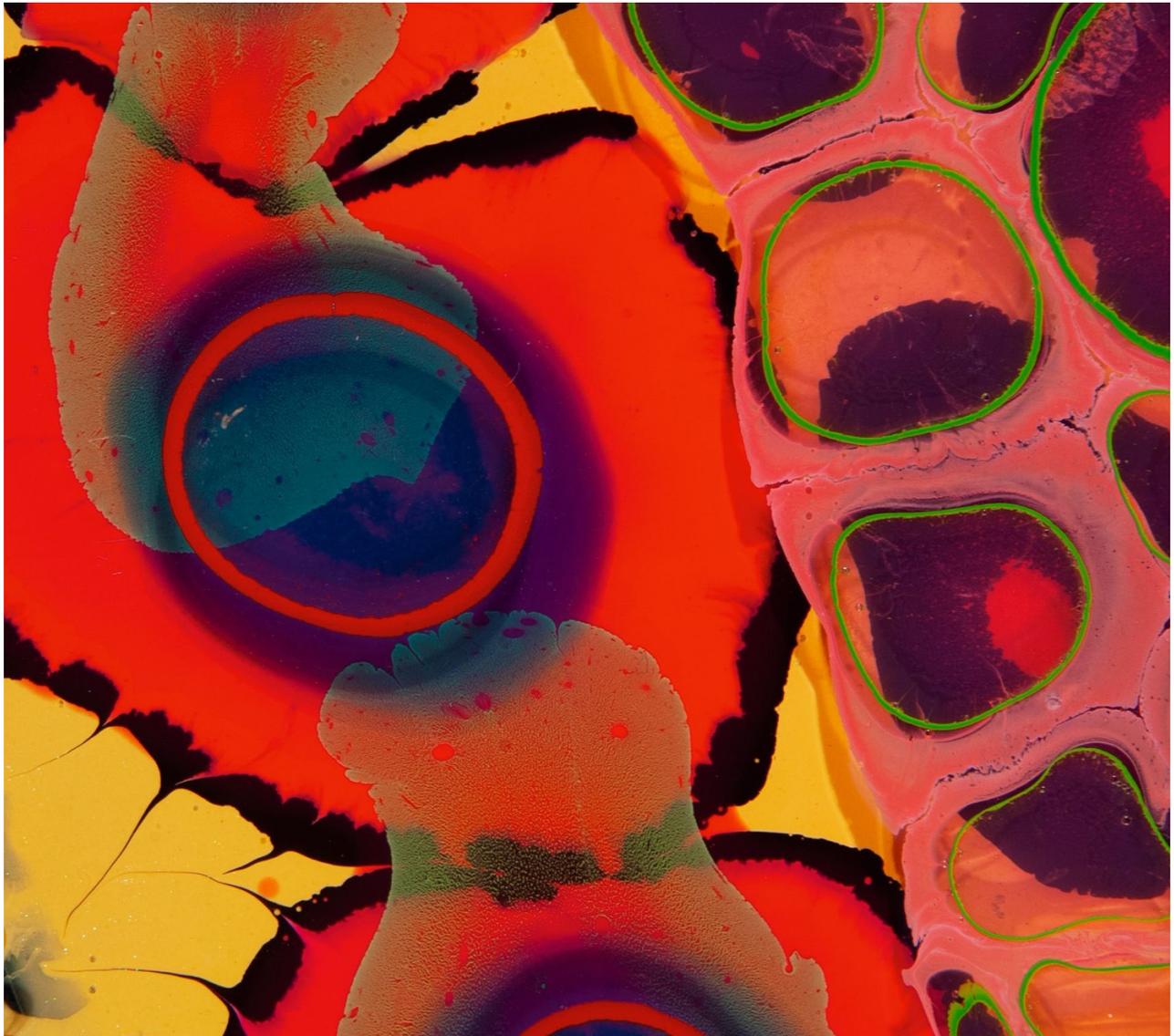
Jeffrey M. Chung, MD
Director, Epilepsy Program

A robust collaboration between epileptologists, neurosurgeons, neuropsychologists, nurses and social workers allows our program to provide comprehensive evaluation and treatment options, including medication trials and epilepsy surgery. Because evaluation of epilepsy can be complex, we created an inpatient Epilepsy Monitoring Unit to evaluate potential candidates for epilepsy surgery and to differentiate seizures from other conditions. We also employ advanced diagnostic studies, including functional mapping, neuropsychological testing, MRI and PET studies, magnetic source imaging testing of the epileptic magnetic activity of the brain, and Ictal SPECT analysis.

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Cedars-Sinai's Epilepsy Program is accredited by the National Association of Epilepsy Centers (NAEC) as a level 4 epilepsy center. Level 4 epilepsy centers have the professional expertise and facilities to provide the highest level of medical and surgical evaluation and treatment for patients with complex epilepsy.

A Cedars-Sinai study led by Ueli Rutishauser, PhD, and Crystal Reed, MD, PhD, revealed how memory and abnormal brain activity are linked in patients with epilepsy who often report problems with memory. Results showed that abnormal electrical pulses in the brain, known as interictal epileptiform discharges (IEDs), temporarily changed the firing of individual cells in the hippocampus. Epilepsy patients commonly experience IEDs between seizures and report transitive cognitive impairment. However, it has so far remained unknown why IEDs cause such impairment. Understanding this process has the potential to lead to improvements in treating epilepsy patients as well as contributing to the knowledge of how memory works.



Because Cedars-Sinai is at the leading edge of research, our experts can find solutions for patients who aren't responding to the conventional "ABC" drugs. For 23-year-old **Deven Townsel**, who has a relapsing form of MS, that means the infusion of an antibody called Tysabri. "Tysabri has been fantastic," says Townsel, who has high praise especially for Nancy L. Sicotte, MD, and her team. "You would never think that going to your doctor's office, especially having MS, would be so enjoyable," he says. "But it is!"

MOVEMENT DISORDERS

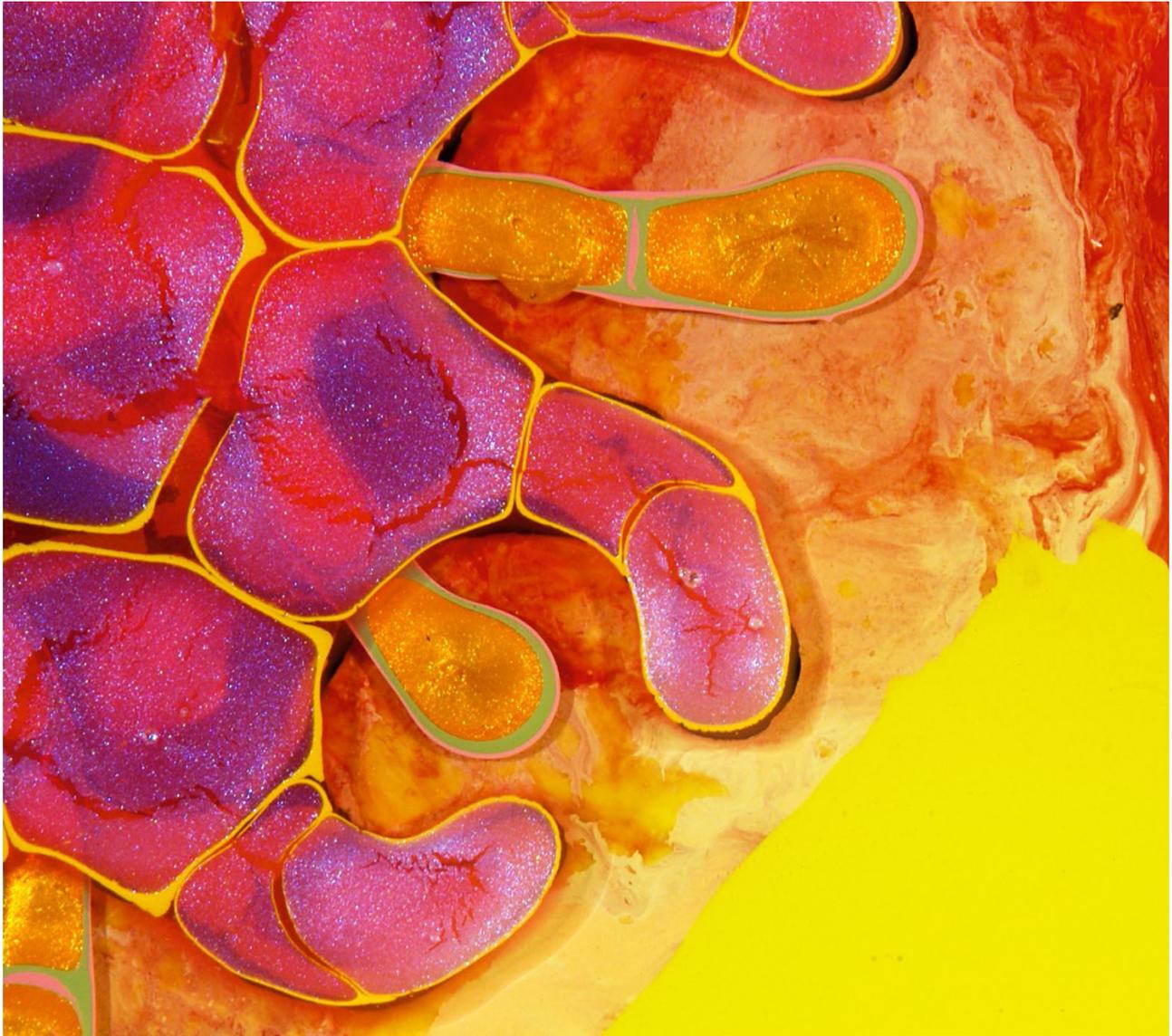
Michele Tagliati, MD
Caron and Steven D. Broidy
 Chair in Movement Disorders
 Director, Movement
 Disorders Program
 Vice Chair, Department
 of Neurology

The Movement Disorders Program at Cedars-Sinai is dedicated to the diagnosis and care of patients with Parkinson's disease and related disorders, including tremors, dystonia and other less common diseases. Patients have access to advanced diagnostics, including MRI and DAT scans. We offer several options for treating movement disorders, including medical management, botulinum toxin injections, deep brain stimulation (DBS) surgery, and physical, occupational and speech therapy. Our multidisciplinary experts offer patients access to high-quality clinical care and leading-edge clinical trials.

2,400

Number of outpatient visits
 the Movement Disorders
 team managed in 2019

Michele Tagliati, MD, director of the Movement Disorders Program and one of the nation's top specialists in the field, is leading the first worldwide effort to evaluate the safety and effectiveness of liraglutide, a GLP-1 agonist currently used for the reversal of insulin resistance in diabetes as well as for the treatment of the motor and non-motor symptoms of Parkinson's disease. The trial may also open new avenues of research into the pathophysiology of the disease. Disease-management trials at the Spine Center include many other investigational drugs for patients with Parkinson's and other movement disorders.



With a disease like ALS, compassion is as important as access to research and support in everyday life. When **Marc Bennet** was told he might have ALS, he found himself confronted with an insensitive physician. A clinical psychologist, Bennet knew the importance of empathy. He found it at Cedars-Sinai. Richard Lewis, MD, confirmed the ALS diagnosis, but delivered the news with a kindness that Bennet says made a big difference. "Having a sensitive and caring doctor like Dr. Lewis, I think, is critical," he says.

MULTIPLE SCLEROSIS & NEUROIMMUNOLOGY

Nancy L. Sicotte, MD
Chair, Department of
Neurology
Women's Guild Distinguished
Chair in Neurology
Director, Multiple Sclerosis
and Neuroimmunology
Program

Our Multiple Sclerosis and Neuroimmunology Center features a team of specialists—neurologists, ophthalmologists, urologists, rheumatologists and physical therapists—who have extensive experience in evaluation, diagnosis and treatment of patients with MS and similar disorders. We treat all variants of MS and related illnesses, including less common conditions such as clinically isolated syndrome (CIS), neuromyelitis optica (NMO), radiologically isolated syndrome (RIS), tumefactive MS and fulminant MS. Cedars-Sinai is designated by the National Multiple Sclerosis Society as one of its Partners in MS Care.

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The percentage of patients with an MS diagnosis who do not, in fact, have MS. The Cedars-Sinai Multiple Sclerosis and Neuroimmunology Center excels in diagnosis and management of MS, and our research team is developing novel imaging and blood tests to decrease the national MS misdiagnosis rate.

A retrospective study, led by investigator Marwa Kaisey, MD, found that nearly 18% of patients diagnosed with multiple sclerosis at other institutions before being referred to Cedars-Sinai or UCLA were actually misdiagnosed with the autoimmune disease. Investigators hope that the study results, along with research in new biomarkers and improved imaging techniques, will help improve diagnostic procedures and prevent future misdiagnoses.



Gabriel Goldberg, 44, was in the middle of his workout routine when he felt a sharp, hot pinprick sensation on his face. Then, he started to feel dizzy and couldn't speak. Paramedics alerted Cedars-Sinai that they were bringing Goldberg in, which triggered a "Code Brain." The team of stroke specialists was in place, ready to start tests and treatment as soon as Goldberg arrived in the ER. They quickly gave him a tPA and performed a mechanical thrombectomy. "Time is critical," says Nestor R. Gonzalez, MD, the neurosurgeon who treated Goldberg. "We want to provide the right interventions as soon as possible for the best outcome."

NERVE AND MUSCLE / ALS

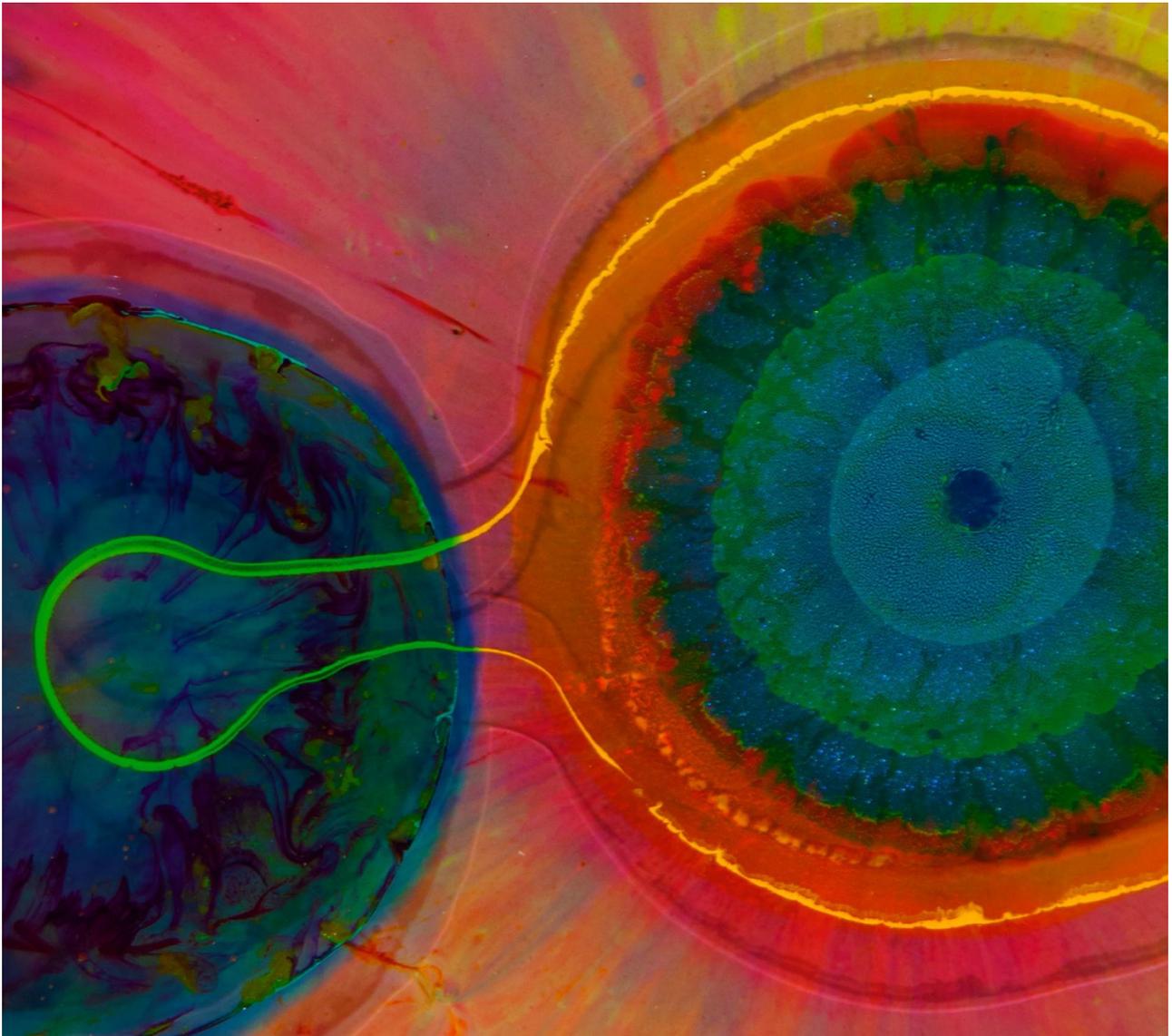
Robert H. Baloh, MD, PhD
*Ben Winters Chair in
 Regenerative Medicine
 Vice Chair, Neurology
 Research
 Director, Center for Neural
 Science and Medicine
 Director, Neuromuscular
 Medicine*

The Nerve and Muscle/ALS Program at Cedars-Sinai is world-renowned. It includes a weekly clinic that brings together a multidisciplinary group of healthcare providers to meet with patients and loved ones, and offers support, education and research opportunities. The program's dedication to extraordinary patient care is reflected in its status as an ALS Association Certified Treatment Center of Excellence. Among many accomplishments, we recently completed enrollment of a first-in-man trial developed at Cedars-Sinai of neural progenitor cell transplantation in ALS patients.

15

Number of team members in the ALS program from 13 different disciplines who are available to see patients on-site in one setting during the weekly multidisciplinary clinic, which makes Cedars-Sinai one of the most comprehensive ALS programs on the West Coast.

A study focused on two related proteins, MFN2 and MFN1, found on the outer membranes of mitochondria. Mitochondria play an especially critical role in nerve cells. Previous research has shown that mutated MFN2 causes mitochondria to malfunction in a common type of Charcot-Marie-Tooth disease: CMT type 2A. The new research, part of a multi-institutional study co-led by Robert Baloh, MD, PhD, and Yuequin Zhou, PhD, and published in the *Journal of Clinical Investigation*, showed that increasing levels of MFN1 to counterbalance mutated MFN2 reduced symptoms of CMT type 2A and neurodegeneration in laboratory mice.



Nicole used to love to do cartwheels. When she began to have pain, they became harder to land. She had an 18-inch tumor that ran from her brain down most of her spinal cord. A highly complex 14-hour surgery performed by Moise Danielpour, MD, director of Pediatric Neurosurgery, gave Nicole her health back. Her brother says that now Nicole can run faster than before—and challenges him to keep up. Best of all? Nicole is doing cartwheels again.

NEUROVASCULAR/STROKE

Shlee Song, MD
 Director, Vascular
 Neurology
 Director, Comprehensive
 Stroke and Telestroke
 Programs
 Co-Director,
 Comprehensive Stroke
 Center

Michael Alexander, MD
 Vice Chair, Neurosurgery
 Director, Neurovascular
 Center and Endovascular
 Neurosurgery
 Co-Director,
 Comprehensive Stroke
 Center

The Comprehensive Stroke Center at Cedars-Sinai is a leader in treating adult and pediatric patients with vascular disorders affecting the brain and spinal cord. Using state-of-the-art imaging technologies and the most advanced therapies and surgical techniques, our internationally renowned experts are breaking new ground on their approach to stroke surgery, neurointervention, vascular stereotactic radiosurgery and neurointensive care. The center is highly regarded for its focus on brain aneurysms, carotid artery disease, acute stroke, blood vessel malformations, blood hemorrhages and trauma.

9.7%

Cedars-Sinai has the lowest mortality rate for ischemic stroke of all teaching hospitals in the country (national rate: 13.8%), and the third lowest mortality of all U.S. hospitals.

Cedars-Sinai was one of 24 medical centers in the nation enrolled in the WEAVE trial to assess the periprocedural safety of the Wingspan stent system in the treatment of symptomatic intracranial atherosclerotic disease. The primary analysis assessed the periprocedural stroke, bleed and death rate within 72 hours of the procedure. The trial was stopped early after the interim analysis of 152 consecutive patients demonstrated a lower than expected 2.6% rate—lower than the 4% benchmark set for the interim analysis in the study.



Rachel Brandt was a healthy 27-year-old who was planning her wedding when a severe and uncharacteristic headache sent her to the Cedars-Sinai Emergency Room. A series of tests revealed a hemorrhaging pituitary tumor. The tumor, which turned out to be benign, was quickly removed via endoscopic endonasal surgery. A few months later, she ran the New York City Marathon. “I’m so lucky. I could have gone to any hospital in the world, but I happened to go to Cedars-Sinai—and I couldn’t be more grateful I made that choice,” says Brandt. “They were able to figure out the puzzle.”

PEDIATRIC NEUROLOGY & NEUROSURGERY

Moise Danielpour, MD
Vera and Paul Guerin
Family Chair in
Pediatric Neurosurgery
Director, Pediatric
Neurosurgery Program
Medical Director, Center
for Pediatric Neurosciences
Associate Professor,
Neurosurgery

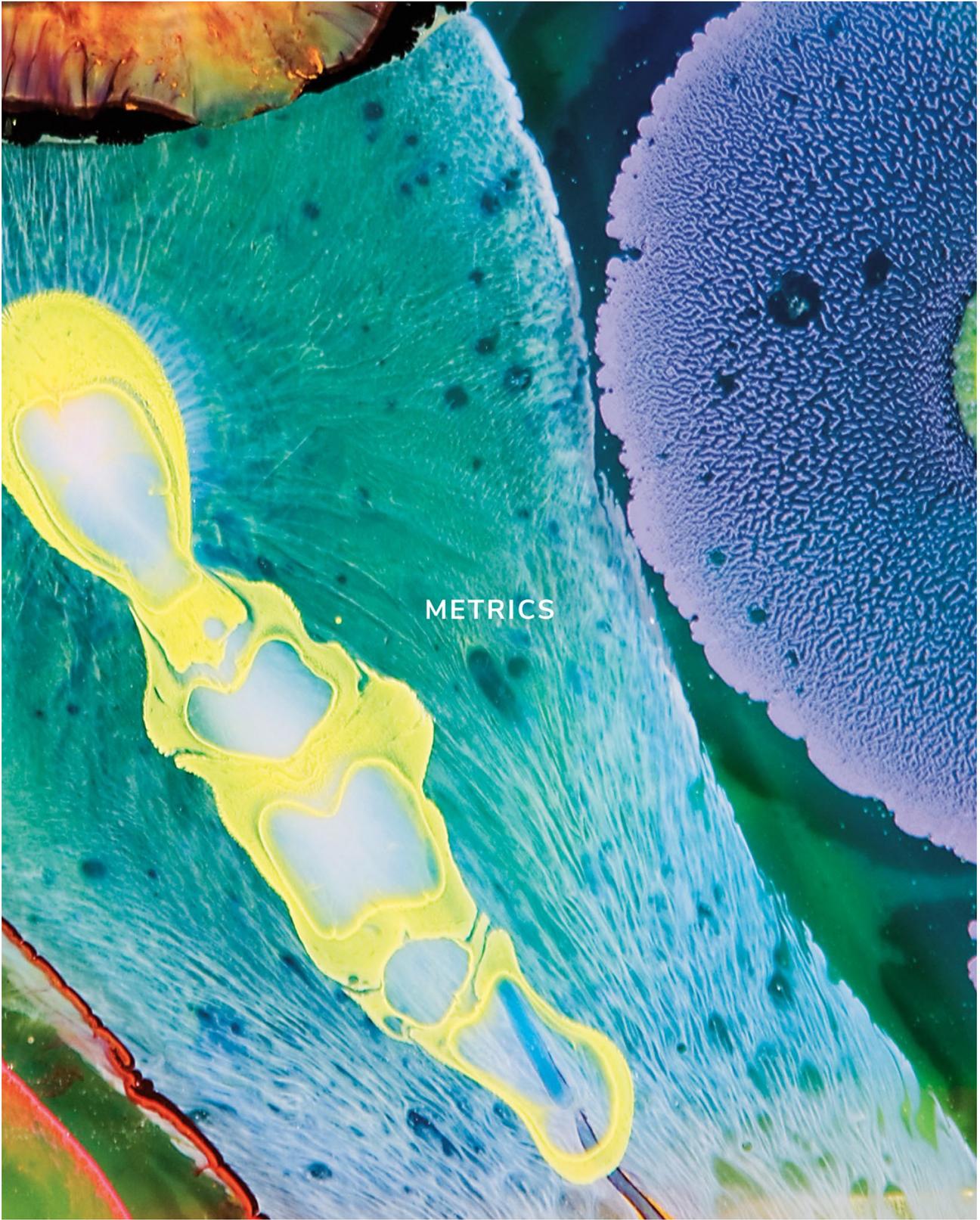
Our pediatric neurology and neurosurgery team is experienced in a variety of neurological disorders, from congenital malformations to tumors and includes neurologists, neurosurgeons, neuroradiologists, oncologists, ophthalmologists and neuropsychologists. We take a family-focused approach so that parents feel at ease during a difficult time. Our young patients have access to a number of clinical trials, including the Maxine Dunitz Neurosurgical Institute's Tumor Vaccine Program, which focuses on using the patient's own immune system to control and destroy tumors.

5.05

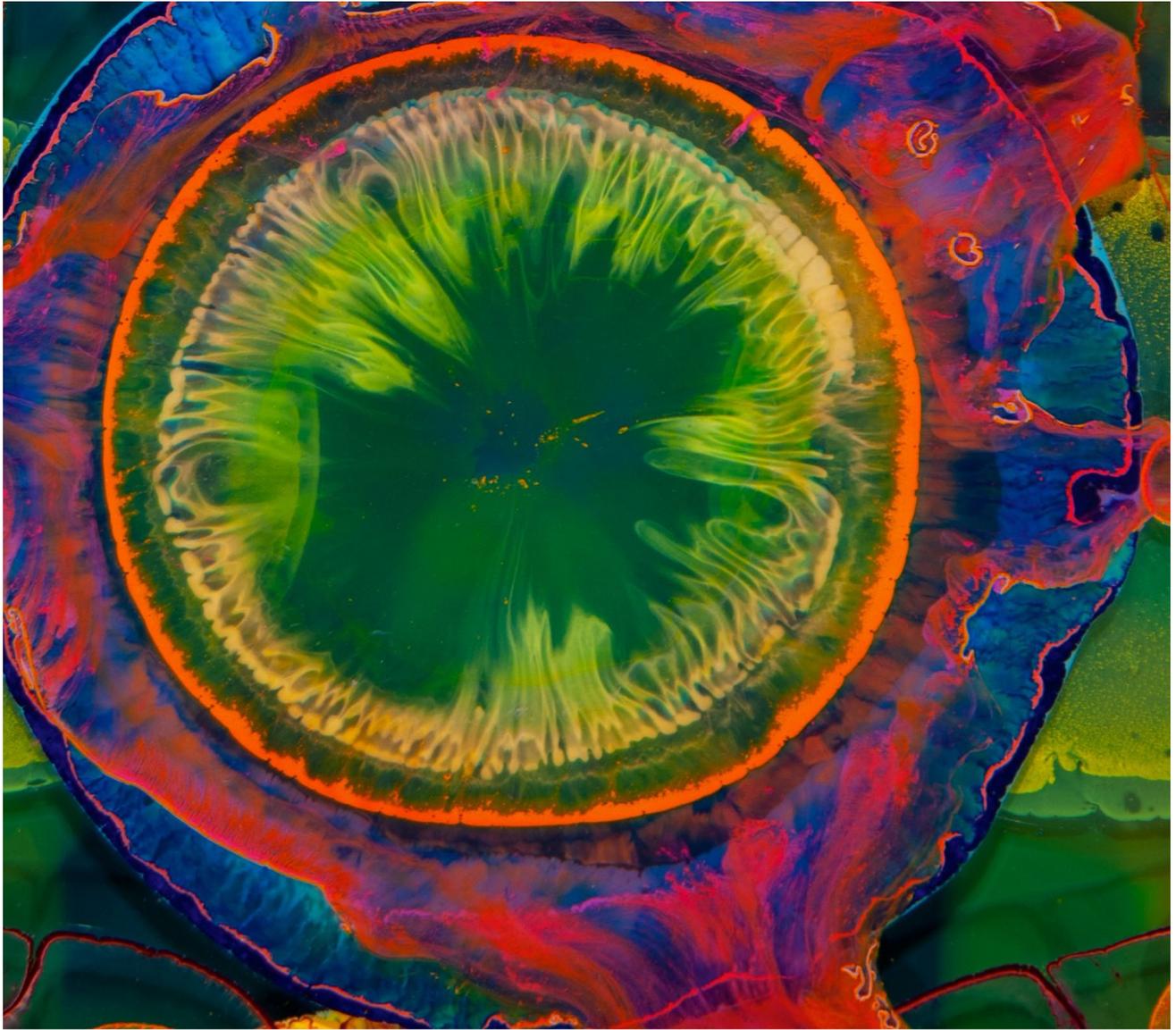
Average stay in days for pediatric neurosurgery at Cedars-Sinai, the lowest in Los Angeles County as compared to Children's Hospital Los Angeles, UCLA, Miller Children's Hospital and Children's Hospital of Orange County. The average length of stay at Cedars-Sinai for pediatric brain tumor surgery is 0.78 days.

The pediatric imaging specialists at Cedars-Sinai's S. Mark Taper Foundation Imaging Center are sensitive to providing children with the lowest-dose radiation possible. The center participates in the Alliance for Radiation Safety's "Image Gently" campaign. A fellowship-trained pediatric radiologist is on staff as well as medical physicists to supervise imaging protocols and ensure that the lowest possible dose of radiation is used to effectively image our young patients.





METRICS



Bobbie Poledouris was diagnosed with Parkinson's disease at 71. After discovering that running helped her symptoms, she came to Cedars-Sinai to see Michele Tagliati, MD, who encourages Parkinson's patients to exercise vigorously. She found top medical care and extraordinary personal support. Eventually, Tagliati joined his patient in a high-profile 5K run. Summing up his approach to both patient care and research, Tagliati says: "We believe that paying attention to what happens outside the brain will ultimately save the brain from bad aging."

VOLUME

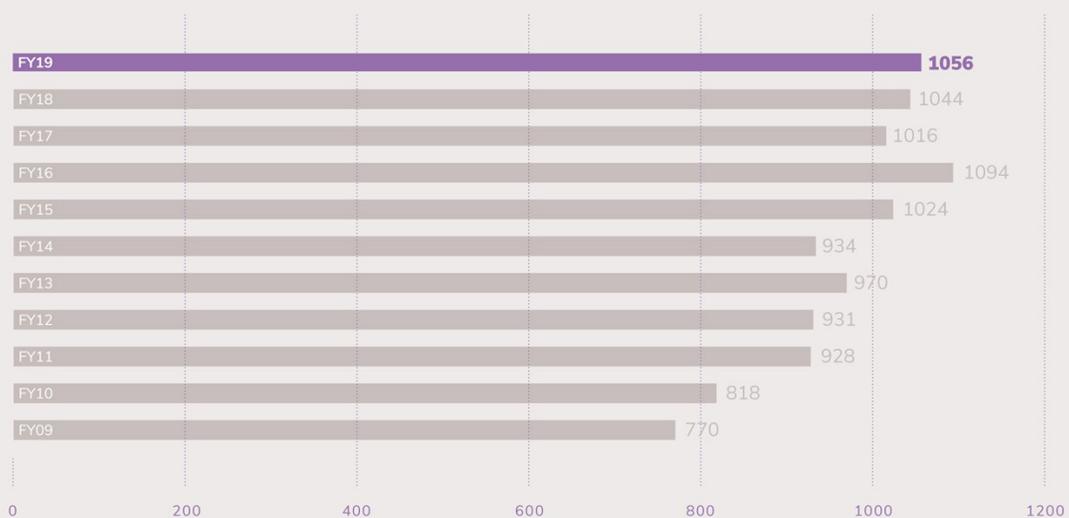
No. 1

Cedars-Sinai ranks No. 1 in Los Angeles County for inpatient neurosciences discharges

Inpatient & Outpatient Volume Summary FY19
 (Cedars-Sinai Medical Center + Cedars-Sinai Medical Group)

		Neurosurgery	Neurology	Combined
Visits	Inpatient	2,135	2,189	
	Outpatient	14,353	33,619	
	Total	16,488	35,808	52,296
Unique Patients	Inpatient	1,948	1,944	
	Outpatient	6,801	16,464	
	Total	8,749	18,408	27,157

Strokes



Inpatient Surgical

	FY16	FY17	FY18	FY19
Spine	818	869	840	1115
Brain Tumor	396	405	366	417
Neurovascular	240	277	265	307
Interventional Radiology	237	442	453	422

9.7%

Lowest mortality rate of all teaching hospitals for ischemic Stroke, and 3rd lowest mortality of all hospitals (Better than National Rate of 13.8%)

77

Percentage of acute ischemic stroke patients receiving intravenous tissue plasminogen activator therapy within 45 minutes of hospital admission (national rate: < 64%)

Length of Stay

Neurology, Neurosurgery and Spine Surgery

	FY17	FY18	FY19
Cedars-Sinai	1.00	1.01	1.00
Stanford	0.95	0.85	0.78
UCLA	1.06	1.01	1.03
UCSF	1.16	1.12	1.13
USC Keck	0.95	0.99	0.97

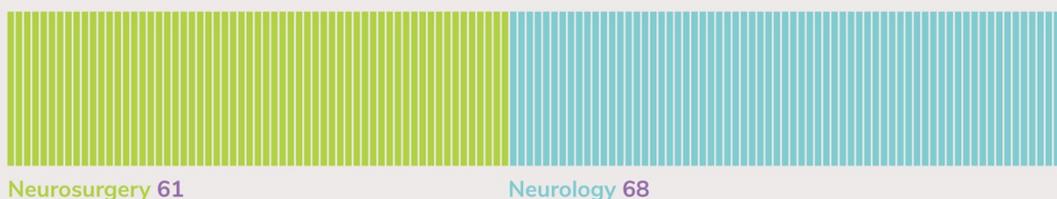
RESEARCH

FY19

		Neurosurgery	Neurology	Combined
Grant Spending	Federal	\$ 4,371,399	\$ 723,257	\$ 5,094,656
	Non-Federal	423,541	528,453	951,994
	Industry	709,325	552,607	1,261,932
	Total	\$ 5,504,265	\$ 1,804,317	\$ 7,308,582

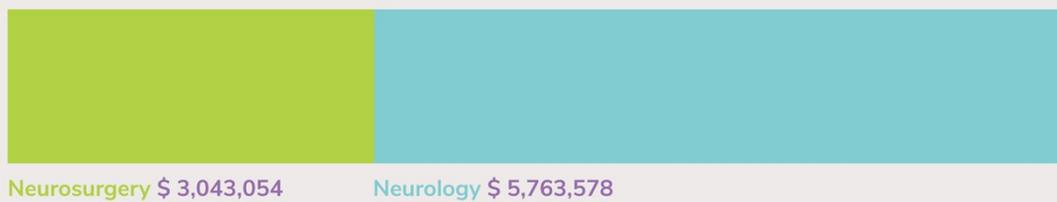
Publications

Combined 129



Philanthropic Donations

Combined \$ 8,806,632



NOTABLE PUBLICATIONS

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Doctors from around the world refer patients to the neurology and neurosurgery specialists at Cedars-Sinai, who are trained to treat conditions ranging from brain tumors to multiple sclerosis, epilepsy and stroke.

If you have a patient you would like to refer to one of our programs, please contact us at 424-315-2444 or visit cedars-sinai.org/neurology-neurosurgery. Our physicians will work with you to understand the unique needs of your patient, develop the best treatment plan and be available for additional consultations and procedures as needed.

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About the art

The images used in this report are details from larger paintings by Bruce Riley, a visual artist living in Chicago. The experimental nature of his technique conveys the feel of naturally occurring phenomenon. This type of mark making uses accidents as much as intent.

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