



NEUROSCIENCES 2015



UCHealth
UNIVERSITY OF COLORADO HOSPITAL



The Neurosciences Center at
University of Colorado Hospital
has experienced tremendous
growth during the past five years.

In addition to recruiting acclaimed faculty and acquiring important equipment and technology, we have more than doubled the size of our neurocritical care unit and created several new clinical and research programs, including cognitive disorders and a headache medicine center.

Even in the midst of building, the Neurosciences Center has been recognized often for our consistent and impressive performance – and we owe these achievements to the countless individuals at University of Colorado Hospital (UCH) who, for many years, have been steadily improving patient care while advancing the field of neurosciences. In fact, our history includes many innovative “firsts” that have helped pave the way for the success we enjoy today.



American Heart Association
American Stroke Association
CERTIFICATION
Meets standards for
Comprehensive Stroke Center

Designated as a
Blue Distinction®
Center +
for Spine Surgery

Anthem 
BlueCross BlueShield
An Independent Licensee of the
Blue Cross and Blue Shield Association



Becker's Hospital Review
100 Great Hospitals
In America

Top Docs
2015
5280





5	Letter from the chairs
7	Overview of neurosciences
9	University of Colorado Hospital overview
11	Innovation in clinical care
15	Brain tumors
21	Cerebrovascular and stroke
31	Cognitive disorders
33	Epilepsy
37	Headache
39	Movement disorders
43	Multiple sclerosis
49	Neurocritical care
51	Neuromuscular
55	Neuro-ophthalmology
57	Neuroradiology
59	Spine
65	Innovation and research
69	Selected publications
77	Research
83	Physician directory

Dear Colleagues,

Chances are, your reasons for pursuing a career in neurosciences are similar to ours. Like you, we are awestruck by the power and mystery of the brain. We are excited about its untapped potential and the discoveries yet to be made. And we are humbled by our ability to help people with life-changing neurological conditions, many of whom are living longer and fuller lives thanks to research that has paved the way for new medical and surgical treatment options.

At University of Colorado Hospital (UCH), we share your passion – and our accomplishments prove it. As the following pages illustrate, in 2014 and 2015 our team continued to produce outcomes in quality, safety, clinical care and research that are often unrivaled. Our achievements have been validated time and again by independent organizations that rate health care institutions or allocate funding based on objective data. While many hospitals can claim a national ranking of some kind, fewer have received multiple prestigious designations within one particular field. Some of the awards and certifications we are most proud of include:

- » UCH is one of only three institutions named by the American Stroke Association and Bugher Foundation as a Center of Excellence in Stroke Collaborative Research (which came with a four-year grant to study how children recover from stroke).
- » The Society of Neurological Surgeons (SNS) has designated fellowship training in Neurocritical Care, Stereotactic and Functional Neurosurgery, and Spine Neurosurgery to the University of Colorado Department of Neurosurgery.
- » We have received five-year funding from the National Multiple Sclerosis Society thanks to our designation as a Collaborative MS Research Center.
- » UCH has been certified by the Muscular Dystrophy Association (MDA) as the only MDA/ALS program in Colorado, and one of only 42 in the country. We also have an active research grant from the MDA.
- » We have been named a Network for Excellence in Neuroscience Clinical Trials (NeuroNEXT) site by the National Institutes of Health and the National Institute of Neurological Disorders and Stroke.
- » UCH is the home to neurocritical specialists certified by both the SNS CAST and the United Council for Neurologic Subspecialties. Our Neuro ICU received the prestigious Beacon Award for Excellence – Gold Level, one of seven in the nation.
- » Our epilepsy center, including our inpatient monitoring unit, is a National Association of Epilepsy Centers Level 4 program.
- » Our neurology and neurosurgery programs were again ranked in the top 30 nationally by *U.S. News and World Report*.

While it is evident that research is a cornerstone of our program, we are just as passionate about patient care and teaching. Throughout this report, you will find many examples that demonstrate our commitment to clinical effectiveness, safety, efficiency and the overall patient experience. Less tangible, but just as important, is the spirit of innovation that is present in everything we do. Lastly, throughout these pages you will get a sense of just how critical our people are. Our accomplishments simply would not be possible without the hundreds of individuals who are equally devoted to healing, science and education. This report is a salute to our caregivers, physicians, scientists, professors and administrative partners.

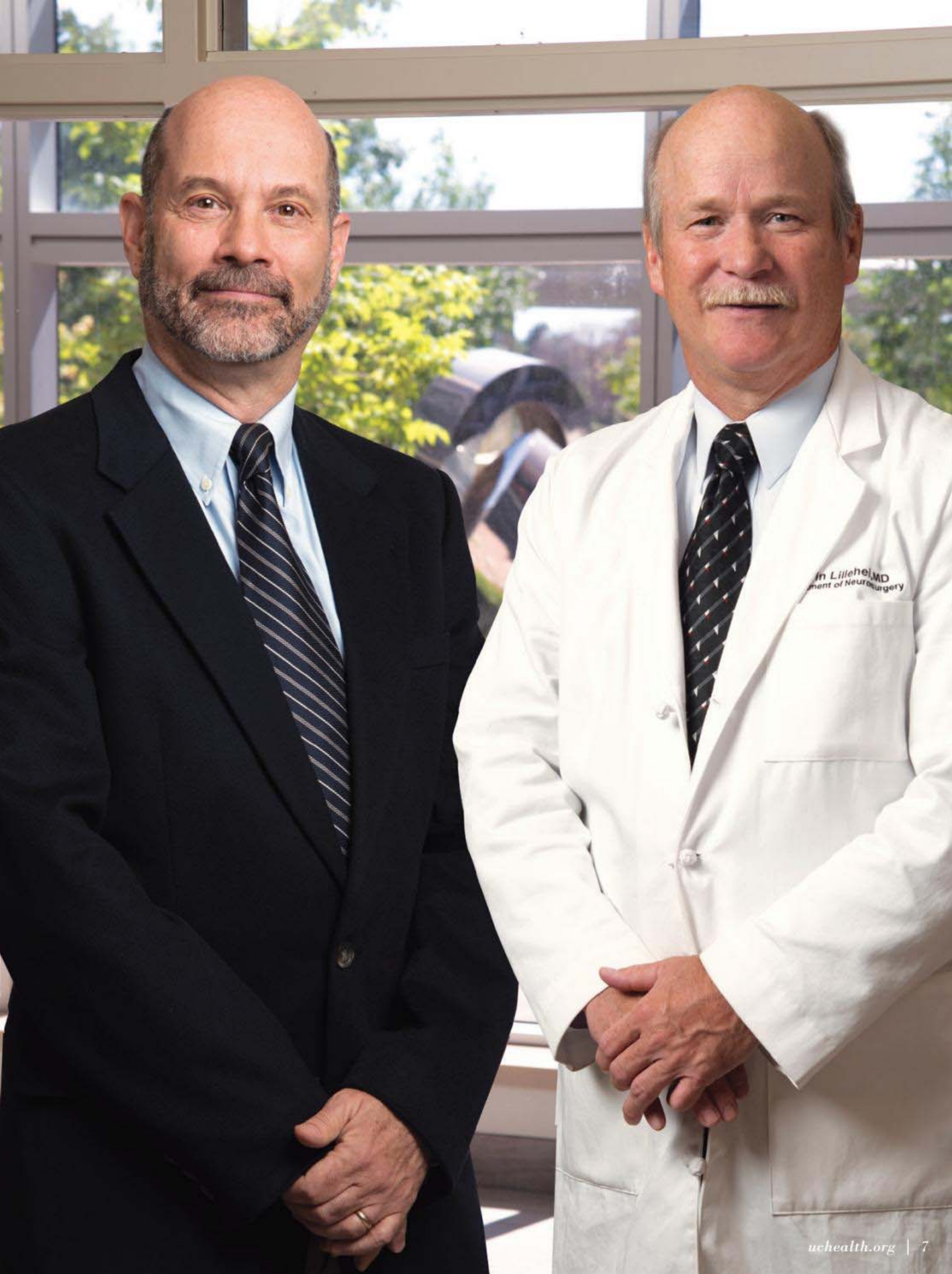
We are proud to share our annual summary of neurosciences outcomes, and hope you find the content as energizing and interesting as we do.

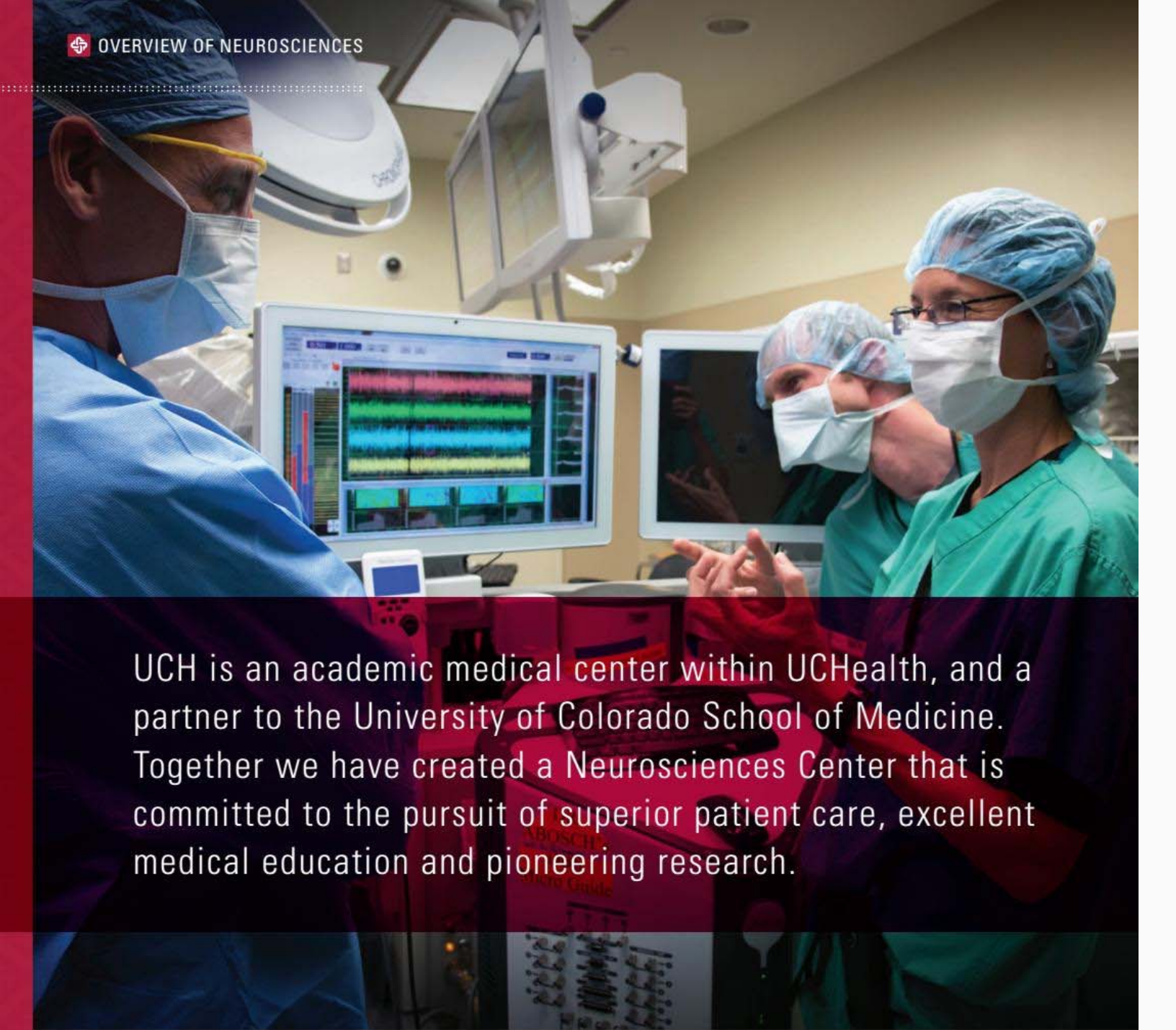
Kevin O. Lillehei, M.D.
Chair, Neurosurgery



Kenneth L. Tyler, M.D.
Chair, Neurology

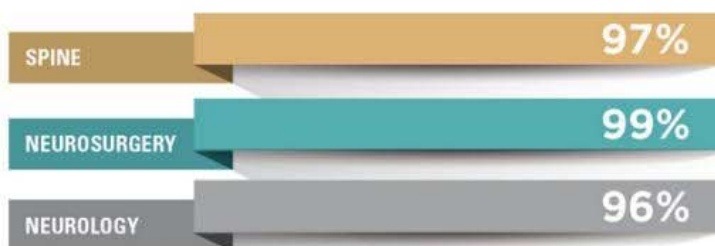






UCH is an academic medical center within UCHealth, and a partner to the University of Colorado School of Medicine. Together we have created a Neurosciences Center that is committed to the pursuit of superior patient care, excellent medical education and pioneering research.

OUTPATIENT SATISFACTION BY PRACTICE



Source: Patient Pulse surveys; percentage of positive responses in 2014

Our physicians offer subspecialty expertise in cerebrovascular and stroke care, cognitive disorders, epilepsy, headache, movement disorders, multiple sclerosis, neurocritical care, neuromuscular care, neuro-oncology, neuro-ophthalmology, neuroradiology and spine care.

BY THE NUMBERS

UCH is the largest provider of neurological and neurosurgical care in the region, and leads the state in the amount and quality of care provided to patients. We also enjoy a growing and well-funded research program.

- » In 2014 we saw more than 45,000 outpatient visits, and our neurosciences units accounted for 3,015 admissions, with 18,110 patient days and nearly 3,400 neurosurgical and spine procedures.
- » Our ambulatory patient satisfaction scores confirm that 96 percent of patients “highly recommend” our neurology and spine services, and 99 percent highly recommend our neurosurgery program.
- » With more than \$18 million in research grants and awards in 2014, our neurosciences program is among the top 30 programs funded by the National Institutes of Health.
- » Together the departments of neurology and neurosurgery are participating in more than 100 active clinical trials, including more than 45 clinical and laboratory trials for multiple sclerosis alone.

TRADITION OF EXCELLENCE

Patients with neurological conditions ranging from the familiar to the rare are often referred to UCH for access to the latest medical and surgical treatment options – including therapies developed or tested by our own physicians and scientists. For example:

- » UCH was the first center in Colorado to perform cerebral intra arterial lysis for stroke.
- » We have the oldest neuro intensive care unit and hired the first neuro-intensivist in the region.
- » We offer the only neurocritical care and neurovascular fellowship programs in the state.
- » Our neuro-ophthalmologists have pioneered the use of 3-D simulation vision testing.
- » We are the only academic medical center in Colorado to offer an EEG biofeedback program for patients with epilepsy.
- » As one of the most experienced deep brain stimulation (DBS) centers in the nation, we were the first in the region to perform stereotactic guided sedated implantation (also known as MRI-based DBS).
- » Our stroke team is reshaping how we deliver acute stroke care with the implementation of the nation’s third mobile stroke treatment unit in early 2016.

THE JOURNEY CONTINUES

While we have much to be proud of, UCH has purposely created an environment of continuous improvement that forces us to challenge ourselves. Whether we are recreating processes that have led to an unsatisfactory patient experience or inefficient care, or launching new programs and services that require vast amounts of time and energy, our team understands that maintaining a laser focus on outcomes is one of the most important things we can do for our patients.

REDEFINING HEALTH CARE QUALITY

At University of Colorado Hospital, we take pride in our work. Sure, we are proud of our reputation and rankings, but it goes well beyond awards and achievements. Mostly we are proud to be that special kind of place where collaboration is key and the patient experience informs all of our decisions. We find joy and gratification in knowing we have provided the best care possible.

As the primary teaching hospital for University of Colorado School of Medicine, UCH offers a unique blend of academic-based and community-focused care. This partnership also allows us to conduct research that gives our patients access to novel clinical trials, and ultimately helps us attract top clinical staff, including faculty who are world renowned for their efforts to bring science to the bedside.

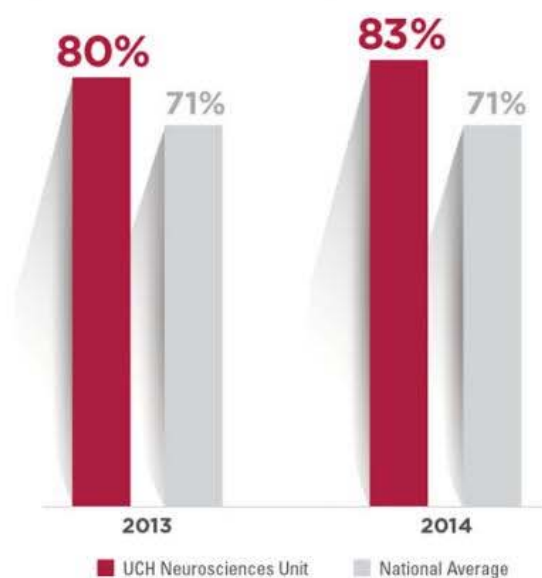
Indeed, the success of our Neurosciences Center is not an anomaly – in 2015, UCH was nationally ranked by *U.S. News & World Report* in 11 adult specialties, including the distinction of being named second in the country for pulmonology.

Our ability to provide exceptional patient care across so many service lines is due largely to our hospital-wide focus on quality. The task of continually self-monitoring our performance is baked into our culture, and allows us to be nimble in response to variances in patient satisfaction scores, clinical outcomes or medical quality measures. Evidence of our commitment includes:

- » In 2014, UCH received its fourth consecutive Magnet designation by the American Nursing Credentialing Center. Notably, fewer than 30 hospitals in the world have achieved this.
- » For five consecutive years, we have been named one of the highest-performing academic hospitals in the U.S. by the University Health System Consortium, which ranks hospitals based on outcomes in patient safety, clinical effectiveness, clinical efficiency, patient experience, mortality, and equity of care for patients, regardless of their ethnic or socioeconomic backgrounds.
- » Compared to national data, our overall patient experience scores from June 2014 to June 2015 place UCH in the top 25 percent of hospitals.

While health care quality can be defined and measured in many different ways, at UCH one thing is consistent: the care we provide must be safe, effective and evidence-based. We are proud – and fortunate – to work in an environment that never loses sight of that.

PERCENTAGE OF INPATIENTS WHO WOULD
"DEFINITELY" RECOMMEND THEIR HOSPITAL



Source: Avatar Solutions' Improving Care system, accessed on 5/16/2015.

UNIVERSITY of COLORADO HOSPITAL

KEY 2014 METRICS

- » Compared to the previous year, the percentage of our hospital patients who rated UCH a nine or 10 (out of a possible score of 10) increased from 77 percent to 78 percent, compared to a national average of 71 percent. This places UCH in the 89th percentile.
- » 83 percent of our hospital patients said they would “definitely recommend” UCH, compared to a national average of 71 percent.
- » Compared to other U.S. teaching hospitals, our neurosciences unit scored in the 80th percentile in terms of overall rating, and our Neuro ICU scored in the 90th percentile.
- » UCH is nationally ranked by U.S. News & World Report in 11 adult specialties, including Neurology & Neurosurgery (26th).

Embracing Innovation to Create New Standards of Care

At University of Colorado Hospital, we have uncovered a simple truth: The best patient care is found at the intersection of clinical practice, medical education and research. When these three elements are performed well – and performed together – the results speak for themselves. We achieve outstanding quality, strong outcomes and happy, healthy patients.

As an academic medical center, we are fortunate to be able to weave a fourth element, innovation, into everything we do. In our environment of continuous improvement, innovation serves us well because it allows us the freedom to make changes, try new things and adopt new practices that ultimately enhance patient care.

In 2014 and 2015, our Neurosciences Center found several new ways to bring innovation to our patients. In some cases we are offering innovation at the bedside, for example, with advanced intraoperative imaging equipment or new surgical treatments for patients with epilepsy. In other cases, we are bringing innovation out into the community, thanks to the launch of programs such as our mobile stroke treatment unit (MSTU). Below are a few examples of how we've helped transform clinical care during the last year.

INTRAOPERATIVE MRI

Earlier this year, we were thrilled to go live with intraoperative magnetic resonance imaging (iMRI) guidance in our operating suite. This technology will offer tremendous value, in the form of safety and efficacy, to our neurosurgeons and patients during delicate brain or pituitary tumor resections.

The addition of the 3.0T unit, which weighs nine tons and spans two operating rooms, represents a major step forward in neuroimaging, because it allows our neurosurgeons to view the brain in real time before, during and after surgery. Specifically, iMRI increases surgical vision by helping to localize and target the tumor, precisely identifying tumor margins and accounting for shifts in the brain that can occur during surgery.

Recently published results of the first randomized controlled trial of iMRI found significantly lower residual tumor volume than conventional microsurgery. Using iMRI, 95.8 percent of patients were found to have had complete tumor resection, compared to 68 percent in the conventional surgery group.

Not only can iMRI guidance help our surgeons confirm that the entire tumor was removed, it helps ensure there is minimal damage to surrounding healthy structures that are key to the patient's postoperative functional ability. This also helps reduce the need for a patient to have a second surgery.

MOBILE STROKE TREATMENT UNIT

It goes without saying that stroke can have devastating consequences if not treated quickly, but those of us in the medical community are all too familiar with the myriad reasons a patient may not receive tissue plasminogen activator (tPA) or neurointerventional surgery in time to prevent disability or death.

While we cannot control how long it takes for a stroke victim or their loved one to call 911, we have a greater influence on the treatment process including “door to needle” times once a patient arrives in our emergency room – and UCH has met or exceeded all of the American Heart Association’s “Target: Stroke” guidelines for getting a stroke patient evaluated, diagnosed and treated.

Despite better-than-average outcomes, our cerebrovascular team felt strongly that there was still room to dramatically alter and improve care for stroke patients in Denver and beyond. With that in mind, we embarked on a complicated but much needed effort to create the country’s third mobile stroke treatment unit. This “emergency room on wheels” which launched early 2016, will allow eligible patients to receive tPA at the scene, saving precious time and brain function.

From creating agreements with local emergency response services and 911, to building the unit and getting it inspected and staffed, to ensuring the on-board data communication systems are functional and HIPAA compliant, establishing a MSTU is no small feat – but we believe the payoff will be invaluable in terms of improving public health.

To put our theory to the test, we will participate in a national, multicenter study assessing the feasibility of implementing mobile stroke units and their effects on treatment time and outcomes, compared to traditional emergency services such as ambulance transport. Together, we hope to change the standard of care for stroke across the nation.



EPILEPSY SURGICAL ADVANCES

Epilepsy diagnosis and treatment has come a long way in the last 50 years, thanks to the convergence of several factors, including: new classes of medication that are safer and more tolerable; the development of surgical treatments including vagus nerve stimulation; new neuroimaging techniques such as functional MRI and magnetoencephalography; and the acceptance of evidence-based, integrative approaches like neurofeedback.

The Comprehensive Epilepsy Center at UCH has long been a leader in seizure disorder management, and we are continuing that legacy by offering our patients novel surgical treatments that are not widely available. In addition to performing traditional and neocortical resections, and implanting vagal nerve stimulators, we are now offering the next generation of implantable devices – specifically, the RNS Neurostimulator made by NeuroPace.

The programmable NeuroPace device provides responsive neurostimulation, meaning it detects abnormal electrical activity in the brain with the help of intracranial leads that are constantly recording brain activity, and then responds by delivering mild electrical stimulation. This response helps interrupt the abnormal activity associated with an impending seizure, and prevents the seizure from occurring. To date, clinical trials have shown patients who received the NeuroPace cranial implant are experiencing significant improvement in seizure frequency.

UCH also offers intracranial electrode placement prior to epilepsy surgery, a technique that allows our physicians to precisely map where in the brain seizures are occurring. In cases where a routine EEG cannot detect the origin of seizure activity, our surgeons can place electrodes directly on the brain. These depth electrodes not only provide detailed EEG monitoring, they help our physicians identify the healthy parts of the brain – including critical areas responsible for speech and motor control – that need to be preserved during surgery.



NEW PAIN RELIEF OPTIONS FOR HEADACHE PATIENTS

To some, treating headache disorders may not seem as glamorous as treating other neurological conditions that require lifesaving surgery or other dramatic measures. But in terms of making a difference, something as “simple” as a headache can cause frequent debilitating pain for millions of people in the U.S. Compare that to the relatively rare incidence of brain cancer, for example, and it’s easier to understand the importance of high-quality headache medicine.

In 2012, UCH created its multidisciplinary headache center, offering patients a combination of top-notch neurological care and access to new clinical trials. As anticipated, our program is growing quickly due to patient demand. People who have been unable to manage their pain through traditional methods, including medication, are turning to UCH for innovative new options that are safe and effective.

For example, our physicians are performing sphenopalatine ganglion (SPG) blocks much more easily – with far less discomfort to the patient – thanks to a relatively new device called the SphenoCath. Historically, SPG blocks were performed with a long needle through the side of the head or with a stiff cotton swab pushed up through the nose. Results were often inconsistent and patients sometimes had to be sedated. Today, with the aid of the SphenoCath, our physicians can quickly apply anesthetic to the sphenopalatine ganglion in both children and adults, often providing immediate relief to patients suffering from migraine, cluster headache, or facial pain.

UCH also is part of a pilot study to evaluate prophylactic treatment of chronic migraine using the Cefaly device, which was approved by the Food and Drug Administration in March 2014 for episodic migraine prevention. Formally called a cranial analgesic electrotherapeutic device, this “wearable headband” generates micro-impulses that stimulate the trigeminal nerve, often associated with migraine pain. Because the Belgian device is so new to the United States, there is little data to support its claims, and patient and physician reviews to date are mixed. To that end, UCH researchers are helping evaluate whether use of the device leads to fewer migraines and a reduction in use of migraine medication.

3-D NAVIGATION DURING SPINE SURGERY

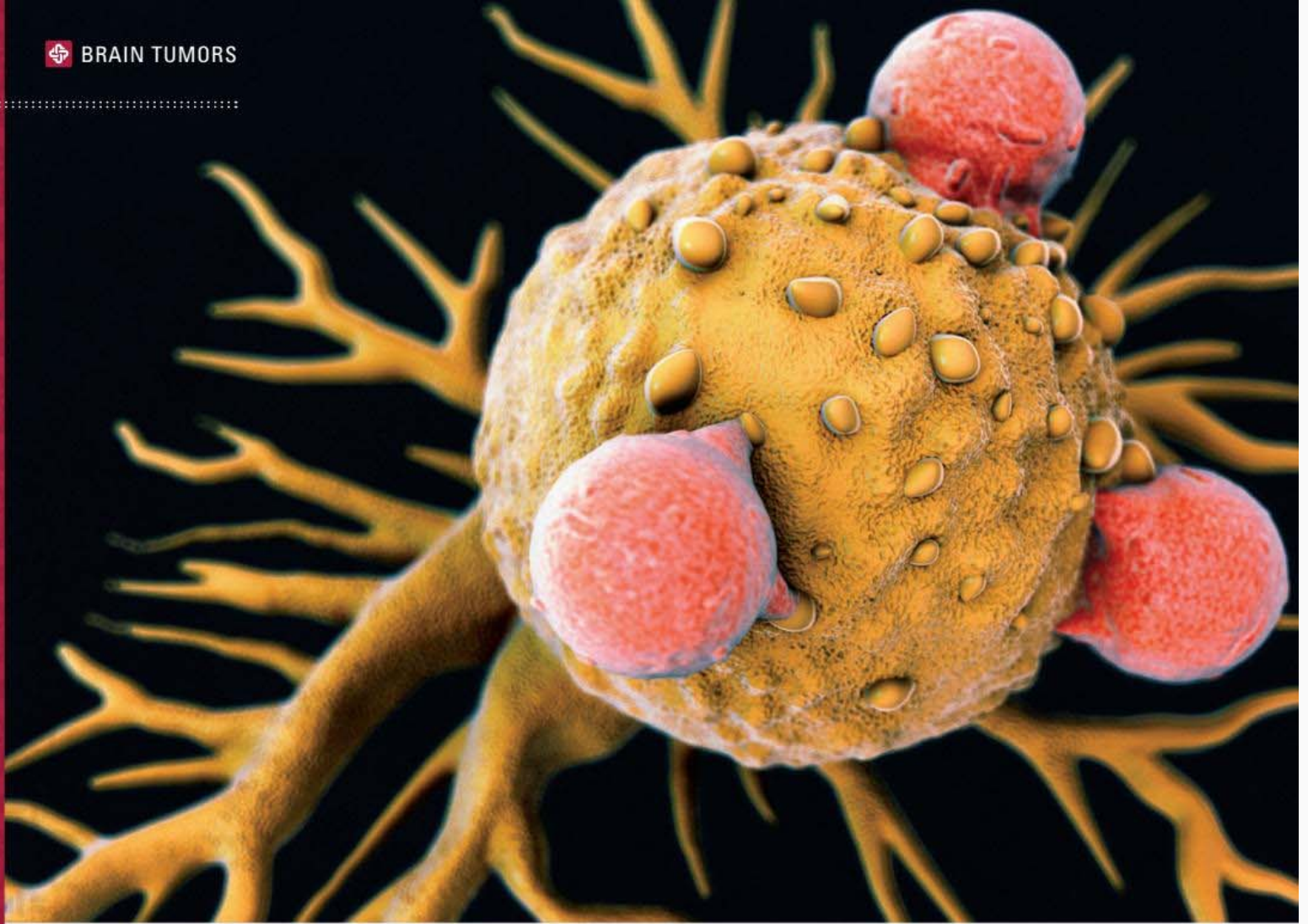
Thanks in part to our status as a tertiary referral hospital, patients turn to the UCH Spine Center when they need complex surgery such as spinal fusion or spinal tumor resection. While there are risks associated with any surgical procedure, today spine surgery is safer and more effective than ever as a result of the development of minimally invasive techniques and advancements in surgical imaging.

At UCH we’ve witnessed strong patient outcomes associated with the use of our three-dimensional surgical navigation system, which offers our neurosurgeons and orthopedic surgeons enhanced surgical vision before, during and after spine surgery. In addition to pre-operative planning, our 3-D system provides intraoperative imaging that helps the surgeon view the patient’s anatomy in real time, allowing for better instrument and hardware placement, as well as navigation around critical structures in the spine that need to be preserved.

REMAINING THOUGHTFUL ABOUT INNOVATION

While innovation helps guide us, at UCH we’re also careful about when, where and how to innovate. As technology rapidly changes the way we deliver care, we must balance our need for better devices and the latest equipment with the knowledge that sometimes, what our patients most need is simple human connection – feeling like their physician answered all their questions, or receiving reassurance prior to a procedure.

At UCH we use innovation to help improve patient care, while preserving the old-fashioned elements that can make the patient and caregiver relationship so meaningful.



SETTING NEW STANDARDS FOR CANCER CARE

Within the cancer treatment community, University of Colorado Hospital is known for our depth and breadth of research, as demonstrated by the University of Colorado Cancer Center's elite designation as one of only 45 National Cancer Institute Comprehensive Cancer Centers in the country.

While we are proud to provide access to the latest clinical trials addressing brain and other nervous system cancers, equally important to patient care is our use of emerging therapies and leading edge technology along with our vast support services. Our survival rates are often higher than average and supported by the close collaboration of physicians from multiple disciplines, including neurologists and neurosurgeons with subspecialty expertise in brain cancers and skull base surgery.

Several qualities differentiate our cancer program from other institutions. For example:

- » We offer one of the busiest neuroendocrinology programs in the country, providing surgery for as many as 100 patients with pituitary tumors each year.
- » During brain tumor surgery, our neurosurgeons often use stereotactic guidance to map the cortex in three dimensions, a highly sophisticated option not available at many hospitals.
- » Our team offers expertise in minimally invasive skull base surgeries for craniopharyngiomas and other complex tumors.

- » Our state-of-the-art radiosurgery services include Gamma Knife surgery for benign and malignant tumors, and the Novalis system for brain tumors and arteriovenous malformations that require multiple doses of radiation.
- » Thanks to the addition of intraoperative magnetic resonance imaging (iMRI), our neurosurgeons now have the ability to view images of a patient's brain during surgery. Not only does this help our surgeons confirm that the entire tumor was removed, but the use of iMRI helps ensure there is minimal damage to surrounding healthy structures that are key to the patient's post-operative functional ability. This technology is especially helpful for tumor resection, especially low grade gliomas, and pituitary tumor resection.

On the research side, UCH is involved in a multicenter, national study assessing a tumor vaccine for newly diagnosed high-grade gliomas. Among other efforts, our team also is studying the role of the immune system in intracranial tumor recognition and eradication.

KEY 2014 METRICS

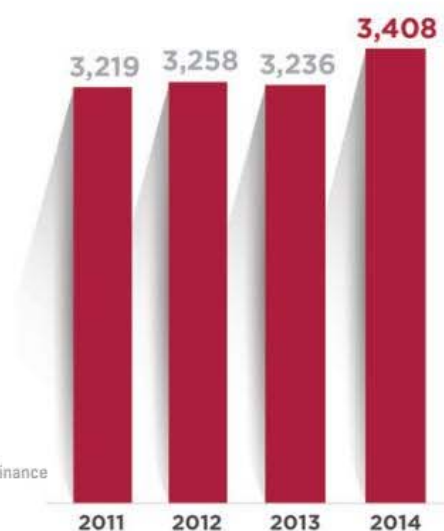
- » Our five-year survival rate for brain and other nervous system cancers is 45 percent (national average 33 percent).
- » 94 percent of our pituitary tumor patients have a survival rate of at least five years following treatment (national average 88 percent).
- » Our 30-day, cause-related readmission rate was 6 percent (national average 7 percent).

LENGTH OF STAY (DAYS)



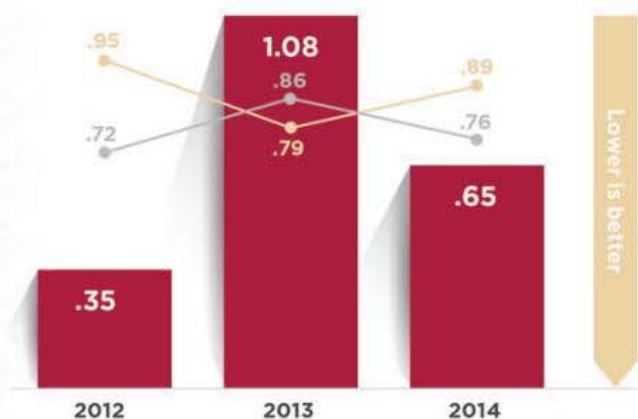
Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL; UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

OUTPATIENT VISITS



Source: UCH Finance

MORTALITY INDEX

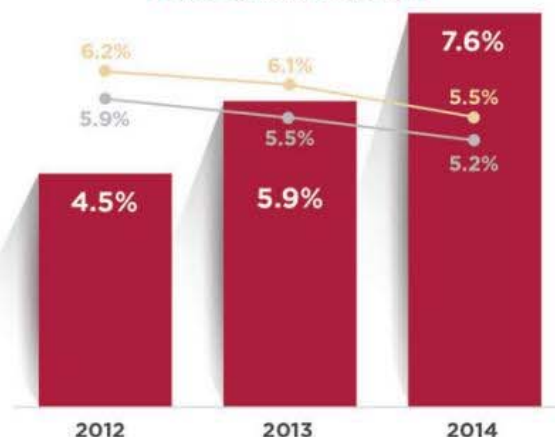


- University of Colorado Hospital
- Comparably-sized academic medical centers (average value for group)
- Leading neuroscience hospitals (average value for group)

Mortality index is the ratio of observed to expected mortality based on a risk adjustment algorithm. An index score of 1 indicates observed and expected mortality are equal. Values below 1 are desirable.

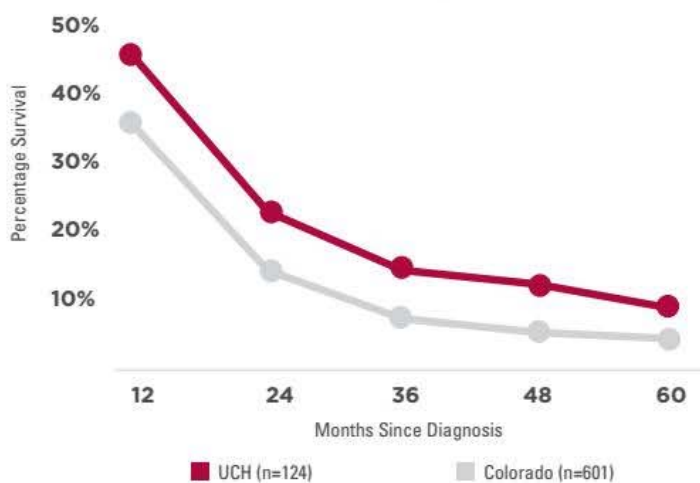
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

COMPLICATION RATES



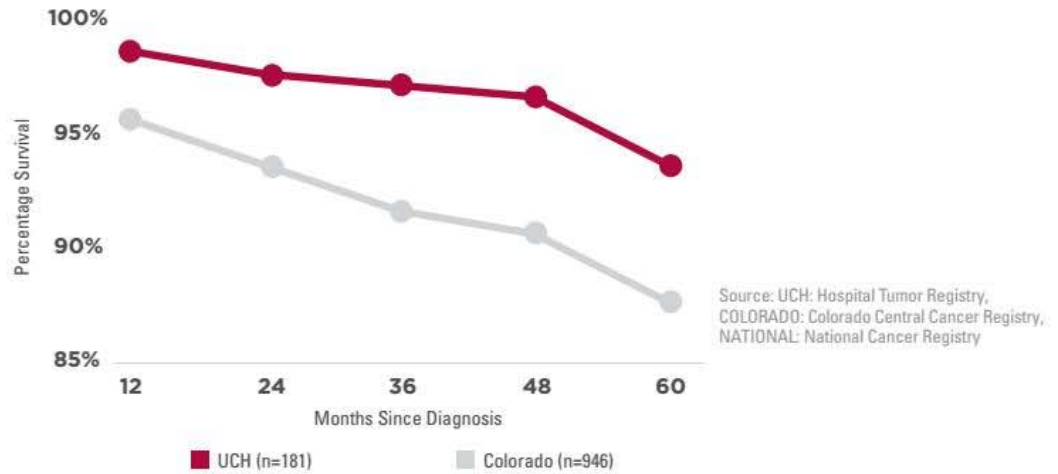
- University of Colorado Hospital
- Comparably-sized academic medical centers (average value for group)
- Leading neuroscience hospitals (average value for group)

BRAIN (GBM ONLY) 5-YEAR SURVIVAL

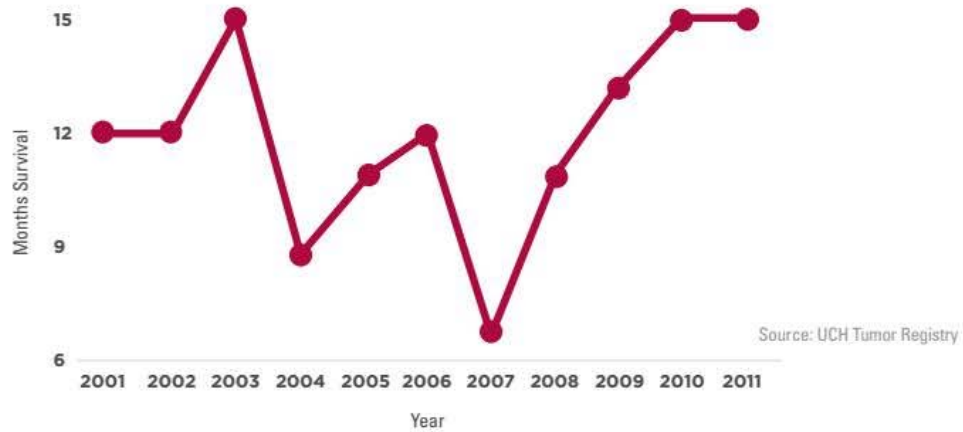


Source: UCH: Hospital Tumor Registry, COLORADO: Colorado Central Cancer Registry, NATIONAL: National Cancer Registry

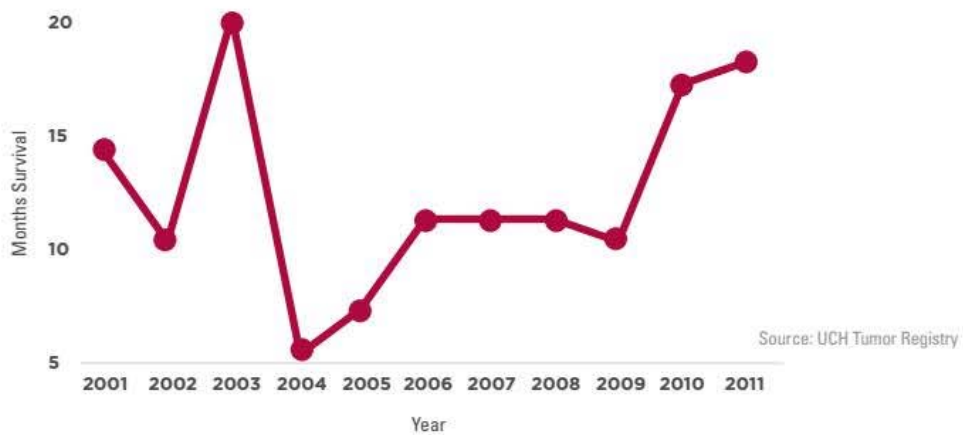
PITUITARY 5-YEAR SURVIVAL



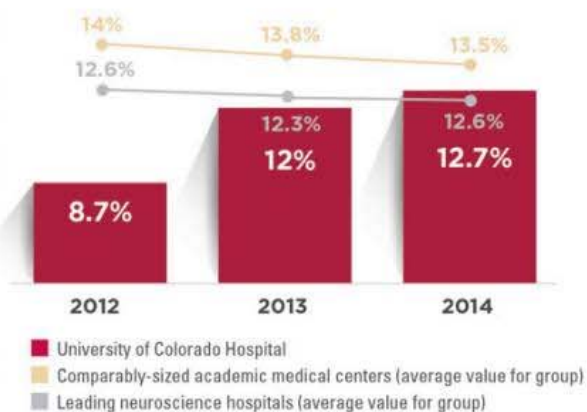
MEDIAN SURVIVAL FOR GBM (MONTHS)



LONG TERM SURVIVAL FOR GBM (% of patients living at least 3 years after diagnosis)

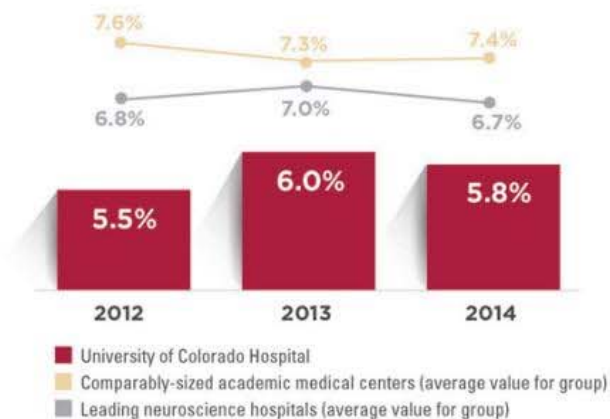


30-DAY READMISSION RATES: ALL CAUSE



Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/8/2015.

30-DAY READMISSION RATES: RELATED CAUSE



Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/8/2015.

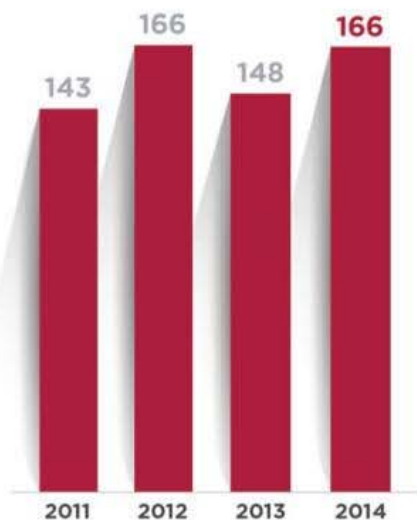
GAMMA KNIFE PROCEDURES

(Performed by UCH Neurosurgeons)



Source: CU Department of Neurosurgery

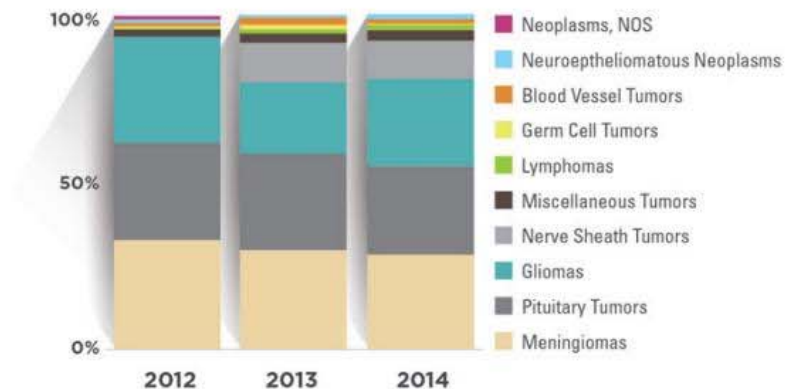
BRAIN TUMOR PROCEDURES*



*Excludes stereotactic radiosurgery and gamma knife procedures.

Source: UCH Hospital Tumor Registry

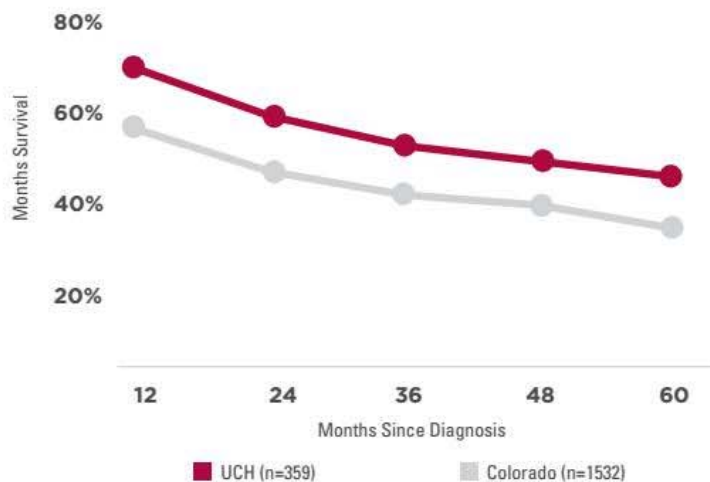
BRAIN TUMOR DIAGNOSIS DISTRIBUTION



Meningiomas, pituitary tumors, gliomas and nerve sheath tumors comprise about 90% of neuro-oncology diagnosis seen at UCH in the past three years.

Source: UCH Hospital tumor registry

BRAIN (INCLUDING BENIGN (5-YEAR SURVIVAL))



Source: UCH: Hospital Tumor Registry, COLORADO: Colorado Central Cancer Registry,

THE GOLD STANDARD IN STROKE CARE

The Stroke Center at University of Colorado Hospital has enjoyed another fruitful year – and shows no signs of slowing down.

Right on the heels of becoming one of the first 30 hospitals in the nation to receive the Joint Commission's esteemed Comprehensive Stroke Center certification, we launched our telestroke program and created the country's third mobile stroke treatment unit (MSTU). Having gone live in early 2016, this "emergency room on wheels" allows eligible patients to receive tissue plasminogen activator (tPA) at the scene, saving precious time and brain function.

Given the significant investments of time, money, training and other resources necessary to create a MSTU and put it into service, we intend to test our theory that its use will significantly improve treatment time for many stroke patients – and ultimately reduce the incidence of stroke-related death or disability in the community. To that end, UCH will participate in a national, multicenter study assessing the feasibility of implementing mobile stroke units and their effect on treatment time and outcomes, compared to traditional emergency services such as ambulance transport.

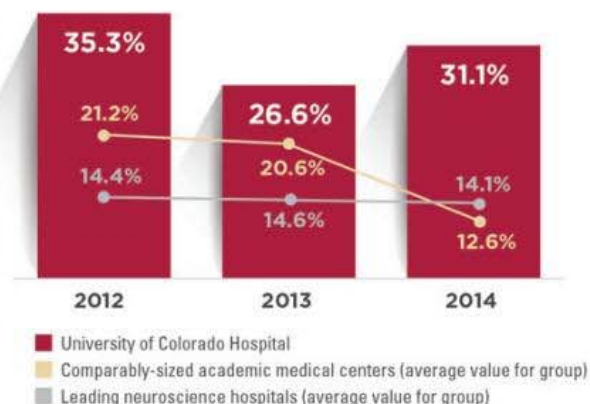
April 2014 marked the activation of our four-year grant from the American Stroke Association and the Bugher Foundation, called the Centers of Excellence in Stroke Collaborative Research for Regeneration, Resilience and Secondary Prevention. This prestigious award was given to only three health care institutions in the country.

UCH also has partnered with pediatric neurologists from Children's Hospital Colorado to create a young adult stroke clinic. Through this effort we're learning more about what causes stroke in young people, with the goal of clarifying treatment guidelines and returning young stroke victims to long, productive lives. By uncovering the mechanisms of brain injury, recovery and repair, scientists can attempt to restore some of the remarkable brain plasticity that is lost with age.

Our researchers also are participating in the multicenter POINT trial, studying the effectiveness of anti-platelet treatments such as aspirin alone versus an aspirin-plus-clopidigrel combination, among patients with transient ischemic attack or minor stroke.

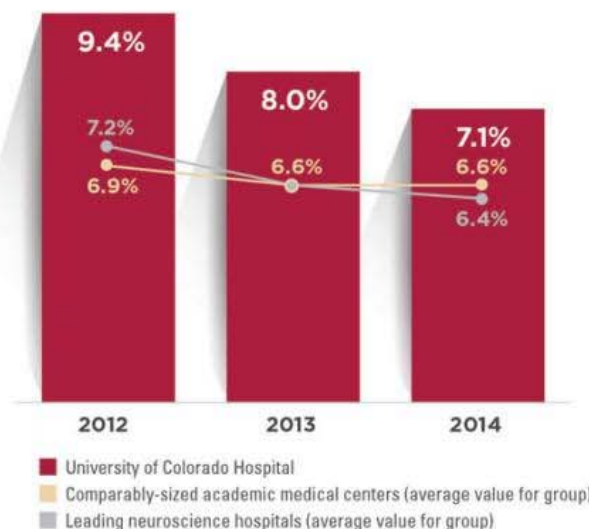


COMPLICATION RATES Hemorrhagic Stroke



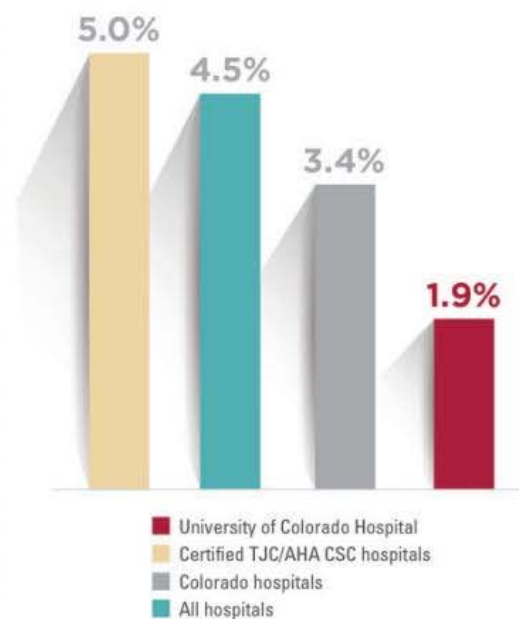
Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/7/2015.

COMPLICATION RATES Ischemic Stroke



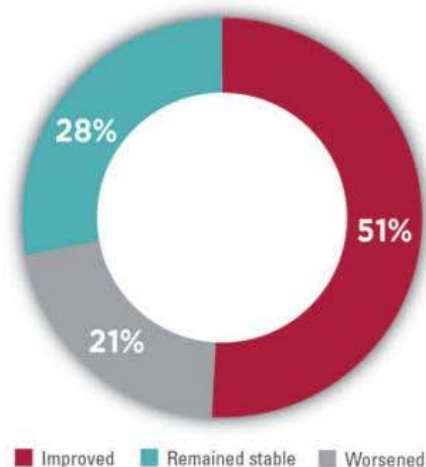
Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/7/2015.

THROMBOLYTIC COMPLICATIONS



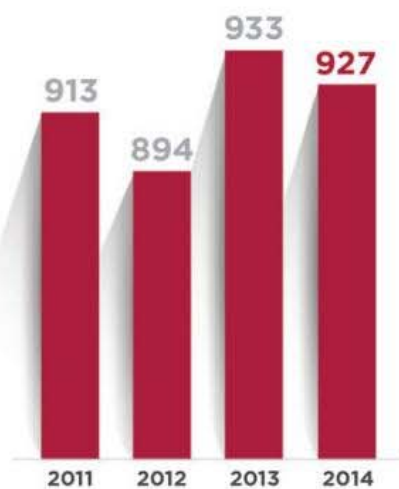
Source: Get With The Guidelines® report run on 6/25/2015.
Percent of Ischemic stroke patients with bleeding complications to thrombolytic therapy.

NIHSS SCORE IMPROVEMENT (N=149)



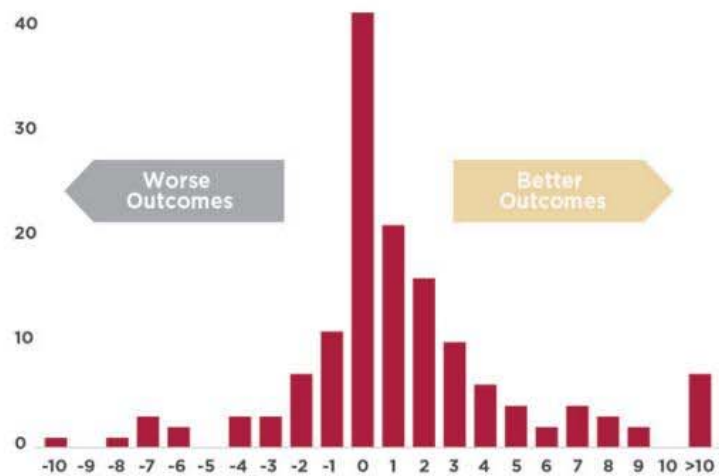
Source: data provided by UCH Stroke Council,
5/6/2015, for patients discharged in 2014.

OUTPATIENT VISITS



Source: UCH Finance

NIHSS SCORE IMPROVEMENT (N=149)



Source: data provided by UCH Stroke Council, 5/6/2015, for patients discharged in 2014.

LENGTH OF STAY (DAYS) Hemorrhagic Stroke



LENGTH OF STAY (DAYS) Ischemic Stroke

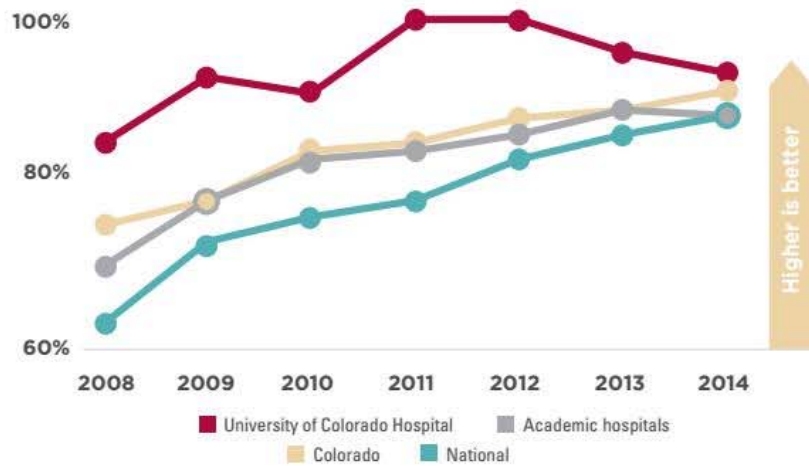


Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/7/2015.

KEY 2014 METRICS

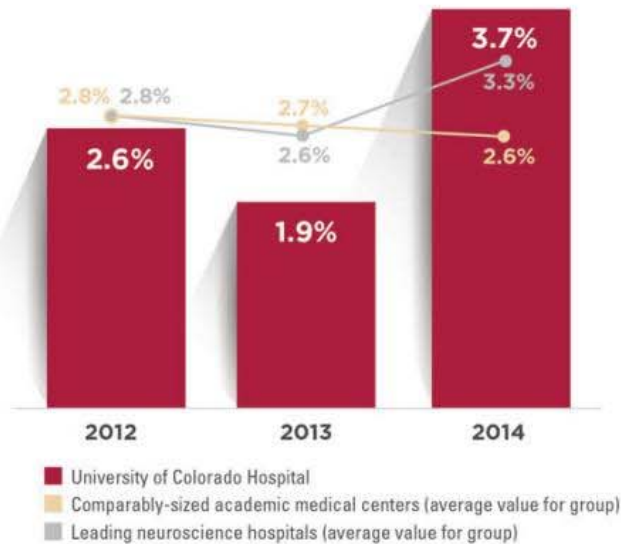
- » 93.5 percent of ischemic stroke patients who arrived at UCH within two hours of stroke onset received intravenous (IV) tPA within three hours of onset.
- » Mortality index for ischemic and hemorrhagic stroke patients were [.68] and [.91], respectively.
- » 51 percent of patients showed significant improvement in their National Institutes of Health Stroke Scale score.
- » IV tPA door-to-needle time was 46 minutes in 2014, well ahead of the National Stroke Association's goal of 60 minutes.

IV RT-PA ARRIVE BY 2 HOURS, TREAT BY 3 HOURS



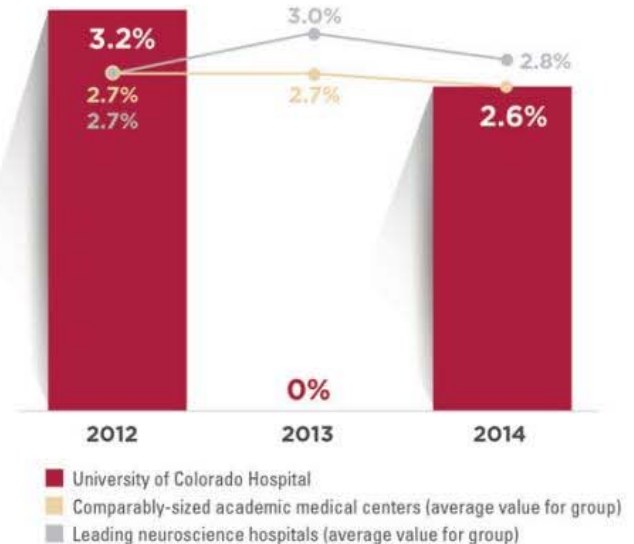
Source: Get With The Guidelines® report run on 6/4/2015.

30-DAY READMISSION RATES: RELATED CAUSE Hemorrhagic Stroke



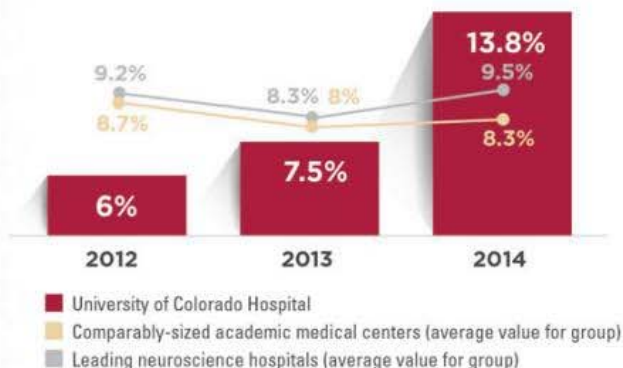
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/8/2015.

30-DAY READMISSION RATES: RELATED CAUSE Ischemic Stroke



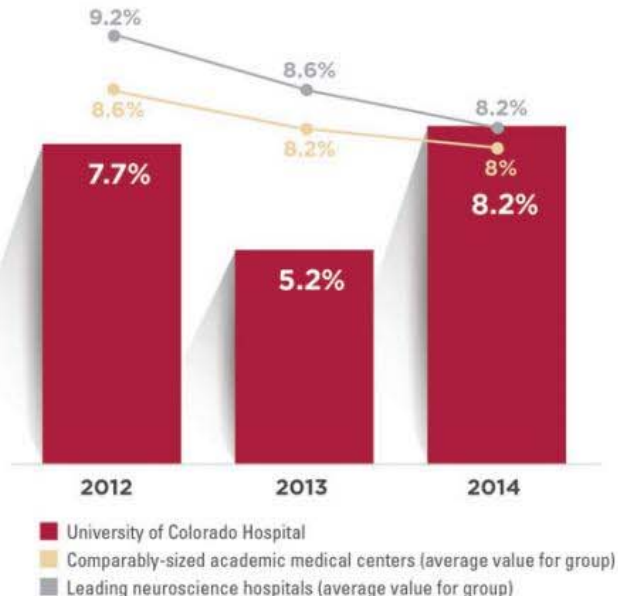
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/8/2015.

30-DAY READMISSION RATES: ALL CAUSE Hemorrhagic Stroke



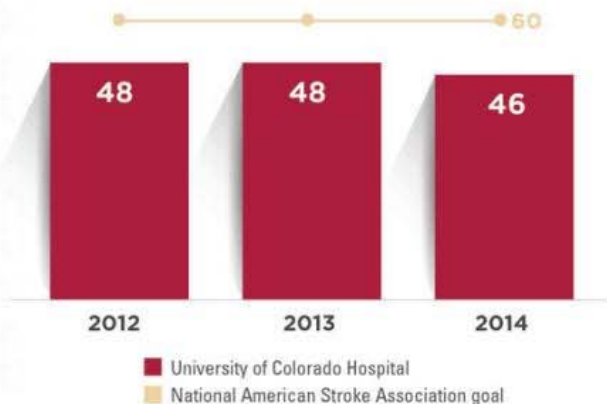
Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

30-DAY READMISSION RATES: ALL CAUSE Ischemic Stroke



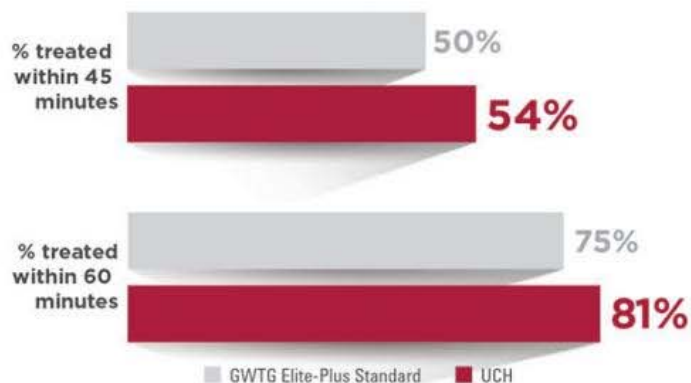
Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

ACUTE ISCHEMIC STROKE IV tPA Door to Needle Time (minutes)



University of Colorado Hospital's median door to needle time in 2014 was 46 minutes and continues to be well below the American Stroke Association's Target: Stroke door to needle time goal of 60 minutes.

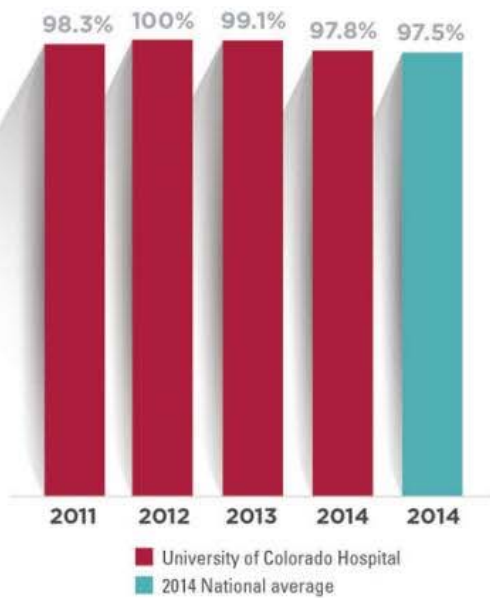
ACUTE ISCHEMIC STROKE IV tPA Door to Needle Time



The primary goal of the American Stroke Association's Target: Stroke Phase II is for Get With The Guidelines-Stroke participating hospitals to treat 75% of the acute ischemic stroke patients with intravenous tissue plasminogen within 60 minutes of arrival and 50% within 45 minutes of arrival at the hospital. University of Colorado Hospital exceeded these goals and received the Stroke Honor Roll-Elite Plus award during the 2014 inaugural year.

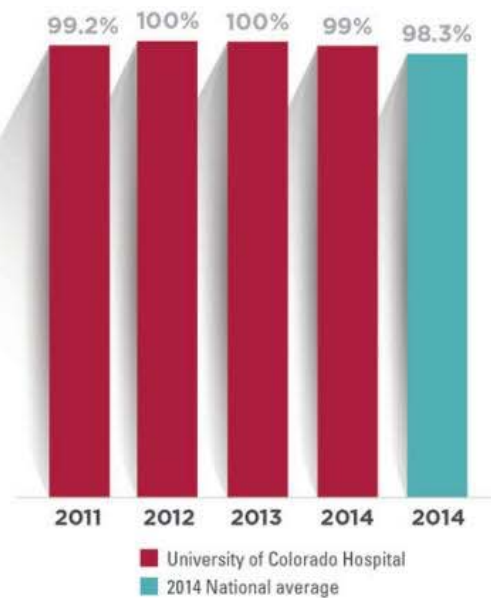
THE JOINT COMMISSION STROKE CORE MEASURE SET

Antithrombotic Therapy by End of Hospital Day 2



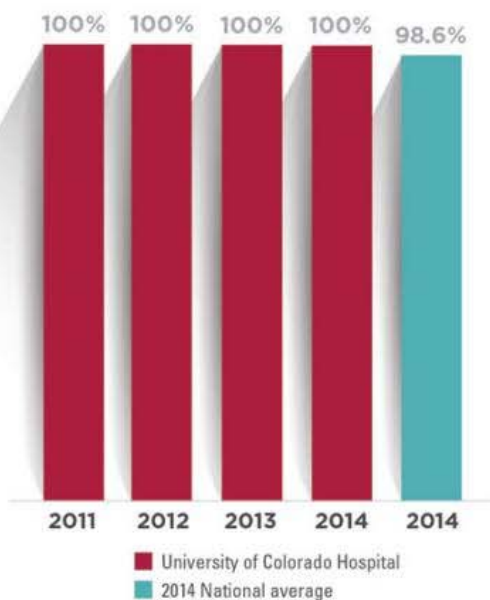
THE JOINT COMMISSION STROKE CORE MEASURE SET

Assessed for Rehabilitation



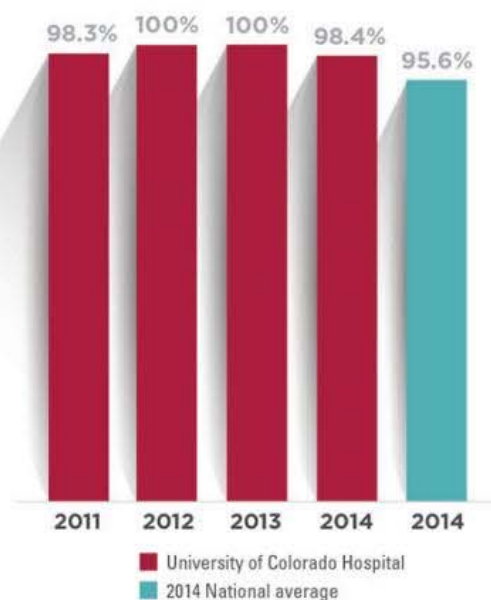
THE JOINT COMMISSION STROKE CORE MEASURE SET

Discharged on Antithrombotic Therapy

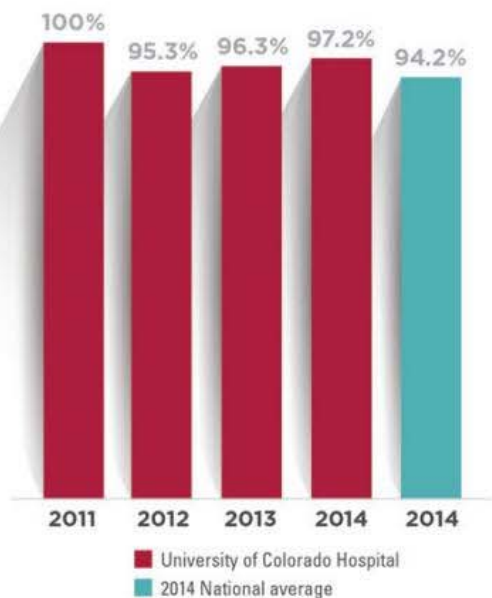


THE JOINT COMMISSION STROKE CORE MEASURE SET

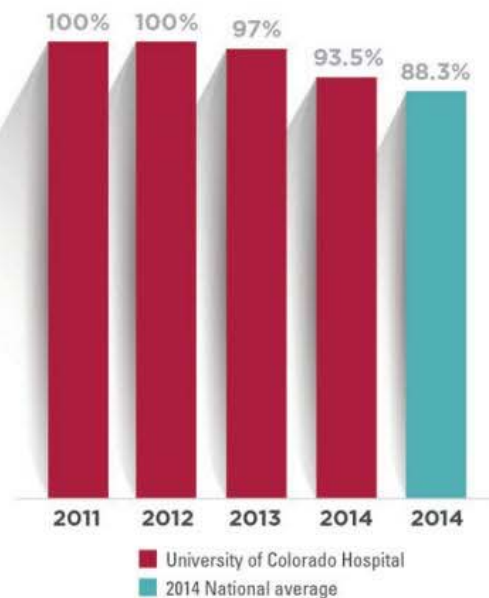
Discharged on Statin Medication



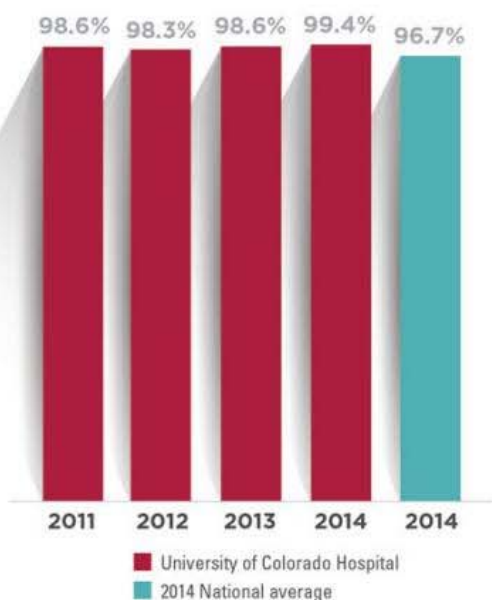
THE JOINT COMMISSION STROKE CORE MEASURE SET Stroke Education



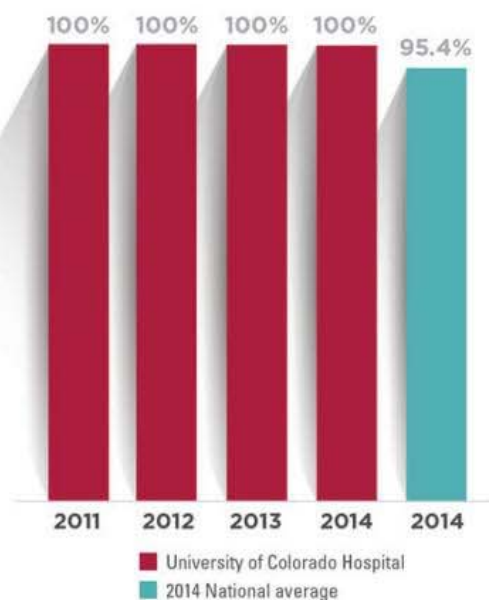
THE JOINT COMMISSION STROKE CORE MEASURE SET Thrombolytic Therapy



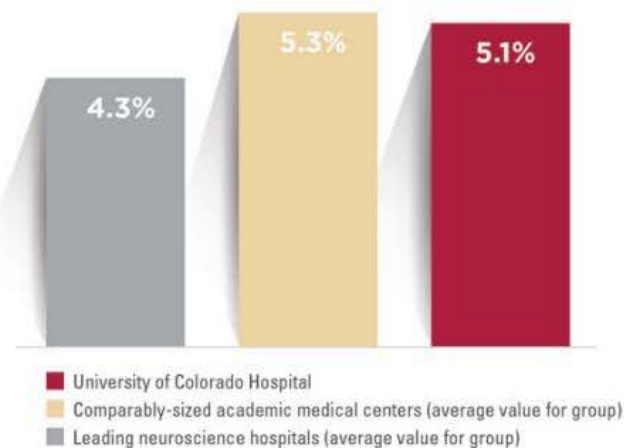
THE JOINT COMMISSION STROKE CORE MEASURE SET Venous Thromboembolism Prophylaxis



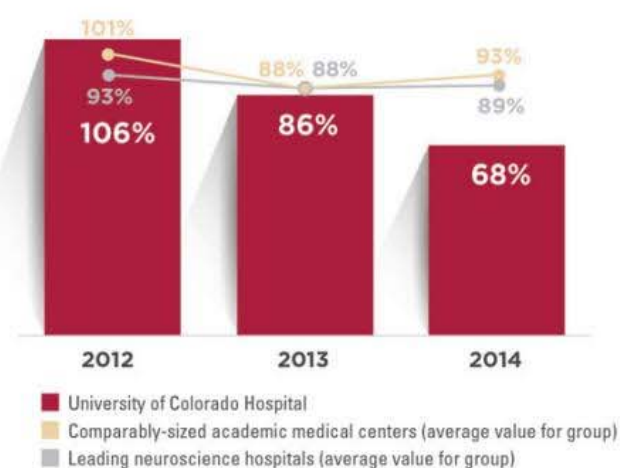
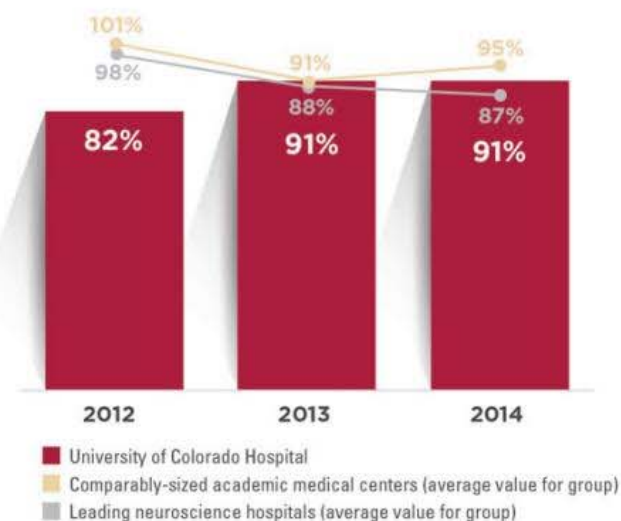
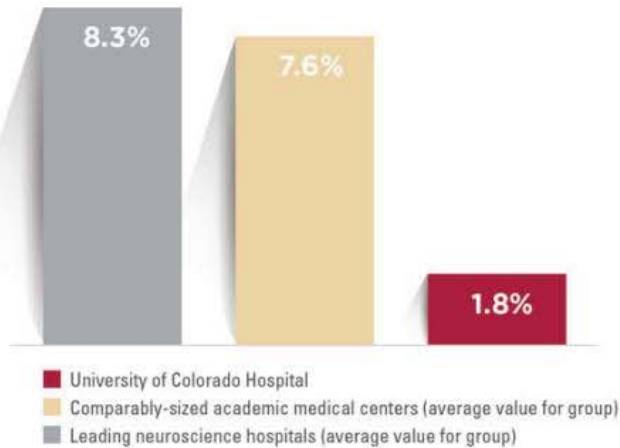
THE JOINT COMMISSION STROKE CORE MEASURE SET Anticoagulation Therapy for Atrial Fibrillation/Flutter



COMPLICATION RATES FOR ISCHEMIC STROKE TREATED WITH CAROTID ENDARTERECTOMY AND STENTING PROCEDURES



COMPLICATION RATES FOR UNRUPTURED ANEURYSMS TREATED WITH CLIPPING AND COILING PROCEDURES



Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 5/30/2015.

<https://www.uhc.edu>. Accessed 5/30/2015.

NEW ALZHEIMER'S PROGRAM HITS THE GROUND RUNNING

While the Alzheimer's Clinical and Research Program at University of Colorado Hospital doesn't yet have the longevity of some of our more established neurosciences programs, we've proven that sometimes age doesn't matter. Despite having just been established in 2012, our cognitive disorders program has already experienced explosive growth and is poised to join the ranks of institutions nationally known for neurodegenerative disease research and patient care.

In less than three years, we have met several milestones that are key to our program's success. For example, thanks to the addition of new faculty and physicians, outpatient visits by people with Alzheimer's disease, dementia or other cognitive disorders has increased 20 percent – and our capacity for new patients has increased seven-fold. This growth in volume is an important step in having patient cohorts large enough in which to initiate clinical trials.

In 2014, together with the University of Colorado School of Medicine, we filed our nearly 600-page application to become a National Institute of Aging (NIA)-funded Alzheimer's Disease Center. Today there are only 29 of these centers in the U.S., each working to translate scientific advances into better patient care and to ultimately find a cure. Our proposal includes a special focus on Alzheimer's disease within the American Indian and Latino populations.

Along these same lines, in fall 2015 we will submit our proposal to become an NIA-funded Alzheimer's Disease Core Center. These centers are designed to support and conduct research on Alzheimer's disease, provide a platform for training, develop novel techniques and methodologies, and translate these research findings into better diagnostic, prevention and treatment strategies.

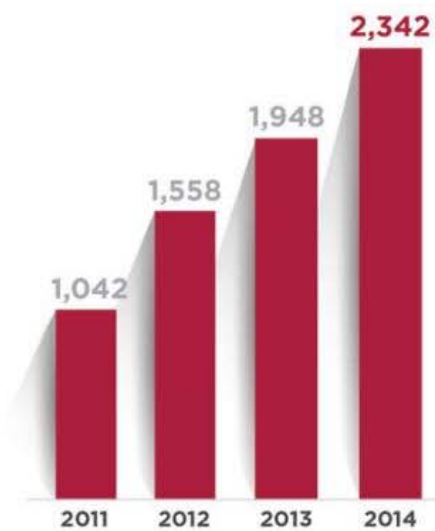
In the meantime, we have kicked off several clinical trials, including recruitment for a pioneering study that will examine the chromosomal link between Alzheimer's disease and Down syndrome. Other active research efforts include:

- » A study of the effects of granulocyte macrophage colony-stimulating factor, better known as Leukine, on patients with Alzheimer's disease. Our team will assess whether Leukine is effective in combating the microscopic clumps of protein that become tangled and ultimately destroy cognitive processes in Alzheimer's patients. Early findings in mice pre-programmed to develop Alzheimer's have shown promise.
- » An assessment of postsynaptic calcineurin signaling with regard to amyloid beta toxicity in animal models of Alzheimer's disease and in human brain samples. Our hypothesis is that a particular scaffold protein (AKAP79/150) helps amyloid beta deposits interfere with calcineurin signaling, leading to dendritic spine loss and diminished cognitive function. Should this prove true, this specific synaptic interaction could become a therapeutic target.

As we look toward 2016 and beyond, we will continue our journey of program expansion, including recruitment of new faculty and management of our behavioral neurology and neuropsychiatry fellows.



OUTPATIENT VISITS



Source: UCH Finance



EXPLORING NEW FRONTIERS IN SEIZURE DISORDERS

The Comprehensive Epilepsy Center has long been a pinnacle of the neurosciences program at University of Colorado Hospital. As a National Association of Epilepsy Centers Level 4 program, we offer a combination of diagnostic, therapeutic and support services not widely available. More importantly, our outcomes confirm that many people who come to UCH seeking care for debilitating seizures are finding relief.

In 2014 we enjoyed further program growth with the addition of new clinics for epilepsy patients who have highly specialized needs. Our clinic for women with epilepsy focuses on reproductive issues, while a second program is geared toward epilepsy patients who have neurocutaneous syndromes, including tuberous sclerosis. We also launched a program for people who suffer from psychogenic non-epileptic seizures, in collaboration with the department of psychiatry.

These new initiatives are augmented by our active and growing programs in epilepsy monitoring, surgery and neurofeedback. Highlights include:

- » More than 300 patients each year are admitted to our eight-bed, inpatient epilepsy monitoring unit. Through 24/7 video EEG surveillance, our physicians can pinpoint when and where in the brain seizures are occurring – a critical step in determining the best medical or surgical treatment options for each patient.
- » Our neurosurgeons perform the full spectrum of surgical treatments for epilepsy, including traditional and neocortical resections, and implantation of devices such as vagus nerve stimulators and NeuroPace neurostimulators. More recently we've begun placing stereotactic electrodes in the brain prior to invasive epilepsy surgery.
- » We are also one of the few academic medical centers in the country to offer EEG biofeedback. Also known as neurofeedback, this treatment method has been shown in studies to both reduce seizure frequency and improve cognitive function.

As always, we round out our program with clinical trials to evaluate promising new therapies. Some of our active studies are assessing medications for daily seizure prophylaxis or to stop seizures as they occur, while others are testing neuromodulation devices intended to better control seizures. Our physicians also are working in collaboration with neuroradiology, investigating the use of diffusion tensor tractography to predict language and memory localization in people with epilepsy.

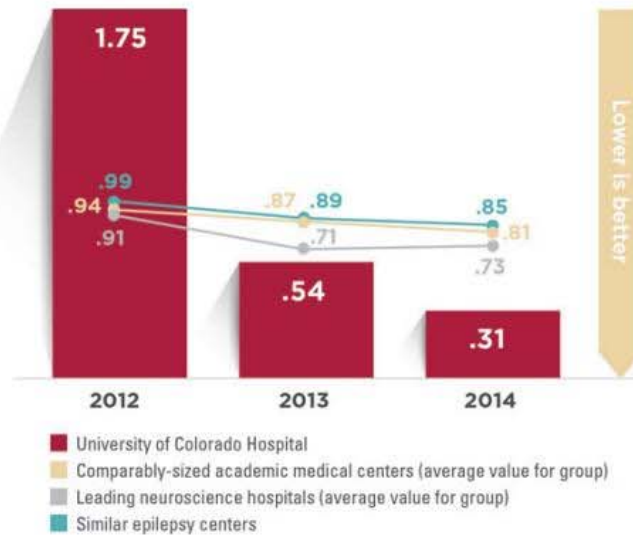
KEY 2014 METRICS

- » Our surgical patients achieved a 78 percent reduction in seizures (and no patients reported an increase in seizures).
- » Patients who did not experience full freedom from their seizures still experienced a 63 percent reduction in seizure activity.
- » Patients with refractive epilepsy surgery reported a reduction in median monthly seizure frequency from 11 to less than 1.

EMU ADMISSIONS



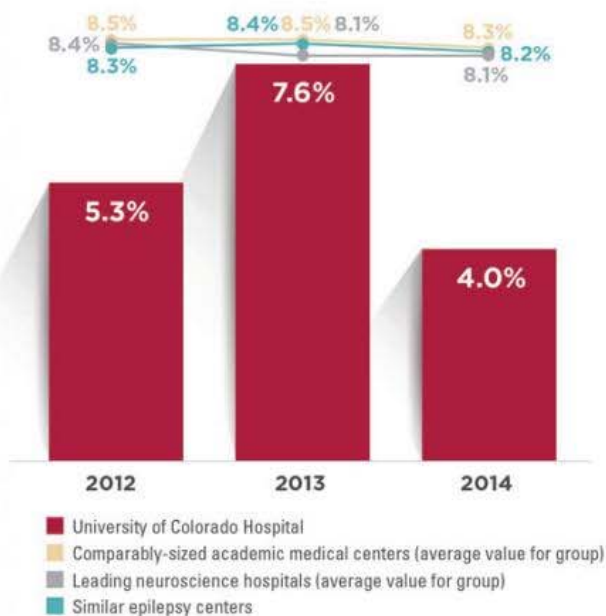
MORTALITY INDEX



Mortality index is the ratio of observed to expected mortality based on a risk adjustment algorithm. An index score of 1 indicates observed and expected mortality are equal. Values below 1 are desirable.

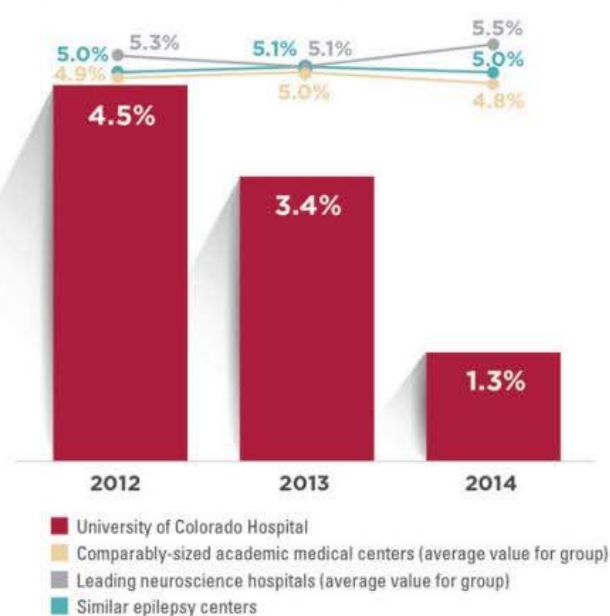
Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

30-DAY READMISSION RATES: ALL CAUSE



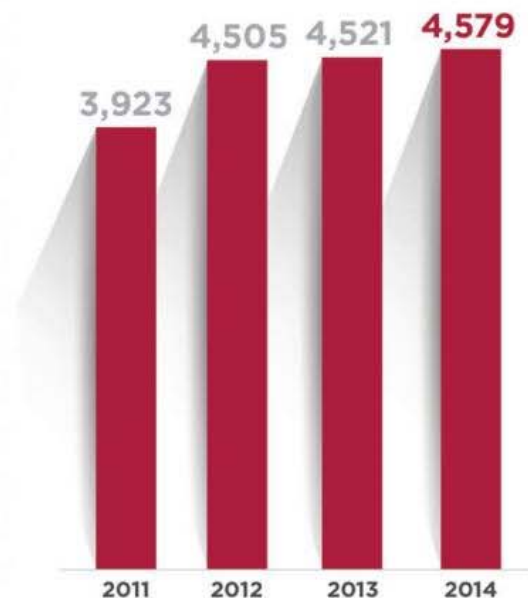
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 6/23/2015.

30-DAY READMISSION RATES: RELATED CAUSE



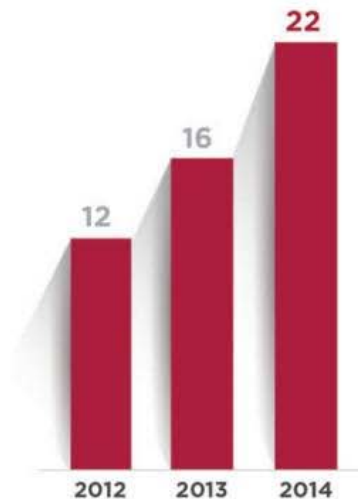
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 6/23/2015.

OUTPATIENT VISITS



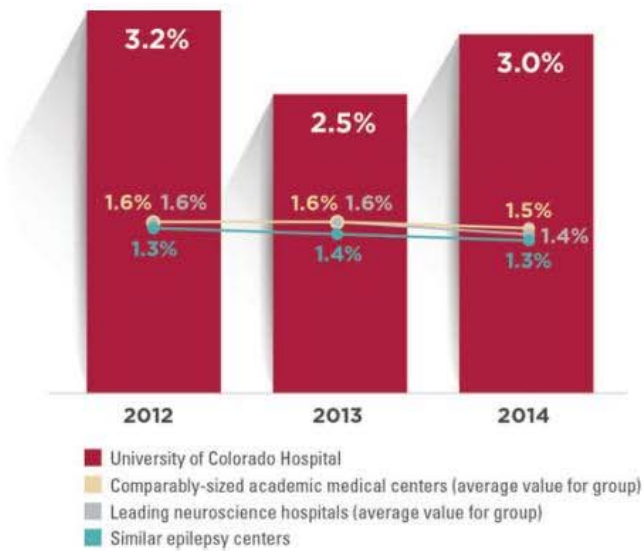
Source: UCH Finance

RESECTIVE SURGERY



Source: CU Department of Neurology

COMPLICATION RATES



Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 6/22/2015.

LENGTH OF STAY (DAYS)



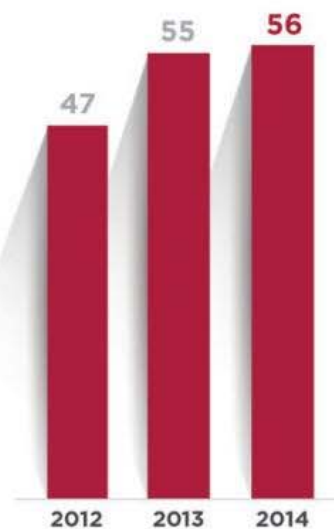
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/7/2015.

VAGAL NERVE STIMULATION (VNS) SURGERY



Source: CU Department of Neurology

EPILEPSY SURGERY



Source: CU Department of Neurology



HELPING PEOPLE STAY AHEAD OF THEIR PAIN

In an effort to better meet community need, University of Colorado Hospital launched a multidisciplinary headache center in 2012 – and we experienced strong demand right out of the gate from children and adults seeking care for disabling headaches or facial pain.

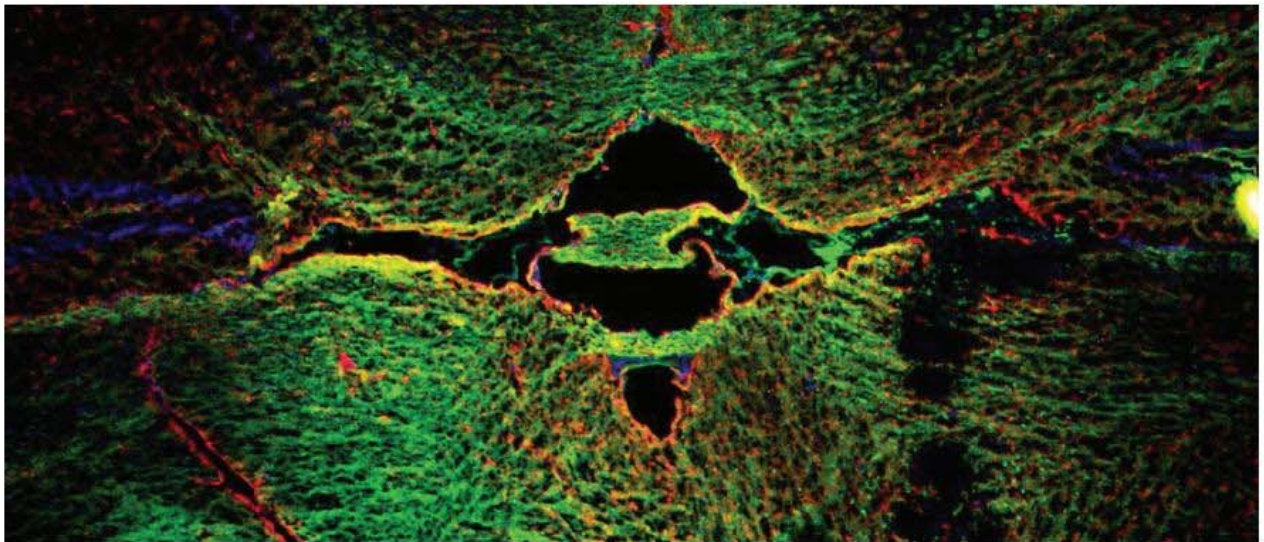
Simultaneous with program expansion - including faculty recruitment and recent approval to start an accredited fellowship program in headache medicine - great strides have already been made in clinical care, as well as research and quality-related initiatives. Highlights include:

- » Our physicians are performing sphenopalatine ganglion blocks much more easily and quickly – with far less discomfort to the patient – thanks to a relatively new device called the SphenoCath.
- » On the research side, UCH is part of a pilot study to evaluate prophylactic treatment of chronic migraine using the Cefaly device. This cranial analgesic electrotherapeutic device generates micro-impulses that stimulate the trigeminal nerve.
- » A quality improvement project that ran through 2014 found that people with migraine could successfully be treated with intravenous medication on an outpatient basis, thanks to a collaboration with UCH's infusion clinic. This allowed our patients to avoid an emergency room visit and receive the care they needed more quickly.



OFFERING PATIENTS BOTH SCIENCE AND SUPPORT

Given the complexities of treating multiple sclerosis (MS), with its wide range of symptoms, its potential to cause disability and the frequency with which patients are prone to comorbidities, it is no wonder MS research efforts are numerous and diverse.



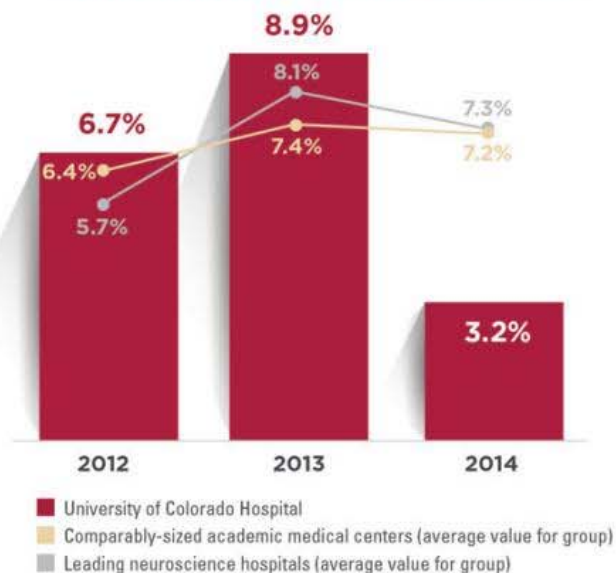
As one of the many organizations devoted to finding a cure, University of Colorado Hospital understands that research will be key to eventually stopping this terrible disease. To that end, our robust investigational efforts within the Rocky Mountain Multiple Sclerosis Center have allowed us to be designated one of only 12 Collaborative MS Research Centers in the country by the National Multiple Sclerosis Society (NMSS). In 2014 we also were accepted as one of only 12 NMSS-supported pediatric MS centers.

As usual, 2014 was a busy year for us in terms of both clinical care and research, with more than 9,000 outpatient visits and 40 active clinical and laboratory trials – including the first controlled medication trial among pediatric MS patients. Some of our most recent endeavors are summarized below:

- » Having long recognized the importance of quality-of-life scales when assessing a patient's response to therapies, our team initiated several patient-reported outcomes (PRO) studies, including an analysis of changes that occur over time between two common MS medications, Gilenya and Tysabri. Another new PRO study uses tablet devices to collect survey data within physical, mental and social domains, using NeuroQOL as a core scale. Long term, the data will allow our physicians to retrospectively study quality-of-life changes and improve clinical care.
- » We opened a NeuroNEXT study examining the safety and tolerability of Ibudilast (MN-166) in patients with progressive MS. Other new effectiveness studies include a comparative evaluation of long-term fingolimod versus glatiramer acetate on brain atrophy rates, cognition, and patient-reported outcomes, in people with MS.
- » Our neurologists have partnered with the neuroradiology team to determine the utility of making quantitative, volumetric MRI part of the standard clinical workflow for patients with MS.
- » Our team also has begun investigating whether there are biomarkers that predict how a person would respond to different medications for MS.

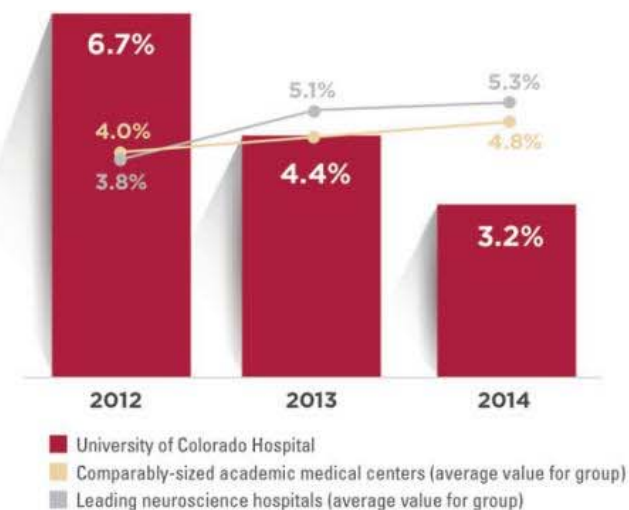
While we are passionate about our MS research efforts, we'd be remiss if we didn't highlight our philosophy about the importance of continuous, high-quality clinical care and support. Our physicians believe strongly that with early and aggressive intervention, including appropriate use of the most effective medications, the majority of MS patients can substantially reduce their risk of new inflammatory disease activity, allowing them to live productive and happy lives. Our team has helped lead the movement to promote life-long brain health among the MS population, in part by promoting health and wellness through weight reduction, smoking cessation, exercise and treatment of comorbidities.

30-DAY READMISSION RATES: ALL CAUSE



Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 7/23/2015.

30-DAY READMISSION RATES: RELATED CAUSE



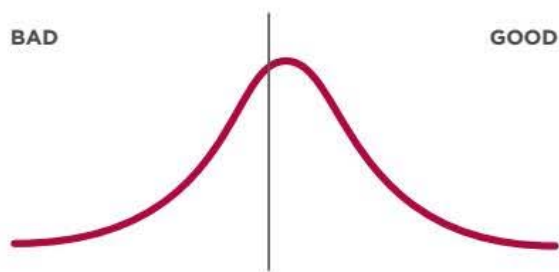
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 7/23/2015.

LENGTH OF STAY



Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 7/23/2015.

NeuroQoL UPPER EXTREMITY DISABILITY



Dept. score: 46.82. # responses: 1268. NeuroQoL mean score: 50

RENOWNED CRITICAL CARE WITH REMARKABLE RESULTS

The 24-bed neuro intensive care unit at University of Colorado Hospital is an uncommon program. It is one of only a handful of Neuro ICUs in the country, led by one of the nation's first board-certified neurointensivists, and offers one of the leading programs in the U.S. for critical care residents and neurointensivist fellows.

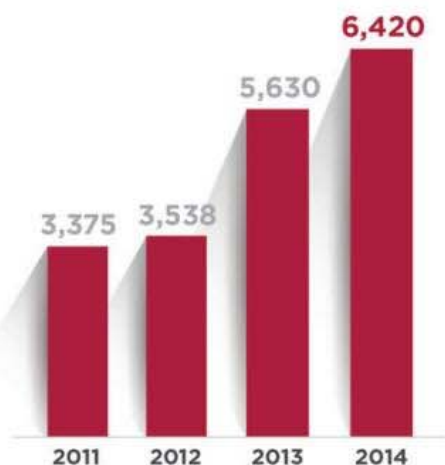
Rarer still, our Neuro ICU not only provides a level of care unmatched by most other hospitals, but at any given time our neurocritical care team is involved in 10 or more active research studies.

As evidence of our quality, our Neuro ICU was one of only seven in the country to earn a three-year Gold-level Beacon Award for Excellence from the American Association of Critical Care Nurses. This designation means we achieved the highest scores possible in five areas including outcomes and use of evidence-based practices.

Our research efforts are varied and include participation in multicenter trials as well as collaboration with other specialists across the UCHHealth system. Recent studies include:

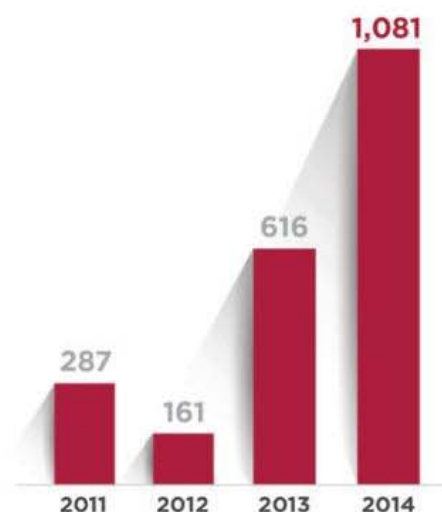
- » An examination of platelet-oriented inhibition in new transient ischemic attack and minor ischemic stroke, and intravascular cooling as part of stroke treatment.
- » A National Institutes of Health-funded assessment of neuromuscular dysfunction in critically ill patients.
- » A study of the physiological effects of intrathoracic pressure regulation in patients with decreased cerebral perfusion due to brain injury or intracranial pathology.

NEUROCRITICAL CARE UNIT PATIENT DAYS



Source: UCH finance

NEUROCRITICAL CARE UNIT ADMISSIONS



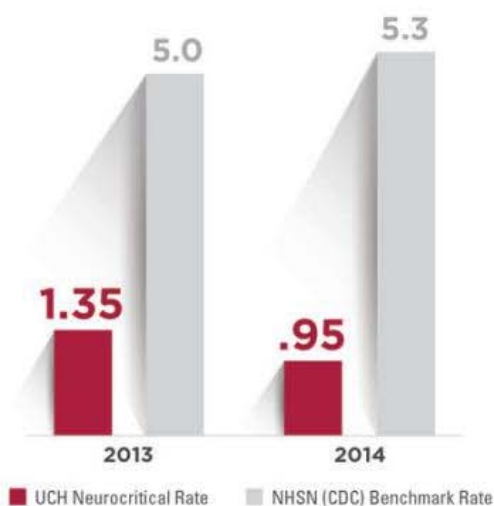
Source: UCH finance



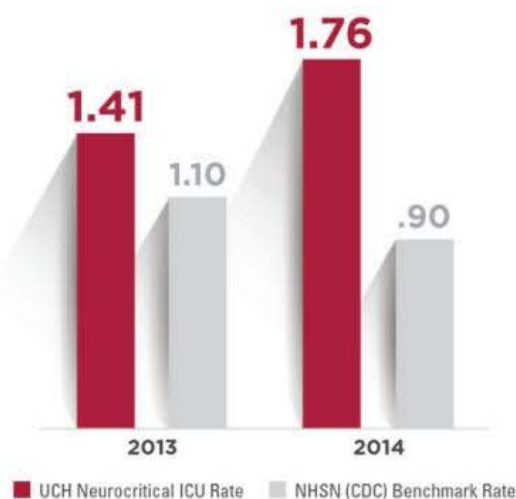
KEY 2014 METRICS

- » Our catheter-associated urinary tract infections rate of .95/1000 days was significantly lower than the national benchmark of 5.3/1000 days.
- » Compared to other U.S. teaching hospitals, our Neuro ICU scored in the 90th percentile for patient satisfaction.
- » 1,081 patients were admitted, with 6,420 bed days.

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS PER 1000 URINARY CATHETER DAYS



CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS PER 1000 LINE DAYS



Source: UCH Infection Prevention

Complications caused by catheter-associated urinary tract infection (CAUTI) cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality. CAUTI rates are expressed as the number of infections per 1000 urinary catheter days.

In 2013 and 2014, the Neurocritical Intensive Care Unit at UCH was well below the benchmark provided by the National Healthcare Safety Network (NHSN).

Source: UCH Infection Prevention

Central line-associated bloodstream infections (CLABSI) typically cause prolonged hospital stay, increased cost and risk of mortality. CLABSI rates are expressed as the number of infections per 1000 central-line days.

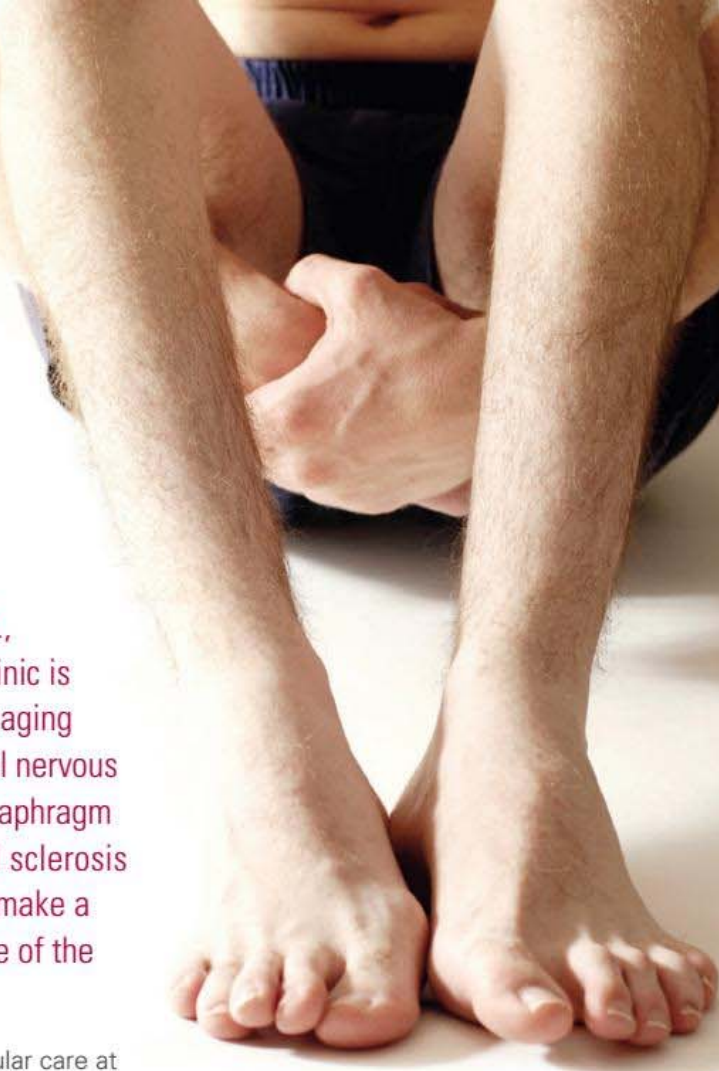
COMBATING NEUROMUSCULAR DISEASE WITH COMPASSION AND RESEARCH

As one of the oldest programs of its kind in the U.S., University of Colorado Hospital's Neuromuscular Clinic is changing lives. Whether it's by diagnosing and managing depression common among patients with peripheral nervous system disorders, or by studying the efficacy of a diaphragm pacing system in patients with amyotrophic lateral sclerosis (ALS), we are demonstrating that it is possible to make a difference – even among people afflicted with some of the most severe neuromuscular disorders.

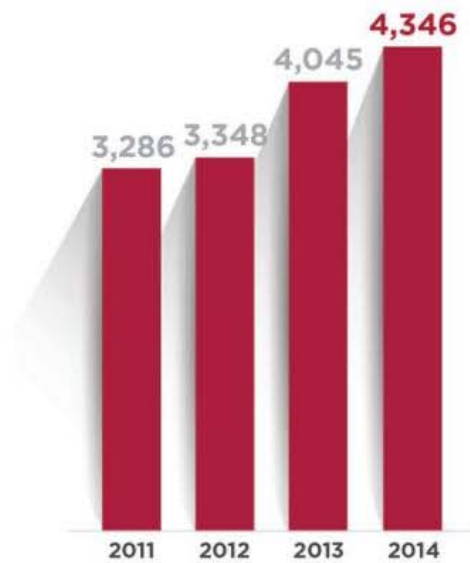
More than 1,000 new patients each year seek neuromuscular care at UCH from six surrounding states, thanks in part to our certification by the Muscular Dystrophy Association (MDA) as the only MDA/ALS program in Colorado (and one of only 42 in the country). As an active neuromuscular research center, we also are able to offer our patients access to novel therapies not widely available.

In 2014 we continued to strengthen our program through a variety of research and quality-related initiatives, including:

- » We opened a NeuroNEXT study to determine if Rituxan (rituximab) is safe and beneficial for patients with myasthenia gravis.
- » We completed enrollment in a diaphragm stimulation study among patients with ALS who have chronic hypoventilation. This post-market study is evaluating the long-term efficacy of the NeuRx Diaphragm Pacing System, which allows patients with mild to severe respiratory insufficiency to breathe normally through a self-controlled device that is implanted via minimally invasive surgery.
- » We began screening patients for the Patisiran Phase 3 study for treatment of transthyretin-mediated amyloidosis in patients with familial amyloidotic polyneuropathy.
- » We are enrolling patients in a comparative effectiveness study to determine the best treatment for painful peripheral neuropathies.
- » With an eye toward process improvement, our team engaged in a project to standardize our approach to peripheral neuropathy evaluation.



OUTPATIENT VISITS



Source: UCH finance

LENGTH OF STAY

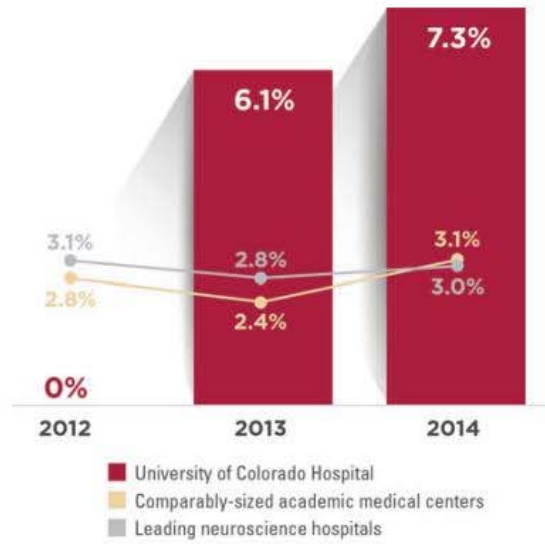


Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 7/2/2015.

KEY 2014 METRICS

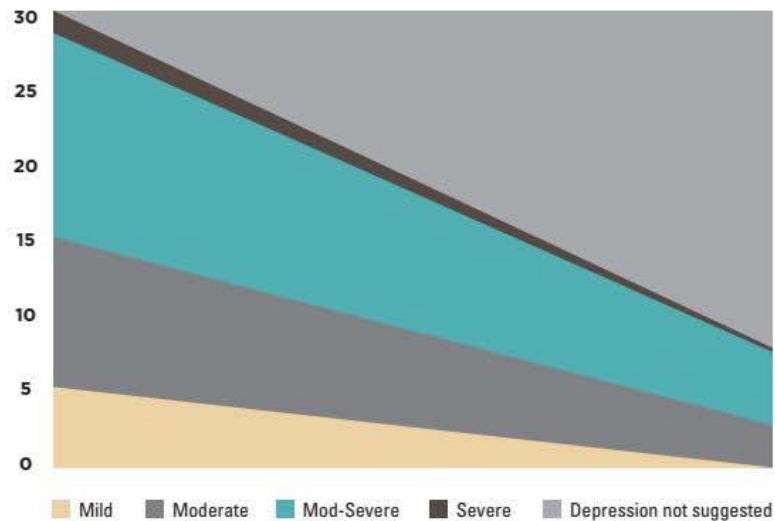
- » Based on PHQ-9 scores, 66 percent of our patients reported an improvement in their depression symptoms.
- » Our inpatient mortality index was 0.
- » UCH has the only MDA/ALS program certified by the Muscular Dystrophy Association in Colorado.

COMPLICATION RATES



Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL: UHC; 2012.
<https://www.uhc.edu>. Accessed 7/23/2015.

IMPROVEMENT IN PHQ-9 SCORES (N=31)



Source: Epic

Patients whose PHQ-9 scores initially suggested possible depressive disorder showed significant improvement. Eighty-one percent of patients (n=25) moved out of the "Depression Suggested" category with an average decrease of 5 points at 281 days follow up interval. Six patients continued to have scores suggestive of depression.



RAISING THE BAR IN NEUROIMAGING CARE

The highly specialized diagnostic services performed by our neuroradiology team at University of Colorado Hospital are essential to our goal of remaining a nationally ranked neuroscience center.

In addition to conducting more than 27,000 exams each year, including advanced functional imaging studies, our neuroradiologists have subspecialty interests that drive their clinical and translational research efforts in four key areas: multiple sclerosis (MS); acute ischemic stroke; movement disorders; and epilepsy. Recent endeavors are highlighted below.

MULTIPLE SCLEROSIS

The neuroradiology team is performing investigative work to determine the utility of making quantitative, volumetric MRI part of the standard clinical workflow for patients with MS.

Additionally, we have received two grants to investigate patient-reported outcomes among people treated with fingolimod and glatiramer acetate.

ACUTE ISHEMIC STROKE

Working in close cooperation with stroke neurologists, neurosurgeons, neuro-interventionalists and neurointensivists, our ongoing studies of interventional stroke treatments and outcomes have resulted in refined imaging and treatment methods for patients with acute ischemic stroke. These efforts have played no small part in helping UCH attain and maintain its designation as a Comprehensive Stroke Center.

MOVEMENT DISORDERS

While deep brain stimulation (DBS) has become a viable treatment option for people who are unable to manage their condition through medical therapy, some patients cannot have conventional DBS because their symptoms are so severe they are unable to undergo the required pre-operative MRI brain mapping. Our neuroradiologists and physicists have played a critical role in giving UCH patients another option: real-time, frameless MRI-guided mapping that can take place while the patient is sedated.

Additionally, our research to better understand the mechanisms of movement disorders recently showed differences in the shape of ventral striatum in different subtypes of Parkinson's disease. We are also investigating the use of diffusion tensor tractography in Parkinson's motor subtypes.

EPILEPSY

Our functional neuroimaging service is vital to helping diagnose and treat patients with epilepsy. To that end, our physicians are currently investigating the use of diffusion tensor tractography to predict language and memory localization in people with epilepsy.

ADVANCED TECHNIQUES PRESERVE MOTION AND MORE

At University of Colorado Hospital, spine surgery is rarely the first line of defense for people suffering from back pain or spine problems. But for those patients who have exhausted all other options, our Spine Center offers the right blend of neurosurgery, orthopedic surgery, and physical medicine and rehabilitation services for even the most complex cases. Even better, our clinical care is integrated with research that's driving improvement in long-term clinical functional outcomes.



Thanks in part to our status as a tertiary referral center, our surgeons perform more than 900 surgeries annually, ranging from spine micro-discectomies to sophisticated procedures that require computer-assisted, three-dimensional surgical navigation. In fact, our Spine Center is home to one of the few neurosurgeons in the country qualified to perform percutaneous lumbar endoscopic discectomy or decompression. The procedure utilizes new endoscopic hardware that allows surgeons to access the spine through transforaminal, interlaminar or posterolateral approaches.

Our physicians also are involved in a variety of research projects designed to propel new advancements in spine surgery, and to refine current techniques with an eye toward patient outcomes. Some of our current studies include:

- » Evaluating new devices and materials used in artificial disc replacement
- » Testing minimally invasive techniques for fusion of the sacroiliac joint
- » Evaluating epidural effectiveness for spinal stenosis

As an added measure of excellence, UCH is helping train the next generation of orthopedic and neurosurgical spine surgeons. Here we offer one of only 18 accredited orthopedic spine surgeries and one of 31 accredited neurosurgical spine fellowships in the country, in addition to a fellowship in pain medicine.

The UCH Spine Center team continues to advance spine care with the implementation of 3D full body spinal imaging, a rapid and low dose method to more fully assess the patient's condition. This imaging allows for viewing of the interplay of the spine, the hips and the lower limbs in a functional weight bearing position. Used in conjunction with 3D modeling and calculation of clinical parameters, and stereotactic surgical planning, more accurate and advanced surgical planning is fostered.

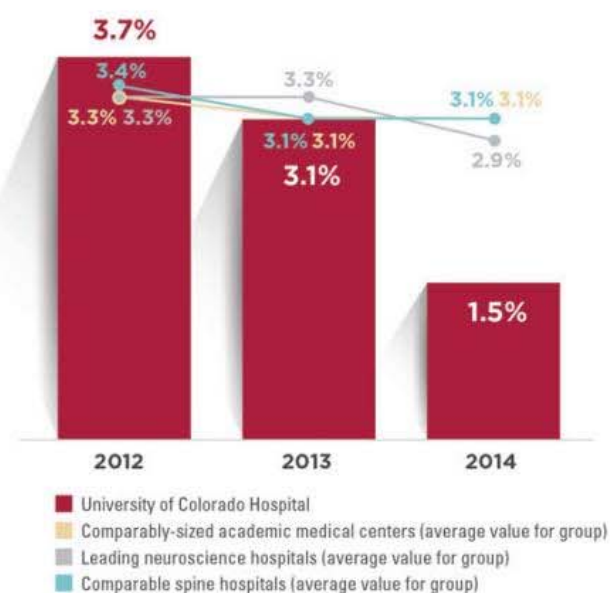
Our collective efforts have paid off – UCH continues to be the only comprehensive spine program in Colorado named a “Blue Distinction Center for Spine Surgery+” by the BlueCross BlueShield Association. This accolade confirms we meet important quality measures for patient safety and outcomes, as well as cost measures.

30-DAY READMISSION RATES: ALL CAUSE



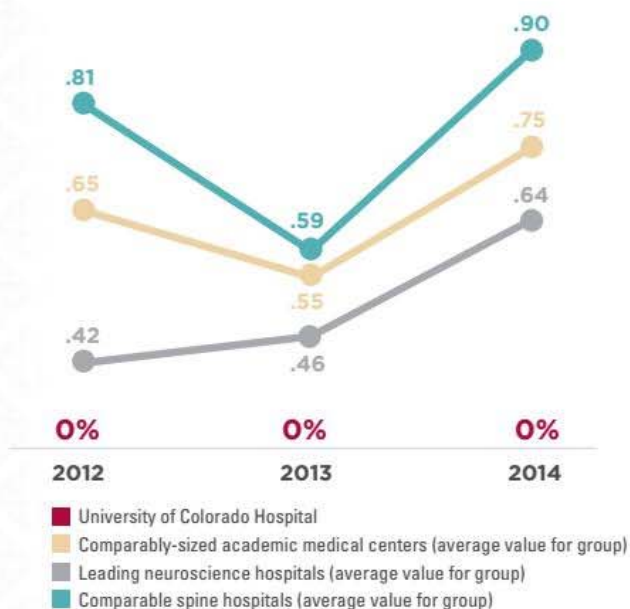
Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

30-DAY READMISSION RATES: RELATED CAUSE



Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

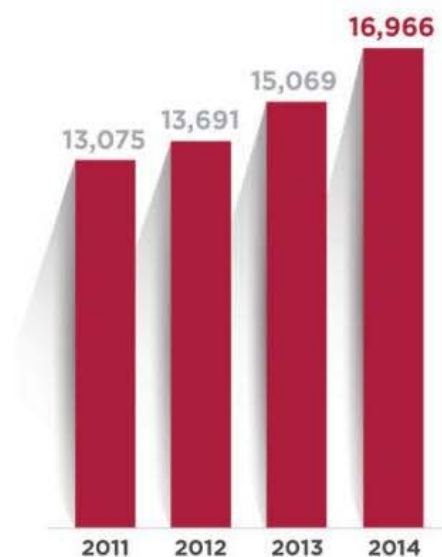
MORTALITY INDEX



Source: UHC Clinical Data Base/Resource Manager™. Chicago, IL: UHC; 2012. <https://www.uhc.edu>. Accessed 5/8/2015.

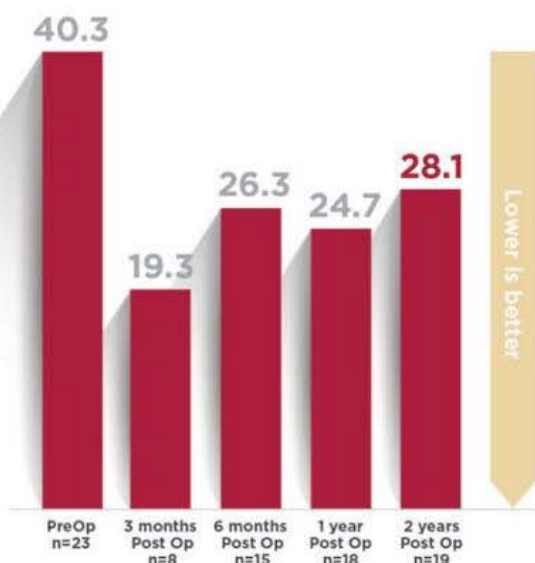
Mortality index is the ratio of observed to expected mortality based on a risk adjustment algorithm. An index score of 1 indicates observed and expected mortality are equal. Values below 1 are desirable.

OUTPATIENT VISITS



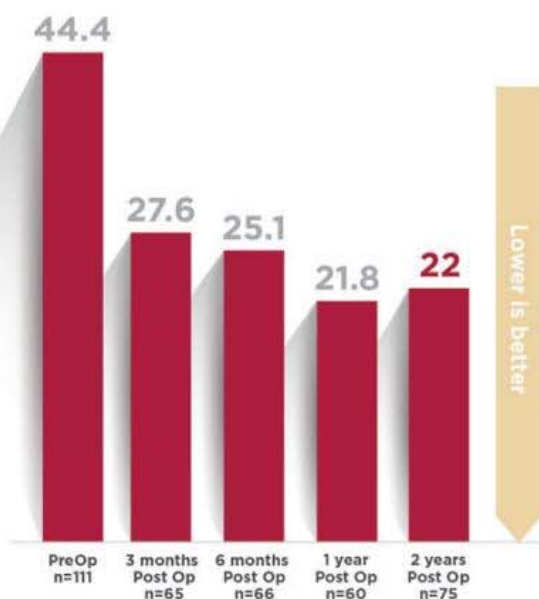
Source: UCH finance (2011-2012) and Epic query (2013-2014)

PRE AND POST OPERATIVE NECK DISABILITY INDEX (NDI) SCORE



Source: HCOL CU Spine Study

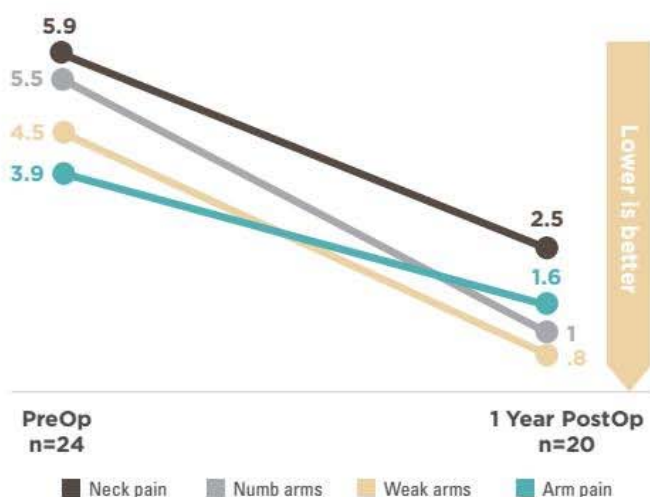
PRE AND POST OPERATIVE OSWESTRY DISABILITY INDEX (ODI) SCORE



Source: HCOL CU Spine Study

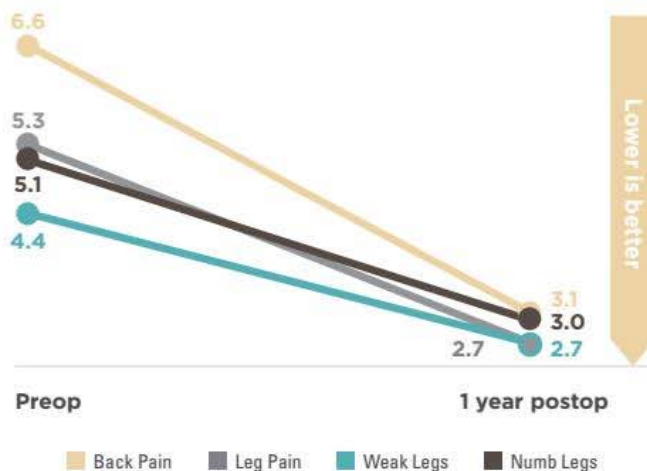
The Oswestry Disability Index (ODI) is the "gold standard" of low back functional outcome measures. Patients who had surgery at UCH between September 2011 and November 2014 showed an average ODI score reduction of 20 points after surgery; well above the minimum clinically important difference of 15 points.

PRE AND POST OPERATIVE SYMPTOM SEVERITY



Source: HCOL CU Spine Study

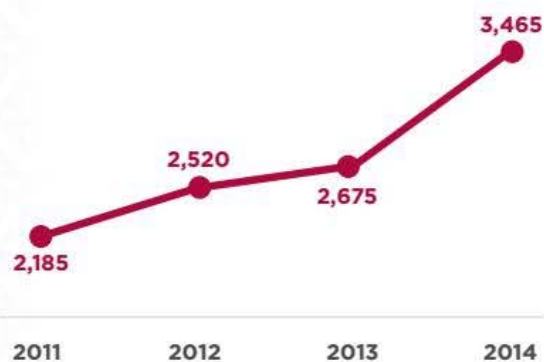
Patients were asked to rate the severity of their pain, weakness, and numbness both pre-operatively and at one year post-operatively. Using 0-10 visual analog scale where 0 means no symptom occurrence, post-operative scores improved dramatically.



Source: HCOL CU Spine Study

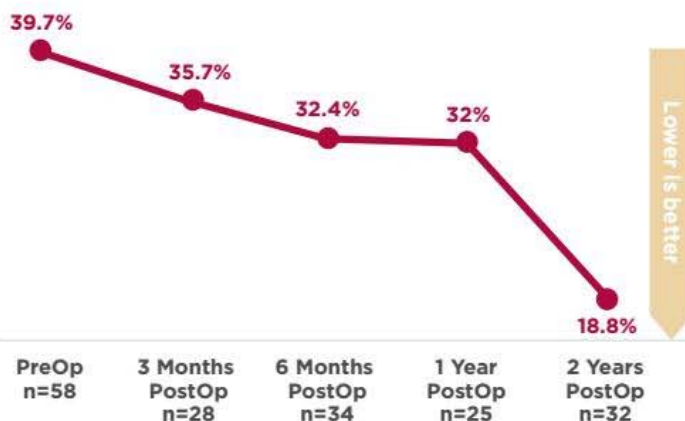
Patients were asked to rate the severity of their pain, weakness, and numbness both pre-operatively and at one year post-operatively. Using 0-10 visual analog scale where 0 means no symptom occurrence, post-operative scores improved dramatically.

OUTPATIENT PROCEDURES (EMG, Injection, Kyphoplasty, RFA)



Source: Spine Administration and IR database

PRE AND POST OPERATIVE WORK LIMITATIONS



Source: HCOL CU Spine Study

Prior to surgery, 60% of surveyed patients who were employed had been placed on limited or light duties due to their spine condition. Two years after surgery, 81% of respondents were free of work restrictions.

ZURICH CLAUDICATION QUESTIONNAIRE (ZCQ) for surgeries between 8/22/2011 and 11/6/2014



Source: HCOL CU Spine Study

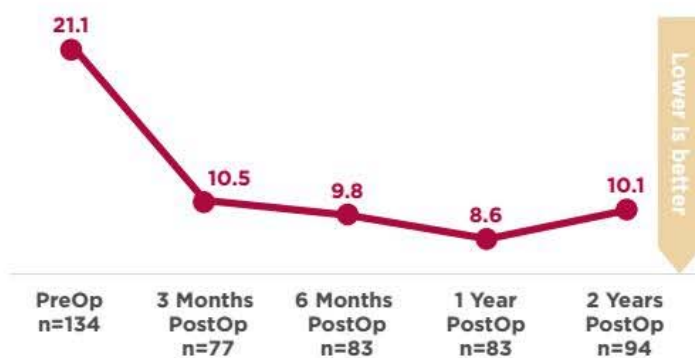
The Zurich Claudication Questionnaire (ZCQ) complements existing measures of spine-related disability and health status. The questionnaire evaluates three dimensions: symptom severity, physical function and patient satisfaction with procedure. For all dimensions, lower scores are better.

LENGTH OF STAY



Source: UHC Clinical Data Base/Resource Manager™, Chicago, IL; UHC; 2012. <https://www.uhc.edu>, Accessed 5/8/2015.

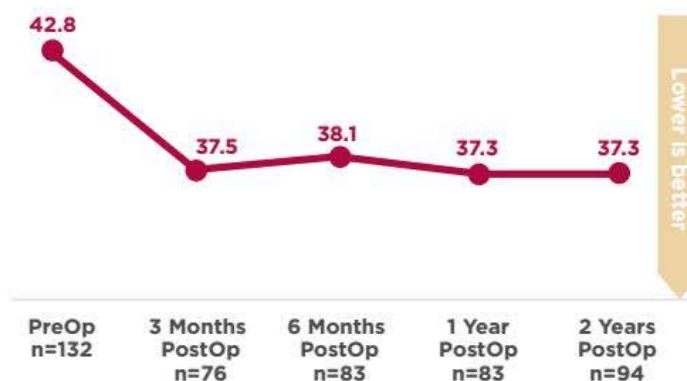
PAIN CATASTROPHIZING SCALE (PCS) for surgeries between 8/22/2011 and 11/6/2014



Source: HCOL CU Spine Study

Pain catastrophizing affects how individuals experience pain. The Pain Catastrophizing Scale (PCS) is one of the most widely used tools for measuring catastrophic thinking related to pain. A score of 30 or higher indicated a clinically relevant level of catastrophizing.

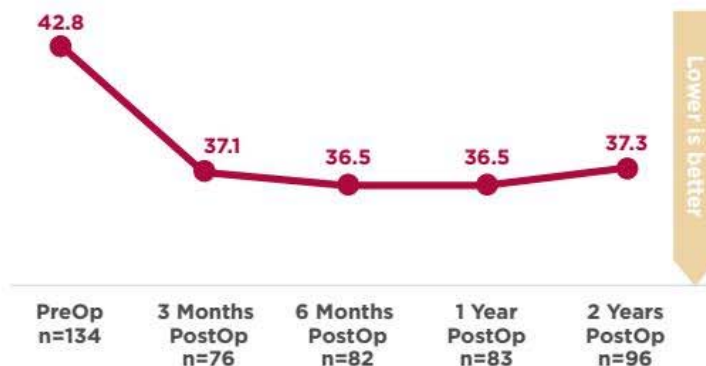
ZUNG SELF-RATING DEPRESSION SCALE (ZDS) for surgeries between 8/22/2011 and 11/6/2014



Source: HCOL CU Spine Study

The Zung Self-Rating Depression Scale (ZDS) is a self-administered survey to quantify the depressed status of a patient. There are 20 items that rate affective, psychological and somatic symptoms associated with depression. Scores at or below 44 are considered in the normal range.

TAMPA SCALE OF KINESIOPHOBIA (TSK) for surgeries between 8/22/2011 and 11/6/2014



Source: HCOL CU Spine Study

The Tampa Scale of Kinesiophobia (TSK) is a 17-item checklist that measures fear of movement and (re)injury in adults with acute and chronic low back pain, fibromyalgia, musculo-skeletal injuries and whiplash associated disorders. The total score ranges between 17 and 68, with 37 differentiating between high and low scores.

AT UCH, SCIENCE IS FOUND AT THE BEDSIDE

Those of us who chose a career in the medical field did so for a variety of reasons. Some of us are inspired by our ability to help people, while others are motivated by the noble pursuit of scientific discovery. At University of Colorado Hospital, many of our faculty have a foot in both worlds – and it is this blend of research-driven, community-focused care that differentiates us from other health care institutions.

We cannot highlight the quality of our care and our neurosciences outcomes without acknowledging the valuable clinical research we are conducting together with our academic partner, University of Colorado School of Medicine. Research, after all, is the catalyst for lifechanging advancements in medicine. And at UCH, clinical care and research are almost seamlessly integrated: our research informs patient care, and we allow patient care to inform our research.

In 2014 our Neurosciences Center received \$13.2 million in clinical research funding, and we are among the top 30 programs funded by the National Institutes of Health. At any given time we have more than 100 active clinical trials spanning all of our neuroscience subspecialties, from epilepsy and multiple sclerosis to neuroradiology and neurocritical care.

While we believe that each of our research endeavors is worthy of recognition, there are several standouts that exemplify how we are introducing innovation to the field of neurosciences – and in some cases, getting recognized for our efforts with substantial grants. In particular, we are proud of the following achievements in 2014 and 2015:

AMERICAN STROKE ASSOCIATION-BUGHER FOUNDATION GRANT

In April 2014 we were honored to activate our four-year, \$2.4 million grant from the American Stroke Association and the Bugher Foundation, called the Centers of Excellence in Stroke Collaborative Research for Regeneration, Resilience and Secondary Prevention.

This prestigious award was given to only three health care institutions in the country. While each organization is leading its own research, together we comprise a network of three centers collaborating on basic, clinical and population research. Our collective efforts will expand on previous Bugher research into recovery after stroke, including the areas of repair, regeneration, neuroplasticity and rehabilitation.

At UCH, our grant will be used to study how children recover from stroke, through the following individual but parallel research projects led by University of Colorado School of Medicine faculty:

- » Childhood Stroke Neuropsychological and Quality of Life Outcomes: Exploring Lesion-Specific Plasticity
- » Neuronal Injury and Functional Recovery Following Experimental Pediatric Arterial Ischemic Stroke
- » Glial Responses in Pediatric Stroke

Our goal is to better understand the mechanisms of injury, recovery and repair, which may shed light on how we can restore some of the brain plasticity that is lost with age. If we can learn how to alleviate the side effects of stroke, we can help return young stroke victims to long, productive lives.

PCORI-FUNDED NEUROPALLIATIVE CARE RESEARCH

In 2015, UCH received a three-year, \$1.9 million award from the Patient-Centered Outcomes Research Institute (PCORI) to study whether outpatient palliative care can improve patient-centered outcomes in people with Parkinson's disease.

As an independent nonprofit, nongovernmental organization, PCORI funds projects that meet their definition of patient-centered outcomes research, meaning they help address questions and concerns that are most relevant to patients. One of PCORI's priorities is funding projects that study the efficacy of "alternative" health care programs and services, along with their potential for sustained impact and replication.

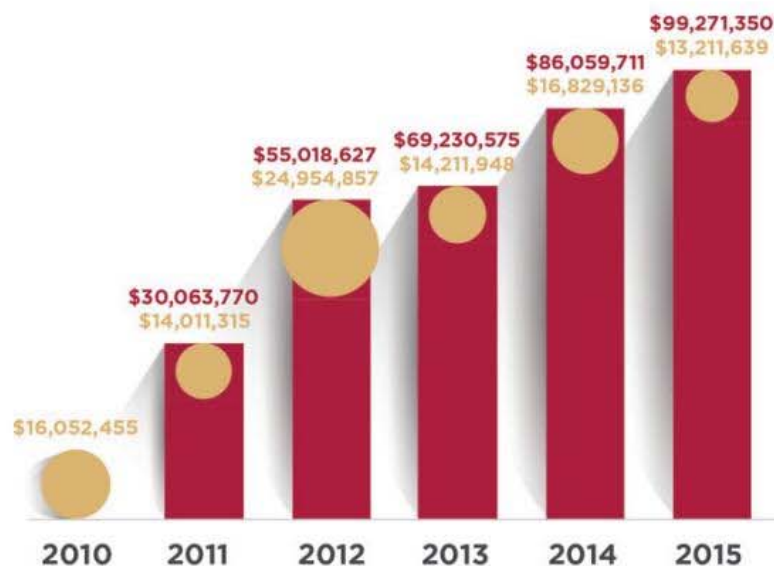
At UCH, our study will assess whether Parkinson's patients benefit from palliative care. While a small but growing group of centers now offers neuropalliative care services, there is no evidence that these programs improve outcomes among Parkinson's patients compared with standard care. There also is no agreement on which patients should be referred for these additional services, and there is significant variability in the types of services provided.

Over the next three years, our team – including an advisory panel of patients, caregivers and members of health care organizations – will fulfill the following objectives:

- » Determine whether an outpatient palliative care team improves patient quality of life and caregiver burden, compared with traditional neurology care
- » Identify which patient and caregiver characteristics best predict benefit from palliative care services
- » Interview patients and caregivers to optimize service delivery and selection

By testing the effectiveness of palliative care services among Parkinson's patients and determining who benefits most, we hope to provide a new option to assist patients who are deemed high risk for poor outcomes.

NEW AND CUMULATIVE RESEARCH FUNDS BY FISCAL YEAR



MINIATURE MICROSCOPE REVOLUTIONIZES VIEW OF THE BRAIN

UCH recently put a \$1 million grant from the National Science Foundation to good use, unveiling a tiny “deep brain” microscope developed in collaboration with scientists and bioengineers from the University of Colorado Boulder.

The current iteration of the laser-scanning microscope uses fiber-optics and a variable focus liquid lens that can quickly focus in on living tissue. These unique qualities allow researchers to see neurons firing inside a living brain, which is remarkable considering conventional microscopes penetrate only about one millimeter into the brain.

To visualize how the microscope is used, during testing the ½-inch diameter device is mounted onto the head of a mouse. A fiber-optic cord attached to the microscope is long enough to allow the mouse to roam freely, while scientists look inside its brain and record reactions to various stimuli.

As the prototype of this microscope is further refined, parts of the living brain such as the amygdala – which have been virtually off-limits to microscopes – will soon be seen in real-time, and recorded via high-resolution, 3-D images.

This ability to stimulate and measure neurons through optical methods is a major step forward in understanding brain function and disease, and offers tremendous potential for human application, including:

- » Screening pharmaceuticals designed to treat brain disorders
- » Allowing neurosurgeons to view small brain areas targeted for Parkinson’s disease treatment
- » Conducting optical, in situ, biopsies to diagnose brain tumors

More information about this microscope was published in the journal *Optics Letters* (Volume 40, Issue 11).

PROUD TO MAKE A DIFFERENCE

While other academic medical centers have experienced a decline in research funding, at UCH it is expanding – and for good reason. Our research efforts are managed by passionate and well-rounded faculty who are equal parts scientist, teacher and clinician. Together we’re making meaningful contributions to the field of neurosciences and steadily improving patient care.



NEUROLOGY

- Abosch, A. Proceedings of IEEE Engineering in Medicine and Biology Society (EMBC'15).
- Abosch, A. Proceedings of IEEE Engineering in Medicine and Biology Society (EMBC'15). Investigation of Automatically Detected High Frequency Oscillations (HFOs) As an Early Predictor of Seizure Onset Zone.
- Abosch, A. Proceedings of IEEE Engineering in Medicine and Biology Society (EMBC'15). Spatial Distribution of Nonlinear Interactions in Subthalamic Nucleus Local Field Potentials in Parkinson's Disease.
- Abosch, A. Proceedings of IEEE Engineering in Medicine and Biology Society. 2105. Intraoperative Macroelectrode Local Field Potential Recordings in Essential Tremor.
- Abosch, A. Journal of Neurology neurosurgery and Psychiatry. Anatomic correlates of deep brain stimulation electrode impedance.
- Abosch, A. J Neurosurgery. Attrition rates in neurosurgery residency: analysis of 1361 consecutive residents matched from 1990 to 1999.
- Abosch, A. Neurosurgery. In Reply: Stereotactic Microanatomy of the Nucleus Accumbens Stimulation for Obsessive-Compulsive Disorder: Reported Coordinates and Mavridis' Area.
- Alvarez E. Should we start evaluating intrathecal IgM production clinically? Eur J Neurol. 2015 Aug;22(8):1143-4.
- Ari C, Borysov SI, Wu J, Padmanabhan J, Potter H. Alzheimer amyloid beta inhibition of Eg5/kinesin 5 reduces neurotrophin and/or transmitter receptor function. Neurobiol Aging. 2014 Aug;35(8):1839-49.
- Asavapanumas N, Ratelade J, Papadopoulos MC, Bennett JL, Levin MH, Verkman AS. Experimental mouse model of optic neuritis with inflammatory demyelination produced by passive transfer of neuromyelitis optica-immunoglobulin G. J Neuroinflammation. 2014 Jan 27;11:16.
- Baird NL, Bowlin JL, Cohrs RJ, Gilden D, Jones KL. Comparison of varicella-zoster virus RNA sequences in human neurons and fibroblasts. J Virol. 2014 May;88(10):5877-80.
- Baird NL, Bowlin JL, Yu X, Jonjić S, Haas J, Cohrs RJ, Gilden D. Varicella zoster virus DNA does not accumulate in infected human neurons. Virology. 2014 Jun;458-459:1-3.
- Baird NL, Bowlin JL, Hotz TJ, Cohrs RJ, Gilden D. Interferon Gamma Prolongs Survival of Varicella-Zoster Virus-Infected Human Neurons In Vitro. J Virol. 2015 Jul 15;89(14):7425-7.
- Beauchamp, K. Pediatric Neurosurgery. Packing to Tamponade Severe Intracranial Hemorrhage in Pediatric Patients.
- Bennett JL, O'Connor KC, Bar-Or A, Zamvil SS, Hemmer B, Tedder TF, von Büdingen HC, Stuve O, Yeaman MR, Smith TJ, Stadelmann C. B lymphocytes in neuromyelitis optica. Neurol Neuroimmunol Neuroinflamm. 2015 Jun;2(3):e104.
- Bennett JL, de Seze J, Lana-Peixoto M, Palace J, Waldman A, Schippling S, Tenembaum S, Banwell B, Greenberg B, Levy M, Fujihara K, Chan KH, Kim HJ, Asgari N, Sato DK, Saiz A, Wuerfel J, Zimmermann H, Green A, Villoslada P, Paul F; GJCFC&BR. Neuromyelitis optica and multiple sclerosis: Seeing differences through optical coherence tomography. Mult Scler. 2015 May;21(6):678-88.
- Berman BD, Hallett M, Herscovitch P, Simonyan K. Striatal dopaminergic dysfunction at rest and during task performance in writer's cramp. Brain. 2013 Dec;136(Pt 12):3645-58.
- Berman BD, Jinnah HA. Dystonia: Five new things. Neurol Clin Pract. 2015 Jun;5(3):232-240.
- Birlea M, Nagel MA, Khmeleva N, Choe A, Kleinschmidt-Demasters B, Hevner R, Boyer P, Lear-Kaul KC, Bos N, Wellish M, Cohrs RJ, Gilden D. Varicella-zoster virus trigeminal ganglionitis without rash. Neurology. 2014 Jan 7;82(1):90-2.
- Birlea M, Cohrs RJ, Bos N, Mehta SK, Pierson DL, Gilden D. Search for varicella zoster virus DNA in saliva of healthy individuals aged 20-59 years. J Med Virol. 2014 Feb;86(2):360-2.
- Boersma I, Miyasaki J, Kutner J, Kluger B. Palliative care and neurology: time for a paradigm shift. Neurology. 2014 Aug 5;83(6):561-7.
- Brück W, Vollmer T. Multiple sclerosis: Oral laquinimod for MS—bringing the brain into focus. Nat Rev Neurol. 2013 Dec;9(12):664-5.
- Bubak AN, Redmond DE Jr, Elsworth JD, Roth RH, Collier TJ, Bjugstad KB, Blanchard BC, Sladek JR Jr. A potential compensatory role for endogenous striatal tyrosine hydroxylase-positive neurons in a nonhuman primate model of Parkinson's disease. Cell Transplant. 2015;24(4):673-80.
- Calabresi PA, Radue EW, Goodin D, Jeffery D, Rammohan KW, Reder AT, Vollmer T, Agius MA, Kappos L, Stites T, Li B, Capiello L, von Rosenstiel P, Lublin FD. Safety and efficacy of fingolimod in patients with relapsing-remitting multiple sclerosis (FREEDOMS II): a double-blind, randomised, placebo-controlled, phase 3 trial. Lancet Neurol. 2014 Jun;13(6):545-56.
- Campbell JD, Ghushchyan V, Brett McQueen R, Cahoon-Metzger S, Livingston T, Vollmer T, Corboy J, Miravalle A, Schreiner T, Porter V, Nair K. Burden of multiple sclerosis on direct, indirect costs and quality of life: National US estimates. Mult Scler Relat Disord. 2014 Mar;3(2):227-36.
- Carlson JA, Reddy K, Gaspar LE, Ney D, Kavanagh BD, Damek D, Lillehei K, Chen C. Hypofractionated-intensity modulated radiotherapy (hypo-IMRT) and temozolomide (TMZ) with or without bevacizumab (BEV) for newly diagnosed glioblastoma multiforme (GBM): a comparison of two prospective phase II trials. J Neurooncol. 2015 Jun;123(2):251-7.
- Cava, L. Journal of Critical Care. Continuous Infusion versus Intermittent Vancomycin in Neurosurgical ICU.
- Chatterjee D, Addya S, Khan RS, Kenyon LC, Choe A, Cohrs RJ, Shindler KS, Sarma JD. Mouse hepatitis virus infection upregulates genes involved in innate immune responses. PLoS One. 2014;9(10):e111351.
- Cheng-Ching E, Jones S, Hui FK, Man S, Gilden D, Bhimraj A, Uchino K. High-resolution MRI vessel wall imaging in varicella zoster virus vasculopathy. J Neurol Sci. 2015 Apr 15;351(1-2):168-73.
- Clarke P, Leser JS, Quick ED, Dionne KR, Beckham JD, Tyler KL. Death receptor-mediated apoptotic signaling is activated in the brain following infection with West Nile virus in the absence of a peripheral immune response. J Virol. 2014 Jan;88(2):1080-9.
- Clarke P, Leser JS, Bowen RA, Tyler KL. Virus-induced transcriptional changes in the brain include the differential expression of genes associated with interferon, apoptosis, interleukin 17 receptor A, and glutamate signaling as well as flavivirus-specific upregulation of tRNA synthetases. MBio. 2014 Mar 11;5(2):e00902-14.
- Cohrs RJ, Gilden D. 2013 Colorado alphaherpesvirus latency symposium. J Neurovirol. 2013 Dec;19(6):610-7.
- Corser-Jensen CE, Goodell DJ, Freund RK, Serbedzija P, Murphy RC, Farias SE, Dell'Acqua ML, Frey LC, Serkova N, Heidenreich KA.

- Blocking leukotriene synthesis attenuates the pathophysiology of traumatic brain injury and associated cognitive deficits. *Exp Neurol*. 2014 Jun;256:7-16.
- Cumbler EU, Simpson JR, Rosenthal LD, Likosky DJ. Inpatient Falls: Defining the Problem and Identifying Possible Solutions. Part II: Application of Quality Improvement Principles to Hospital Falls. *Neurohospitalist*. 2013 Oct;3(4):203-8.
- Damek DM. Leptomenigeal enhancement in a 58-year-old woman. *Oncology (Williston Park)*. 2014 May;28(5):438, 440.
- Dilli CR, Childs R, Berk J, Christian MK, Nguyen N, Brown RP, Kluger BM. Does prior acupuncture exposure affect perception of blinded real or sham acupuncture? *Acupunct Med*. 2014 Apr;32(2):155-9.
- Enduri S, Taylor MR, Liewluck T. Clinical reasoning: a 52-year-old woman with progressive proximal weakness. *Neurology*. 2014 Sep 2;83(10):e106-9.
- Fang JY, Pérez A, Christine CW, Leehey M, Aminoff MJ, Boyd JT, Morgan JC, Dhall R, Nicholas AP, Bodis-Wollner I, Zweig RM, Goudreau JL; NINDS NET-PD Investigators. Parkinson's disease severity and use of dopaminergic medications. *Parkinsonism Relat Disord*. 2015 Mar;21(3):297-9.
- Fenoglio C, Ridolfi E, Cantoni C, De Riz M, Bonsi R, Serpente M, Villa C, Pietroboni AM, Naismith RT, Alvarez E, Parks BJ, Bresolin N, Cross AH, Piccio LM, Galimberti D, Scarpini E. Decreased circulating miRNA levels in patients with primary progressive multiple sclerosis. *Mult Scler*. 2013 Dec;19(14):1938-42.
- Filley CM, Bernick C. Children and football: a cautionary tale. *Neurology*. 2015 Mar 17;84(11):1068-9.
- Filley CM, Brown MS, Onderko K, Ray M, Bennett RE, Berry-Kravis E, Grigsby J. White matter disease and cognitive impairment in FMR1 premutation carriers. *Neurology*. 2015 May 26;84(21):2146-52.
- Finseth TA, Hedeman JL, Brown RP 2nd, Johnson KI, Binder MS, Kluger BM. Self-reported efficacy of cannabis and other complementary medicine modalities by Parkinson's disease patients in Colorado. *Evid Based Complement Alternat Med*. 2015;2015:874849.
- Forrest KM, Foulds N, Millar JS, Sutherland PD, Pappachan VJ, Holden S, Mein R, Hopkins PM, Jungbluth H. RYR1-related malignant hyperthermia with marked cerebellar involvement - a paradigm of heat-induced CNS injury? *Neuromuscul Disord*. 2015 Feb;25(2):138-40.
- Frey L, Lepkin A, Schickedanz A, Huber K, Brown MS, Serkova N. ADC mapping and T1-weighted signal changes on post-injury MRI predict seizure susceptibility after experimental traumatic brain injury. *Neurol Res*. 2014 Jan;36(1):26-37.
- Fridman V, Oaklander AL, David WS, Johnson EA, Pan J, Novak P, Brown RH Jr, Eichler FS. Natural history and biomarkers in hereditary sensory neuropathy type 1. *Muscle Nerve*. 2015 Apr;51(4):489-95.
- Geis C, Ritter C, Ruschil C, Weishaupt A, Grünwald B, Stoll G, Holmoy T, Misu T, Fujihara K, Hemmer B, Stadelmann C, Bennett JL, Sommer C, Toyka KV. The intrinsic pathogenic role of autoantibodies to aquaporin 4 mediating spinal cord disease in a rat passive-transfer model. *Exp Neurol*. 2015 Mar;265:8-21.
- Ghaffari BD, Kluger B. Mechanisms for alternative treatments in Parkinson's disease: acupuncture, tai chi, and other treatments. *Curr Neurol Neurosci Rep*. 2014 Jun;14(6):451.
- Gilden D. Association of varicella zoster virus with giant cell arteritis. *Monoclon Antib Immunodiagn Immunother*. 2014 Jun;33(3):168-72.
- Gilden D, Nagel MA, Cohrs RJ. Varicella-zoster. *Handb Clin Neurol*. 2014;123:265-83.
- Gilden D, Schiffmann R. Leukoencephalopathy: "Before concluding treatment efficacy..." *Neurology*. 2015 Jan 20;84(3):218-9.
- Gilden D, White T, Khmeleva N, Heintzman A, Choe A, Boyer PJ, Grose C, Carpenter JE, Rempel A, Bos N, Kandasamy B, Lear-Kaul K, Holmes DB, Bennett JL, Cohrs RJ, Mahalingam R, Mandava N, Eberhart CG, Bockelman B, Poppiti RJ, Tamhankar MA, Fogt F, et al. Prevalence and distribution of VZV in temporal arteries of patients with giant cell arteritis. *Neurology*. 2015 May 12;84(19):1948-55.
- Gilden D, White T, Galetta SL, Fogt F, Nagel MA. Widespread arterial infection by varicella-zoster virus explains refractory giant cell arteritis. *Neurol Neuroimmunol Neuroinflamm*. 2015 Aug;2(4):e125.
- Gilden D. Hilary Koprowski, MD, 5 December 1916-11 April 2013. *J Infect Dis*. 2015 Jul 15;212 Suppl 1:S2-4.
- Gilden D, Nagel M. Varicella Zoster Virus in Temporal Arteries of Patients With Giant Cell Arteritis. *J Infect Dis*. 2015 Jul 15;212 Suppl 1:S37-9.
- Gilden D, Lieberman P. Memories and Vignettes From Friends of Hilary Koprowski. *J Infect Dis*. 2015 Jul 15;212 Suppl 1:S5-S11.
- Golas L, Bennett JL, White TM, Skarf B, Lesser R, Nagel MA, Gilden D. Varicella Zoster Virus in Ischemic Optic Neuropathy. *Ophthalmology*. 2015 Jun 5.
- Goldman JG, Holden S, Bernard B, Ouyang B, Goetz CG, Stebbins GT. Defining optimal cutoff scores for cognitive impairment using Movement Disorder Society Task Force criteria for mild cognitive impairment in Parkinson's disease. *Mov Disord*. 2013 Dec;28(14):1972-9.
- Goldman JG, Holden S. Treatment of psychosis and dementia in Parkinson's disease. *Curr Treat Options Neurol*. 2014 Mar;16(3):281.
- Goldman JG, Holden S, Ouyang B, Bernard B, Goetz CG, Stebbins GT. Diagnosing PD-MCI by MDS Task Force criteria: how many and which neuropsychological tests? *Mov Disord*. 2015 Mar;30(3):402-6.
- Goodwin TJ, McCarthy M, Cohrs RJ, Kaufer BB. 3D tissue-like assemblies: A novel approach to investigate virus-cell interactions. *Methods*. 2015 May 15.
- Graner, M. J Extracell Vesicles. Biological properties of extracellular vesicles and their physiological functions.
- Graner, M. Front Oncol. Endoplasmic reticulum chaperones and their roles in the immunogenicity of cancer vaccines.
- Graner, M. Mol Cell Proteomics. A novel tuberculosis antigen identified from human tuberculosis granulomas.
- Graner, M. J Control Release. Biodistribution and delivery efficiency of unmodified tumor-derived exosomes.
- Hall D, Todorova-Koteva K, Pandya S, Bernard B, Ouyang B, Walsh M, Pounardjian T, Deburghraeve C, Zhou L, Losh M, Leehey M, Berry-Kravis E. Neurological and Endocrine Phenotypes of Fragile X Carrier Women. *Clin Genet*. 2015 Jul 25.
- Hall DA, Birch RC, Anheim M, Jøneh AE, Pintado E, O'Keefe J, Trollor JN, Stebbins GT, Hagerman RJ, Fahn S, Berry-Kravis E, Leehey MA. Emerging topics in FXTAS. *J Neurodev Disord*. 2014;6(1):31.
- Handler, M. Journal of Neurosurgery: Pediatrics. Routine Perioperative Ketorolac Administration is Not Associated with Hemorrhage in Pediatric Neurosurgery Patients.
- Handler, M. Neurosurgery. Pediatric low-grade ganglioglioma: epidemiology, treatments, and outcome analysis on 348 children from the surveillance, epidemiology, and end results database.
- Handler, M. J Neurooncol. Pediatric choroid plexus tumors: epidemiology, treatments, and outcome analysis on 202 children from the SEER database.
- Handler, M. Acta Neuropathol Commun. Identification of targets for rational pharmacological therapy in childhood craniopharyngioma.

Handler, M. *Cancer Immunol Res.* Interleukin-6/STAT3 pathway signaling drives an inflammatory phenotype in Group A ependymoma.

Handler, M. *Lancet.* A cervical spine mass caused by *Onchocerca lupi*.

Hankinson, T. *Journal of Neurosurgery: Pediatrics.* Routine Perioperative Ketorolac Administration is Not Associated with Hemorrhage in Pediatric Neurosurgery Patients.

Hankinson, T. *Neurosurgery.* Pediatric low-grade ganglioglioma: epidemiology, treatments, and outcome analysis on 348 children from the surveillance, epidemiology, and end results database.

Hankinson, T. *Journal of neurosurgery-pediatrics.* Operative management of traumatic cervical spine distraction and complete cord transection in a 3-year-old patient.

Hankinson, T. *J Neurooncology.* Pediatric choroid plexus tumors: epidemiology, treatments, and outcome analysis on 202 children from the SEER database.

Hankinson, T. *Acta Neuropathol Commun.* Identification of targets for rational pharmacological therapy in childhood craniopharyngioma.

Hampton CW, Galperin D, Alvarez E, West MS. Encephalomyeloneuropathy with CRMP-5 antibodies in a patient with a primary mediastinal serinoma. *Neurol Neuroimmunol Neuroinflamm.* 2015 Jun;2(3):e82.

Hildreth KL, Van Pelt RE, Moreau KL, Grigsby J, Hoth KF, Pelak V, Anderson CA, Parnes B, Kittelson J, Wolfe P, Nakamura T, Linnebur SA, Trujillo JM, Aquilante CL, Schwartz RS. Effects of pioglitazone or exercise in older adults with mild cognitive impairment and insulin resistance: a pilot study. *Dement Geriatr Cogn Dis Extra.* 2015 Jan-Apr;5(1):51-63.

Hudak ML, Graves A, Reichelt KA, Sweigart J, Harry E, Glasheen J, Jones W, Cumbler E. What makes a positive deviant: utilizing common themes in best practice stroke hospitals to influence institutional quality improvement. *Am J Med Qual.* 2014 Mar-Apr;29(2):170.

James SF, Traina-Dorge V, Deharo E, Wellish M, Palmer BE, Gilden D, Mahalingam R. T cells increase before zoster and PD-1 expression increases at the time of zoster in immunosuppressed nonhuman primates latently infected with simian varicella virus. *J Neurovirol.* 2014 Jun;20(3):309-13.

Kennedy PG, Rovnak J, Badani H, Cohrs RJ. A Comparison of HSV-1 and VZV Latency and Reactivation. *J Gen Virol.* 2015 Mar 20.

Kennel C, Michas-Martin A, Berman BD, Poisson S. Non convulsive status epilepticus masquerading as stroke. *Am J Emerg Med.* 2015 Mar;33(3):482.e1-2.

Kittelson AJ, Thomas AC, Kluger BM, Stevens-Lapsley JE. Corticospinal and intracortical excitability of the quadriceps in patients with knee osteoarthritis. *Exp Brain Res.* 2014 Dec;232(12):3991-9.

Kleinschmidt-DeMasters BK, West M. CLIPPERS with chronic small vessel damage: more overlap with small vessel vasculitis? *J Neuropathol Exp Neurol.* 2014 Mar;73(3):262-7.

Kluger B, Triolo P, Jones W, Jankovic J. The therapeutic potential of cannabinoids for movement disorders. *Mov Disord.* 2015 Mar;30(3):313-27.

Kowarik MC, Soltys J, Bennett JL. The treatment of neuromyelitis optica. *J Neuroophthalmol.* 2014 Mar;34(1):70-82.

Kowarik MC, Dzieciatkowska M, Wemlinger S, Ritchie AM, Hemmer B, Owens GP, Bennett JL. The cerebrospinal fluid immunoglobulin transcriptome and proteome in neuromyelitis optica reveals central nervous system-specific B cell populations. *J Neuroinflammation.* 2015 Jan 28;12:19.

Kremer S, Renard F, Achard S, Lana-Peixoto MA, Palace J, Asgari N, Klawiter EC, Tenembaum SN, Banwell B, Greenberg BM, Bennett JL, Levy M, Villoslada P, Saiz A, Fujihara K, Chan KH, Schippling S, Paul F, Kim HJ, de Seze J, Wuerfel JT, Guthy-Jackson Charitable Foundation (GJCF) Neuromyelitis Optica (NMO) International Clinical Consortium and Biorepository, et al. Use of Advanced Magnetic Resonance Imaging Techniques in Neuromyelitis Optica Spectrum Disorder. *JAMA Neurol.* 2015 Jul 1;72(7):815-22.

Lafosse JM, Mitchell SM, Corboy JR, Filley CM. The nature of verbal memory impairment in multiple sclerosis: a list-learning and meta-analytic study. *J Int Neuropsychol Soc.* 2013 Oct;19(9):995-1008.

Lampe E, Forster J, Herbst E, Spitz M, Frey L. Pre-admission clinical factors affect length of stay in the epilepsy monitoring unit. *Neurodiagn J.* 2014 Jun;54(2):138-47.

Larsen DP, Butler AC, Aung WY, Corboy JR, Friedman DI, Sperling MR. The effects of test-enhanced learning on long-term retention in AAN annual meeting courses. *Neurology.* 2015 Feb 17;84(7):748-54.

Leppert MH, Campbell JD, Simpson JR, Burke JF. Cost-Effectiveness of Intra-Arterial Treatment as an Adjunct to Intravenous Tissue-Type Plasminogen Activator for Acute Ischemic Stroke. *Stroke.* 2015 Jul;46(7):1870-6.

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

Liewluck T, Klein CJ, Jones LK Jr. Cramp-fasciculation syndrome in patients with and without neural autoantibodies. *Muscle Nerve.* 2014 Mar;49(3):351-6.

Liewluck T, Milone M, Mauermann ML, Castro-Couch M, Cerhan JH, Murthy NS. A novel VCP mutation underlies scapuloperoneal muscular dystrophy and dropped head syndrome featuring lobulated fibers. *Muscle Nerve.* 2014 Aug;50(2):295-9.

Liewluck T, Tian X, Wong LJ, Pestronk A. Dystrophinopathy mimicking metabolic myopathies. *Neuromuscul Disord.* 2015 Aug;25(8):653-7.

Liewluck T, Miravalle A. Immune-Mediated Neurological Disorders. *Curr Neurol Neurosci Rep.* 2015 Sep;15(9):581.

Lillehei, L. *World Neurosurgery.* Unilateral Tailored Fronto-Orbital Approach for Giant Olfactory Groove Meningiomas: Technical Nuances.

Lillehei, L. *J Neurooncology.* Hypofractionated-intensity modulated radiotherapy (hypo-IMRT) and temozolomide (TMZ) with or without bevacizumab (BEV) for newly diagnosed glioblastoma multiforme (GBM): a comparison of two prospective phase II trials.

Lillehei, L. *J Neurooncology.* Phase II trial of hypofractionated intensity-modulated radiation therapy combined with temozolomide and bevacizumab for patients with newly diagnosed glioblastoma.

Lillehei, L. *Mol Endocrinol.* Mammalian Ste20-like kinase 4 promotes pituitary cell proliferation and survival under hypoxia.

Lillehei, L. *Endocrine.* Growth hormone tumor histological subtypes predict response to surgical and medical therapy.

Lozowska D, Liewluck T, Quan D, Ringel SP. Exertional rhabdomyolysis associated with high intensity exercise. *Muscle Nerve.* 2015 Jul 25.

- Lublin FD, Bowen JD, Huddleston J, Kremenchutzky M, Carpenter A, Corboy JR, Freedman MS, Krupp L, Paulo C, Hariri RJ, Fischkoff SA. Human placenta-derived cells (PDA-001) for the treatment of adults with multiple sclerosis: a randomized, placebo-controlled, multiple-dose study. *Mult Scler Relat Disord*. 2014 Nov;3(6):696-704.
- Maa E, Figi P. The case for medical marijuana in epilepsy. *Epilepsia*. 2014 Jun;55(6):783-6.
- Marker RJ, Stephenson JL, Kluger BM, Curran-Everett D, Maluf KS. Modulation of intracortical inhibition in response to acute psychosocial stress is impaired among individuals with chronic neck pain. *J Psychosom Res*. 2014 Mar;76(3):249-56.
- McQueen RB, Livingston T, Vollmer T, Corboy J, Buckley B, Allen RR, Nair K, Campbell JD. Increased relapse activity for multiple sclerosis natalizumab users who become nonpersistent: a retrospective study. *J Manag Care Spec Pharm*. 2015 Mar;21(3):210-8b.
- Messacar K, Schreiner TL, Maloney JA, Wallace A, Ludke J, Oberste MS, Nix WA, Robinson CC, Glodé MP, Abzug MJ, Dominguez SR. A cluster of acute flaccid paralysis and cranial nerve dysfunction temporally associated with an outbreak of enterovirus D68 in children in Colorado, USA. *Lancet*. 2015 Apr 25;385(9978):1662-71.
- Miravalle AA, Schreiner T. Neurologic complications of vaccinations. *Handb Clin Neurol*. 2014;121:1549-57.
- Miyasaki JM, Kluger B. Palliative care for Parkinson's disease: has the time come? *Curr Neurol Neurosci Rep*. 2015 May;15(5):26.
- Moss M, Yang M, Macht M, Sottile P, Gray L, McNulty M, Quan D. Screening for critical illness polyneuromyopathy with single nerve conduction studies. *Intensive Care Med*. 2014 May;40(5):683-90.
- Nagel M, Gilden D. Editorial commentary: varicella zoster virus infection: generally benign in kids, bad in grown-ups. *Clin Infect Dis*. 2014 Jun;58(11):1504-6.
- Nagel MA. Varicella zoster virus vasculopathy: clinical features and pathogenesis. *J Neurovirol*. 2014 Apr;20(2):157-63.
- Nagel MA, Khmeleva N, Boyer PJ, Choe A, Bert R, Gilden D. Varicella zoster virus in the temporal artery of a patient with giant cell arteritis. *J Neurol Sci*. 2013 Dec 15;335(1-2):228-30.
- Nagel MA, Khmeleva N, Choe A, Gutierrez J, Gilden D. Varicella zoster virus (VZV) in cerebral arteries of subjects at high risk for VZV reactivation. *J Neurol Sci*. 2014 Apr 15;339(1-2):32-4.
- Nagel MA, Rempel A, Huntington J, Kim F, Choe A, Gilden D. Frequency and abundance of alphaherpesvirus DNA in human thoracic sympathetic ganglia. *J Virol*. 2014 Jul;88(14):8189-92.
- Nagel MA, Gilden D. Neurological complications of varicella zoster virus reactivation. *Curr Opin Neurol*. 2014 Jun;27(3):356-60.
- Nagel MA, Gilden D. Update on varicella zoster virus vasculopathy. *Curr Infect Dis Rep*. 2014 Jun;16(6):407.
- Nagel MA, James SF, Traktinskiy I, Wyborny A, Choe A, Rempel A, Baird NL, Gilden D. Inhibition of phosphorylated-STAT1 nuclear translocation and antiviral protein expression in human brain vascular adventitial fibroblasts infected with varicella-zoster virus. *J Virol*. 2014 Oct;88(19):11634-7.
- Nagel MA, Gilden D. The relationship between herpes zoster and stroke. *Curr Neurol Neurosci Rep*. 2015 Apr;15(4):16.
- Nagel MA, Choe A, Traktinskiy I, Gilden D. Burning mouth syndrome due to herpes simplex virus type 1. *BMJ Case Rep*. 2015 Apr 1;2015.
- Nagel MA, Lenggenhager D, White T, Khmeleva N, Heintzman A, Boyer PJ, Gilden D. Disseminated VZV infection and asymptomatic VZV vasculopathy after steroid abuse. *J Clin Virol*. 2015 May;66:72-5.
- Naj AC, Jun G, Reitz C, Kunkle BW, Perry W, Park YS, Beecham GW, Rajbhandary RA, Hamilton-Nelson KL, Wang LS, Kauwe JS, Huettelman MJ, Myers AJ, Bird TD, Boeve BF, Baldwin CT, Jarvik GP, Crane PK, Rogaeva E, Barmada MM, Demirci FY, Cruchaga C, et al. [Potter H]. Effects of multiple genetic loci on age at onset in late-onset Alzheimer disease: a genome-wide association study. *JAMA Neurol*. 2014 Nov;71(11):1394-404.
- Nandhagopal R, Khmeleva N, Jayakrishnan B, White T, Al Azri F, George J, Heintzman A, Al Zeedy K, Rorke-Adams L, Gujjar AR, Schmid DS, Al-Asmi A, Nagel MA, Jacob PC, Gilden D. Varicella zoster virus pneumonitis and brainstem encephalitis without skin rash in an immunocompetent adult. *Open Forum Infect Dis*. 2014 Sep;1(2):ofu064.
- Neumann, R. *Journal of Critical Care*. Continuous Infusion versus Intermittent Vancomycin in Neurosurgical ICU.
- Ney DE, Messersmith W, Behbakht K. Anti-ma2 paraneoplastic encephalitis in association with recurrent cervical cancer. *J Clin Neurol*. 2014 Jul;10(3):262-6.
- Ney DE, Carlson JA, Damek DM, Gaspar LE, Kavanagh BD, Kleinschmidt-DeMasters BK, Waziri AE, Lillehei KO, Reddy K, Chen C. Phase II trial of hypofractionated intensity-modulated radiation therapy combined with temozolomide and bevacizumab for patients with newly diagnosed glioblastoma. *J Neurooncol*. 2015 Mar;122(1):135-43.
- Niu YQ, Yang JC, Hall DA, Leehey MA, Tassone F, Olichney JM, Hagerman RJ, Zhang L. Parkinsonism in fragile X-associated tremor/ataxia syndrome (FXTAS): revisited. *Parkinsonism Relat Disord*. 2014 Apr;20(4):456-9.
- Nyberg EM, Tanabe J, Honce JM, Krmpotich T, Shelton E, Hedeman J, Berman BD. Morphologic changes in the mesolimbic pathway in Parkinson's disease motor subtypes. *Parkinsonism Relat Disord*. 2015 May;21(5):536-40.
- O'Neill. *Journal of Neurosurgery: Pediatrics*. Routine Perioperative Ketorolac Administration is Not Associated with Hemorrhage in Pediatric Neurosurgery Patients.
- O'Neill. *Minim Invasive Neurosurgery*. Endoscopic-assisted craniofacial resection of esthesioneuroblastoma: minimizing facial incisions—technical note and report of 3 cases.
- O'Neill. *J Neurosurgery Pediatric*. Incidence of seizures on continuous EEG monitoring following traumatic brain injury in children.
- Ormond, D. *World Neurosurgery*. Unilateral Tailored Fronto-Orbital Approach for Giant Olfactory Groove Meningiomas: Technical Nuances.
- Ormond, D. *J Neurol Neurosurgery Psychiatry*. A second chance: reoperation in patients with failed surgery for intractable epilepsy: long-term outcome, neuropsychology and complications.
- Ormond, D. *J Neuropathol Exp Neurol*. Tibial adamantinoma: late metastasis to the brain.
- Ormond, D. *World Neurosurgery*. Cerebrospinal Fluid Leaks and Encephaloceles of Temporal Bone Origin: Nuances to Diagnosis and Management.
- Owens GP, Ritchie A, Rossi A, Schaller K, Wemlinger S, Schumann H, Shearer A, Verkman AS, Bennett JL. Mutagenesis of the aquaporin 4 extracellular domains defines restricted binding patterns of pathogenic neuromyelitis optica IgG. *J Biol Chem*. 2015 May 8;290(19):12123-34.
- Oyer RJ, David Beckham J, Tyler KL. West Nile and St. Louis encephalitis viruses. *Handb Clin Neurol*. 2014;123:433-47.
- Papadopoulos MC, Bennett JL, Verkman AS. Treatment of neuromyelitis optica: state-of-the-art and emerging therapies. *Nat Rev Neurol*. 2014 Sep;10(9):493-506.

Pastula DM, Aliabadi N, Haynes AK, Messacar K, Schreiner T, Maloney J, Dominguez SR, Davison ES, Leshem E, Fischer M, Nix WA, Oberste MS, Seward J, Feikin D, Miller L; Centers for Disease Control and Prevention (CDC). Acute neurologic illness of unknown etiology in children - Colorado, August-September 2014. *MMWR Morb Mortal Wkly Rep*. 2014 Oct 10;63(40):901-2.

Poisson SN, Schardt TQ, Dingman A, Bernard TJ. Etiology and treatment of arterial ischemic stroke in children and young adults. *Curr Treat Options Neurol*. 2014 Oct;16(10):315.

Poisson SN, Glidden D, Johnston SC, Fullerton HJ. Deaths from stroke in US young adults, 1989-2009. *Neurology*. 2014 Dec 2;83(23):2110-5.

Poonia S, Berge EM, Aisner DL, Damek D, Doebele RC. EGFR exon 19 deletion mutations and systemic/microglial phagocytosis in an ex vivo spinal metastasis: clinical correlations and response to therapy. *Clin Lung Cancer*. 2014 Sep;15(5):387-9.

Potter H. Kinesin light chain-1 variant E disrupts axonal transport and A β generation in Alzheimer's disease (comment on DOI 10.1002/bies.201400131). *Bioessays*. 2015 Feb;37(2):118.

Quick ED, Leser JS, Clarke P, Tyler KL. Activation of intrinsic immune responses and microglial phagocytosis in an ex vivo spinal cord slice culture model of West Nile virus infection. *J Virol*. 2014 Nov;88(22):13005-14.

Raible DJ, Frey LC, Brooks-Kayal AR. Effects of JAK2-STAT3 signaling after cerebral insults. *JAKSTAT*. 2014;3:e29510.

Raible DJ, Frey LC, Del Angel YC, Carlsen J, Hund D, Russek SJ, Smith B, Brooks-Kayal AR. JAK/STAT pathway regulation of GABA(A) receptor expression after differing severities of experimental TBI. *Exp Neurol*. 2015 Jul 11;271:445-456.

Ringel SP. Reflections: neurology and the humanities. Aging doctors. *Neurology*. 2014 Sep 23;83(13):e122-4.

Ringel SP. The practice of neurology: Looking ahead by looking back. *Neurology*. 2015 May 19;84(20):2086-91.

Rusthoven CG, Carlson JA, Waxweiler TV, Dally MJ, Barón AE, Yeh N, Gaspar LE, Liu AK, Ney DE, Damek DM, Lillehei KO, Kavanagh BD. The impact of adjuvant radiation therapy for high-grade gliomas by histology in the United States population. *Int J Radiat Oncol Biol Phys*. 2014 Nov 15;90(4):894-902.

Saadoun S, Waters P, Owens GP, Bennett JL, Vincent A, Papadopoulos MC. Neuromyelitis optica MOG-IgG causes reversible lesions in mouse brain. *Acta Neuropathol Commun*. 2014 Mar 31;2:35.

Sabry A, Hauk PJ, Jing H, Su HC, Stence NV, Mirsky DM, Nagel MA, Abbott JK, Dragone LL, Armstrong-Wells J, Curtis DJ, Cohrs R, Schmid DS, Gilden D, Gelfand EW. Vaccine strain varicella-zoster virus-induced central nervous system vasculopathy as the presenting feature of DOK8 deficiency. *J Allergy Clin Immunol*. 2014 Apr;133(4):1225-7.

Seibert JB, Alvarez E. Severe anemia in a patient with multiple sclerosis treated with natalizumab. *Neurology*. 2015 Feb 24;84(8):861.

Sergott RC, Bennett JL, Rieckmann P, Montalban X, Mikol D, Freudensprung U, Plitz T, van Beek J; ATON Trial Group. ATON: results from a Phase II randomized trial of the B-cell-targeting agent atacicept in patients with optic neuritis. *J Neurol Sci*. 2015 Apr 15;351(1-2):174-8.

Seritan AL, Nguyen DV, Mu Y, Tassone F, Bourgeois JA, Schneider A, Cogswell JB, Cook KR, Leehey MA, Grigsby J, Olichney JM, Adams PE, Legg W, Zhang L, Hagerman PJ, Hagerman RJ. Memantine for fragile X-associated tremor/ataxia syndrome: a randomized, double-blind, placebo-controlled trial. *J Clin Psychiatry*. 2014 Mar;75(3):264-71.

Shahzad A, Gilden D, Cohrs RJ. Translational medicine and varicella zoster virus: need for disease modeling. *New Horiz Transl Med*. 2015 Mar 1;2(3):89-91.

Solomon AJ, Klein EP, Corboy JR, Bernat JL. Patient perspectives on physician conflict of interest in industry-sponsored clinical trials for multiple sclerosis therapeutics. *Mult Scler*. 2015 Feb 25.

Steiner I, Tyler KL. The toll (like receptor 3) to the pathogenesis of herpes simplex encephalitis. *Neurology*. 2014 Nov 18;83(21):1882-3.

Teodoro T, Nagel MA, Geraldine R, White T, Mahalingam R, Batista P, Wellish M, Pimentel J, Khmeleva N, Heintzman A, Albuquerque L, Boyer PJ, Choe A, Peralta R, Gilden D. Biopsy-negative, varicella zoster virus (VZV)-positive giant cell arteritis, zoster, VZV encephalitis and ischemic optic neuropathy, all in one. *J Neurol Sci*. 2014 Aug 15;343(1-2):195-7.

Thompson, J. Journal of Neurophysiology. Optogenetic cholinergic modulation of the mouse superior colliculus in vivo.

Traina-Dorge V, Sanford R, James S, Doyle-Meyers LA, de Haro E, Wellish M, Gilden D, Mahalingam R. Robust pro-inflammatory and lesser anti-inflammatory immune responses during primary simian varicella virus infection and reactivation in rhesus macaques. *J Neurovirol*. 2014 Oct;20(5):526-30.

Traina-Dorge V, Doyle-Meyers LA, Sanford R, Manfredo J, Blackmon A, Wellish M, James S, Alvarez X, Midkiff C, Palmer BE, Deharo E, Gilden D, Mahalingam R. Simian Varicella Virus is Present in Macrophages, Dendritic Cells and T Cells in Lymph Nodes of Rhesus Macaques after Experimental Reactivation. *J Virol*. 2015 Jul 15.

Tyler KL. Current developments in understanding of West Nile virus central nervous system disease. *Curr Opin Neurol*. 2014 Jun;27(3):342-8.

Tyler KL. Fingolimod and risk of varicella-zoster virus infection: back to the future with an old infection and a new drug. *JAMA Neurol*. 2015 Jan;72(1):10-3.

Tyler KL. Rationale for the evaluation of fluoxetine in the treatment of enterovirus D68-associated acute flaccid myelitis. *JAMA Neurol*. 2015 May;72(5):493-4.

Verweij MC, Wellish M, Whitmer T, Malouli D, Lapel M, Jonjić S, Haas JG, DeFilippis VR, Mahalingam R, Früh K. Varicella Viruses Inhibit Interferon-Stimulated JAK-STAT Signaling through Multiple Mechanisms. *PLoS Pathog*. 2015 May;11(5):e1004901.

Visanji NP, Marras C, Kern DS, Al Dakheel A, Gao A, Liu LW, Lang AE, Hazrati LN. Colonic mucosal α -synuclein lacks specificity as a biomarker for Parkinson disease. *Neurology*. 2015 Feb 10;84(6):609-16.

Vollmer TR. Editor's note: new initiatives and other changes underway. *J Appl Behav Anal*. 2014 Spring;47(1):1-2.

Waid DM, Schreiner T, Vaitaitis G, Carter JR, Corboy JR, Wagner DH Jr. Defining a new biomarker for the autoimmune component of Multiple Sclerosis: Th40 cells. *J Neuroimmunol*. 2014 May 15;270(1-2):75-85.

Wakeman DR, Weiss S, Sladek JR, Elsworth JD, Bauereis B, Leranthe C, Hurley PJ, Roth RH, Redmond DE. Survival and integration of neurons derived from human embryonic stem cells in MPTP-lesioned primates. *Cell Transplant*. 2014;23(8):981-94.

Wakeman DR, Redmond DE Jr, Dodiya HB, Sladek JR Jr, Leraneth C, Teng YD, Samulski RJ, Snyder EY. Human neural stem cells survive long term in the midbrain of dopamine-depleted monkeys after GDNF overexpression and project neurites toward an appropriate target. *Stem Cells Transl Med*. 2014 Jun;3(6):692-701.

Wang C, Ding M, Kluger BM. Change in intraindividual variability over time as a key metric for defining performance-based cognitive fatigability. *Brain Cogn*. 2014 Mar;85:251-8.

Wang C, Ding M, Kluger BM. Functional Roles of Neural Preparatory Processes in a Cued Stroop Task Revealed by Linking Electrophysiology with Behavioral Performance. *PLoS One*. 2015;10(7):e0134686.

Wang LS, Naj AC, Graham RR, Crane PK, Kunkle BW, Cruchaga C, Murcia JD, Cannon-Albright L, Baldwin CT, Zetterberg H, Blennow K, Kukull WA, Faber KM, Schupf N, Norton MC, Tschanz JT, Munger RG, Corcoran CD, Rogaeva E; Alzheimer's Disease Genetics Consortium, Lin CF, Dombroski BA, et al. IPotter, HJ. Rarity of the Alzheimer disease-protective APP A673T variant in the United States. *JAMA Neurol*. 2015 Feb;72(2):209-16.

Weinshenker BG, Barron G, Behne JM, Bennett JL, Chin PS, Cree BA, de Seze J, Flor A, Fujihara K, Greenberg B, Higashi S, Holt W, Khan O, Knappertz V, Levy M, Melia AT, Palace J, Smith TJ, Sormani MP, Van Herle K, VanMeter S, Villoslada P, et al. Challenges and opportunities in designing clinical trials for neuromyelitis optica. *Neurology*. 2015 Apr 28;84(17):1805-15.

Wingerchuk DM, Banwell B, Bennett JL, Cabre P, Carroll W, Chitnis T, de Seze J, Fujihara K, Greenberg B, Jacob A, Jarius S, Lana-Peixoto M, Levy M, Simon JH, Tenenbaum S, Traboulsee AL, Waters P, Wellik KE, Weinshenker BG. International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology*. 2015 Jul 14;85(2):177-89.

Winston, K. Pediatric Neurosurgery. Packing to Tamponade Severe Intracranial Hemorrhage in Pediatric Patients.

Winston, K. J Neurosurgery. Relationship of vocal cord paralysis to the coil diameter of vagus nerve stimulator leads.

Writing Group for the NINDS Exploratory Trials in Parkinson Disease (NET-PD) Investigators, Kieburtz K, Tilley BC, Elm JJ, Babcock D, Hauser R, Ross GW, Augustine AH, Augustine EU, Aminoff MJ, Bodis-Wollner IG, Boyd J, Cambi F, Chou K, Christine CW, Cines M, Dahodwala N, Derwent L, Dewey RB Jr, Hawthorne K, Houghton DJ, Kamp C, et al. [Leehey, MJ]. Effect of creatine monohydrate on clinical progression in patients with Parkinson disease: a randomized clinical trial. *JAMA*. 2015 Feb 10;313(6):584-93.

Wrzoc C, Winkler A, Metz I, Kayser DM, Thal DR, Wegner C, Brück W, Nessler S, Bennett JL, Stadelmann C. Early loss of oligodendrocytes in human and experimental neuromyelitis optica lesions. *Acta Neuropathol*. 2014 Apr;127(4):523-38.

Youssef, S. World Neurosurgery. Unilateral Tailored Fronto-Orbital Approach for Giant Olfactory Groove Meningiomas: Technical Nuances.

Youssef, S. J Neurol Surgery B Skull Base. Junctional Internal Carotid Artery Aneurysms: The Schrödinger's Cat of Vascular Neurosurgery.

Zhang CJ, Zhai H, Yan Y, Hao J, Li MS, Jin WN, Su N, Vollmer TL, Shi FD. Glatiramer acetate ameliorates experimental autoimmune neuritis. *Immunol Cell Biol*. 2014 Feb;92(2):164-9.

NEURORADIOLOGY

Woodward K, Wegryn S, Staruk C, Nyberg EM. The Dotter method revisited: early experience with a novel method of rapid internal carotid artery revascularization in the setting of acute ischemic stroke. *J Neurointerv Surg*. 2015 Jan 30.

Weisfeld-Adams JD, Katz Sand IB, Honce JM, Lublin FD. Differential diagnosis of Mendelian and mitochondrial disorders in patients with suspected multiple sclerosis. *Brain*. 2015 Mar; 138(Pt 3):517-39.

Krmpotich T, Mikulich-Gilbertson S, Sakai J, Thompson L, Banich MT, Tanabe J. Impaired Decision-Making, Higher Impulsivity, and Drug Severity in Substance Dependence and Pathological Gambling. *J Addict Med*. 2015 Apr 25. [Epub ahead of print]

Yamamoto DY, Woo C, Wager TD, Regner M, Tanabe, J. Influence of dorsolateral prefrontal lobe and ventral striatum on risk avoidance in addiction: A Mediation Analysis. *Drug Alcohol Depend*. 2015 Apr 1;149:10-7.

Nyberg EM, Tanabe J, Honce JM, Krmpotich T, Shelton E, Hedeman J, Berman BD. Morphologic changes in the mesolimbic pathway in Parkinson's disease. *Parkinsonism Relat Disord*. 2015 May;21(5):536-40.

Dalwani MS, McMahon MA, Mikulich-Gilbertson SK, Young SE, Regner MF, Raymond KM, McWilliams SK, Banich MT, Tanabe JL, Crowley TJ, Sakai JT. Female adolescents with severe substance and conduct problems have substantially less brain gray matter volume. *PLoS One*. 2015 May 22;10(5):e0126368.

Kiseljak-Vassiliades K, Carlson NE, Borges MT, Kleinschmidt-DeMasters BK, Lillehei KO, Kerr JM, Wierman ME. Growth hormone tumor histological subtypes predict response to surgical and medical therapy. *Endocrine*. 2015 May;49(1):231-41.

Regner M, Dalwani M, Perry R, Sakai J, Honce J, Yamamoto D, Tanabe J. Sex Differences in Gray Matter Changes and Brain-Behavior Relationships in Patients with Stimulant Dependence. *Radiology* 2015 Jul 14:142541. [Epub ahead of print]

Narayanan V, Honce JM, Mehrotra S, Camidge DR. Cystic Brain Metastases Occurring in Anaplastic Lymphoma Kinase Gene Rearranged Non-Small-Cell Lung Cancer Patients Receiving Crizotinib. *Clin Lung Cancer*. 2015 Jul 30. [Epub ahead of print]

Gilden D, White T, Nagae L, Gurdin W, Boyer P, Nagel M. Successful Antiviral Treatment of Giant Cell Arteritis and Takayasu's Arteritis. *JAMA Neurol*. 2015 Aug 1;72(8):943-6.

Chumachenkoa SY, Sakai JT, Dalwani M, Mikulich-Gilbertson SK, Dunn R, Tanabe J, Young S, McWilliams SK, Banich MT, Crowley TJ. Brain cortical thickness in male adolescent patients with antisocial substance dependence. *Am J Drug Alcohol Abuse*. 2015 Sep;41(5):414-24.

NEUROSURGERY

Albrecht, O., A. Dondzillo, F. Mayer, J. A. Thompson and A. Klug (2014). "Inhibitory projections from the ventral nucleus of the trapezoid body to the medial nucleus of the trapezoid body in the mouse." *Front Neural Circuits* 8: 83.

Altunbas, C., T. C. Hankinson, M. Miften, T. Tello, S. R. Plimpton, K. Stühr and A. K. Liu (2013). "Rotational setup errors in pediatric stereotactic radiation therapy." *Pract Radiat Oncol* 3(3): 194-198.

Aman, J. E., A. Abosch, M. Bebler, C. H. Lu and J. Konczak (2014). "Subthalamic nucleus deep brain stimulation improves somatosensory function in Parkinson's disease." *Mov Disord* 29(2): 221-228.

Boehme, A. K., P. V. Rawal, M. J. Lyster, K. C. Albright, R. Bavarsad Shahripour, P. Palazzo, N. Kapoor, M. Alvi, J. T. Houston, M. R. Harrigan, L. Cava, A. Sisson, A. W. Alexandrov and A. V. Alexandrov (2014). "Investigating the utility of previously developed prediction scores in acute ischemic stroke patients in the stroke belt." *J Stroke Cerebrovasc Dis* 23(8): 2001-2006.

Burlew, C. C., W. L. Biffi, E. E. Moore, F. M. Pieracci, K. M. Beauchamp, R. Stovall, A. E. Wagenaar and G. J. Jurkovich (2014). "Endovascular stenting is rarely necessary for the management of blunt cerebrovascular injuries." *J Am Coll Surg* 218(5): 1012-1017.

Delev, D., K. Send, J. Wagner, M. von Lehe, D. R. Ormond, J. Schramm and A. Grote (2014). "Epilepsy surgery of the rolandic and immediate perirolandic cortex: surgical outcome and prognostic factors." *Epilepsia* 55(10): 1585-1593.

Donson, A. M., B. K. Kleinschmidt-DeMasters, D. L. Aisner, L. T. Bemis, D. K. Birks, J. M. Levy, A. A. Smith, M. H. Handler, N. K. Foreman and S. Z. Rush (2014). "Pediatric brainstem gangliogliomas show BRAF(V600E) mutation in a high percentage of cases." *Brain Pathol* 24(2): 173-183.

Freeman, J. L. and K. R. Winston (2015). "Breach of Posterior Wall of Frontal Sinus: Management with Preservation of the Sinus." *World Neurosurg* 83(6): 1080-1089.

Graner, M. W., K. O. Lillehei and E. Katsanis (2014). "Endoplasmic reticulum chaperones and their roles in the immunogenicity of cancer vaccines." *Front Oncol* 4: 379.

Hamani, C., J. Pilitsis, A. I. Rughani, J. M. Rosenow, P. G. Patil, K. S. Slavin, A. Abosch, E. Eskandar, L. S. Mitchell and S. Kalkanis (2014). "Deep brain stimulation for obsessive-compulsive disorder: systematic review and evidence-based guideline sponsored by the American Society for Stereotactic and Functional Neurosurgery and the Congress of Neurological Surgeons (CNS) and endorsed by the CNS and American Association of Neurological Surgeons." *Neurosurgery* 75(4): 327-333; quiz 333.

Hankinson, T. C., N. O. Palmeri, S. A. Williams, M. R. Torok, C. A. Serrano, N. K. Foreman, M. H. Handler and A. K. Liu (2013). "Patterns of care for craniopharyngioma: survey of members of the American Association of Neurological Surgeons." *Pediatr Neurosurg* 49(3): 131-136.

Hoffman, L. M., A. M. Donson, I. Nakachi, A. M. Griesinger, D. K. Birks, V. Amani, M. S. Hemenway, A. K. Liu, M. Wang, T. C. Hankinson, M. H. Handler and N. K. Foreman (2014). "Molecular sub-group-specific immunophenotypic changes are associated with outcome in recurrent posterior fossa ependymoma." *Acta Neuropathol* 127(5): 731-745.

Hoffman, L. M., S. R. Plimpton, N. K. Foreman, N. V. Stence, T. C. Hankinson, M. H. Handler, M. S. Hemenway, R. Vibhakar and A. K. Liu (2014). "Fractionated stereotactic radiosurgery for recurrent ependymoma in children." *J Neurooncol* 116(1): 107-111.

Kennedy, B. C., M. M. McDowell, P. H. Yang, C. M. Wilson, S. Li, T. C. Hankinson, N. A. Feldstein and R. C. Anderson (2014). "Pial synangiosis for moyamoya syndrome in children with sickle cell anemia: a comprehensive review of reported cases." *Neurosurg Focus* 36(1): E12.

Levy, J. M., J. C. Thompson, A. M. Griesinger, V. Amani, A. M. Donson, D. K. Birks, M. J. Morgan, D. M. Mirsky, M. H. Handler, N. K. Foreman and A. Thorburn (2014). "Autophagy inhibition improves chemosensitivity in BRAF(V600E) brain tumors." *Cancer Discov* 4(7): 773-780.

Liao, M., Q. Yang, J. Zhang, M. Zhang, Q. Deng, H. Liu, M. W. Graner, H. Kornfeld, B. Zhou and X. Chen (2014). "Gamma interferon immunospot assay of pleural effusion mononuclear cells for diagnosis of tuberculous pleurisy." *Clin Vaccine Immunol* 21(3): 347-353.

Lummus, S., R. Breeze, M. S. Lucia and B. K. Kleinschmidt-DeMasters (2014). "Histopathologic features of intracranial vascular involvement in fibromuscular dysplasia, ehlers-danlos type IV, and neurofibromatosis I." *J Neuropathol Exp Neurol* 73(10): 916-932.

Lummus, S. C., D. L. Aisner, S. B. Sams, N. K. Foreman, K. O. Lillehei and B. K. Kleinschmidt-DeMasters (2014). "Massive dissemination from spinal cord gangliogliomas negative for BRAF V600E: report of two rare adult cases." *Am J Clin Pathol* 142(2): 254-260.

Miller, T., T. Lau, R. Vasan, C. Danner, A. S. Youssef, H. van Loveren and S. Agazzi (2014). "Reporting success rates in the treatment of vestibular schwannomas: are we accounting for the natural history?" *J Clin Neurosci* 21(6): 914-918.

Olson, J. J., L. Nayak, D. R. Ormond, P. Y. Wen and S. N. Kalkanis (2014). "The role of cytotoxic chemotherapy in the management of progressive glioblastoma: a systematic review and evidence-based clinical practice guideline." *J Neurooncol* 118(3): 501-555.

Olson, J. J., L. Nayak, D. R. Ormond, P. Y. Wen, S. N. Kalkanis and T. C. Ryken (2014). "The role of targeted therapies in the management of progressive glioblastoma: a systematic review and evidence-based clinical practice guideline." *J Neurooncol* 118(3): 557-599.

Ormond, D. R. and C. G. Hadjipanayis (2014). "The history of neurosurgery and its relation to the development and refinement of the frontotemporal craniotomy." *Neurosurg Focus* 36(4): E12.

Ormond, D. R., C. Shannon, J. Oppenheim, R. Zeman, K. Das, R. Murali and M. Jhanwar-Uniyal (2014). "Stem cell therapy and curcumin synergistically enhance recovery from spinal cord injury." *PLoS One* 9(2): e88916.

Redzic, J. S., T. H. Ung and M. W. Graner (2014). "Glioblastoma extracellular vesicles: reservoirs of potential biomarkers." *Pharmgenomics Pers Med* 7: 65-77.

Rusthoven, C. G., J. A. Carlson, T. V. Waxweiler, M. J. Dally, A. E. Baron, N. Yeh, L. E. Gaspar, A. K. Liu, D. E. Ney, D. M. Damek, K. O. Lillehei and B. D. Kavanagh (2014). "The impact of adjuvant radiation therapy for high-grade gliomas by histology in the United States population." *Int J Radiat Oncol Biol Phys* 90(4): 894-902.

Smyth, T., K. Petrova, N. M. Payton, I. Persaud, J. S. Redzic, M. W. Graner, P. Smith-Jones and T. J. Anchordoquy (2014). "Surface functionalization of exosomes using click chemistry." *Bioconjug Chem* 25(10): 1777-1784.

Smyth, T. J., J. S. Redzic, M. W. Graner and T. J. Anchordoquy (2014). "Examination of the specificity of tumor cell derived exosomes with tumor cells in vitro." *Biochim Biophys Acta* 1838(11): 2954-2965.

Srinivasan, V. M., B. R. O'Neill, D. Jho, D. M. Whiting and M. Y. Oh (2014). "The history of external ventricular drainage." *J Neurosurg* 120(1): 228-236.

Stratford, J. M. and J. A. Thompson (2014). "Beta-galactosidase staining in the nucleus of the solitary tract of Fos-Tau-LacZ mice is unaffected by monosodium glutamate taste stimulation." *PLoS One* 9(9): e107238.

Telkes, I., N. F. Ince, I. Onaran and A. Abosch (2014). "Localization of subthalamic nucleus borders using macroelectrode local field potential recordings." *Conf Proc IEEE Eng Med Biol Soc* 2014: 2621-2624.

Thompson, J. A., D. Lanctin, N. F. Ince and A. Abosch (2014). "Clinical implications of local field potentials for understanding and treating movement disorders." *Stereotact Funct Neurosurg* 92(4): 251-263.

Ung, T. H., H. J. Madsen, J. E. Hellwinkel, A. M. Lencioni and M. W. Graner (2014). "Exosome proteomics reveals transcriptional regulator proteins with potential to mediate downstream pathways." *Cancer Sci* 105(11): 1384-1392.

Van Gompel, J. J., P. Alikhani, M. H. Tabor, H. R. van Loveren, S. Agazzi, S. Froelich and A. S. Youssef (2014). "Anterior inferior petrosectomy: defining the role of endonasal endoscopic techniques for petrous apex approaches." *J Neurosurg* 120(6): 1321-1325.

Van Gompel, J. J., M. H. Tabor, A. S. Youssef, T. Lau, A. P. Carlson, H. R. van Loveren and S. Agazzi (2014). "Field of view comparison between two-dimensional and three-dimensional endoscopy." *Laryngoscope* 124(2): 387-390.

Winston, K. R., J. T. Ho and S. A. Dolan (2013). "Recurrent cerebrospinal fluid shunt infection and the efficacy of reusing infected ventricular entry sites." *J Neurosurg Pediatr* 11(6): 635-642.

SPINE ORTHOPEDICS

Burger, E. L., Noshchenko, A., Patel, V. V., Lindley, E. M., & Bradford, A. P. (2014). Ultrastructure of Intervertebral Disc and Vertebra-Disc Junctions Zones as a Link in Etiopathogenesis of Idiopathic Scoliosis. *Advances in Orthopedic Surgery*, Article ID 850594.

Lindley, E. M., Levy, B. J., Burger, E. L., Cain, C. M. J., & Patel, V. V. (2014). Failure of the Fernstrom ball in contemporary spine surgery: A case of history repeating itself. *Current Orthopedic Practice*, 25(1), 87-91.

Noshchenko, A., Hoeffcker, L., Lindley, E. M., Burger, E. L., Cain, C. M., & Patel, V. V. (2014). Perioperative and long-term clinical outcomes for bone morphogenetic protein versus iliac crest bone graft for lumbar fusion in degenerative disk disease: systematic review with meta-analysis. *J Spinal Disord Tech*, 27(3), 117-135. doi: 10.1097/01.bsd.0000446752.34233.ca.

Patel, V. V., Whang, P. G., Haley, T. R., Bradley, W. D., Nunley, P. D., Miller, L. E., . . . Geisler, F. H. (2014). Two-year clinical outcomes of a multicenter randomized controlled trial comparing two interspinous spacers for treatment of moderate lumbar spinal stenosis. *BMC Musculoskelet Disord*, 15, 221. doi: 10.1186/1471-2474-15-221.

Barton, C., Noshchenko, A., Patel, V., Cain, C., Kleck, C., & Burger, E. (2015). Risk factors for rod fracture after posterior correction of adult spinal deformity with osteotomy: a retrospective case-series. *Scoliosis*, 10, 30. doi: 10.1186/s13013-015-0056-5.

Kleck, C. J., Cullimore, I., LaFleur, M., Lindley, E., Rentschler, M. E., Burger, E. L., . . . Patel, V. V. (2015). A new 3-dimensional method for measuring precision in surgical navigation and methods to optimize navigation accuracy. *Eur Spine J*. doi: 10.1007/s00586-015-4235-0.

Lindley, E. M., Milligan, K., Farmer, R., Burger, E. L., & Patel, V. V. (2015). Patient-Controlled Transdermal Fentanyl Versus Intravenous Morphine Pump After Spine Surgery. *Orthopedics*, 38(9), e819-824. doi: 10.3928/01477447-20150902-61.

Noshchenko, A., Hoeffcker, L., Lindley, E. M., Burger, E. L., Cain, C. M., & Patel, V. V. (2015). Long-term Treatment Effects of Lumbar Arthrodeses in Degenerative Disk Disease: A Systematic Review With Meta-Analysis. *J Spinal Disord Tech*, 28(9), E493-521. doi: 10.1097/BSD.0000000000000124.

Patel, V., Patel, P., Jeffery, R., Taylor, J., & Thomas, H. (2015). Examination of the musculoskeletal system: junior doctors' perceptions of the usefulness of the Gait, Arms, Legs and Spine (GALS) technique. *Postgrad Med J*, 91(1078), 418-422. doi: 10.1136/postgradmedj-2015-133340.

Patel, V. V., Nunley, P. D., Whang, P. G., Haley, T. R., Bradley, W. D., Davis, R. P., . . . Geisler, F. H. (2015). Superion((R)) InterSpinous Spacer for treatment of moderate degenerative lumbar spinal stenosis: durable three-year results of a randomized controlled trial. *J Pain Res*, 8, 657-662. doi: 10.2147/JPR.S92633.

Patel, V. V., Whang, P. G., Haley, T. R., Bradley, W. D., Nunley, P. D., Davis, R. P., . . . Geisler, F. H. (2015). Superion interspinous process spacer for intermittent neurogenic claudication secondary to moderate lumbar spinal stenosis: two-year results from a randomized controlled FDA-IDE pivotal trial. *Spine (Phila Pa 1976)*, 40(5), 275-282. doi: 10.1097/BRS.0000000000000735.

Price, J. S., Tackett, S., & Patel, V. (2015). Observational evaluation of outcomes and resource utilization from hemostatic matrices in spine surgery. *J Med Econ*, 18(10), 777-786. doi: 10.3111/13696998.2015.1046879.

SPINE PM&R

Friedly JL, Comstock BA, Turner JA, Heagerty PJ, Deyo RA, Sullivan SD, Bauer Z, Bresnahan BW, Avins AL, Nedeljkovic SS, Nerenz DR, Standaert C, Kessler L, Akuthota V, Annaswamy T, Chen A, Diehn F, Firtch W, Gerges FJ, Gilligan C, Goldberg H, Kennedy DJ, Mandel S, Tyburski M, Sanders W, Sibell D, Smuck M, Wasan A, Won L, Jarvik JG. A randomized trial of epidural glucocorticoid injections for spinal stenosis. *N Engl J*.

Friedly J, Akuthota V, Amtmann D, Patrick D. Why disability and rehabilitation specialists should lead the way in patient-reported outcomes. *Arch Phys Med Rehabil*. 2014 Aug; 95(8): 1419-22.

Laker S. Sport-related concussion. *Curr Pain Headache Rep*. 2015 Aug;19(8): 41.

Niehaus W, Boimbo S, Akuthota V. Physical Medicine and Rehabilitation Resident Use of iPad Mini Mobile Devices. *PM R* 2015 May;7(5):512-8.

Worsowicz GM, D'Orsie S, Laker S. The never-ending sustainable growth-rate debate. *PM R*. 2014 Aug;6(8): 739-41.

Yang Aj, Brakke RA, Boimbo S, Sauerwein K, Coronado RA, Schumacher A. Residency and Beyond: Subspecialization Trends Among Graduating Physiatry Residents and the Musculoskeletal Curriculum. *Am J Phys Med Rehabil*. 2015 Aug 7.

Yang A, Emig M, Akuthota V. Kissing spine and the retrodural space of Okada: more than just a kiss? *PM R*. 2014 Mar;6(3): 287-9.

NEUROLOGY

Phase III, Randomized, Double-Blind, Double Dummy, Multicenter Trial Comparing the Efficacy and Safety of 2 Doses of Daily Oral ONO 4641 (0.05 mg and 0.1 mg) versus Interferon- β -1a 30 μ g IM Weekly in Subjects with Relapsing Multiple Sclerosis
Principle Investigator: Alvarez

Collaborative International Research in Clinical and Longitudinal Experience for Neuromyelitis Optica (NMO) Studies (CIRCLES)
Principle Investigator: Bennett

Analysis of B-cell Trafficking in Multiple Sclerosis Patients Receiving Tysabri(R) (natalizumab) and Gilenya (fingolimod) Immunomodulatory Therapy
Principle Investigator: Bennett

A Phase IV Trial of Neuroprotection with ACTH in Acute Optic Neuritis
Principle Investigator: Bennett

Functional Connectivity of the Basal Ganglia in Primary Focal Dystonia: A Pilot Project
Principle Investigator: Berman

Natural History and Biospecimen Repository for Dystonia
Principle Investigator: Berman

Functional Connectivity of the Motor Network in Two Major Subtypes of Parkinson Disease.
Principle Investigator: Berman

Neural Mechanisms of Reflexive Blinking and Eye Muscle Spasms in Blepharospasm
Principle Investigator: Berman

Open-label, single-arm extension study to the double-blind, randomized, multicenter, placebo-controlled, parallel-group study comparing the efficacy and safety of 0.5 mg FTY720 administered orally once daily versus placebo in patients with primary progressive multiple sclerosis
Principle Investigator: Corboy

The role of TH40 cell in Multiple Sclerosis and Type 1 Diabetes
Principle Investigator: Corboy

A 12-month, randomized, rate- and dose-blinded study to compare the efficacy and safety of fingolimod 0.25 mg and 0.5 mg administered orally once daily with glatiramer acetate 20 mg administered subcutaneously once daily in patients with relapsing-remitting multiple sclerosis
Principle Investigator: Corboy

A multicenter, randomized, double-blind, parallel-group, placebo-controlled variable treatment duration study evaluating the efficacy and safety of Siponimod (BAF312) in patients with secondary progressive multiple sclerosis
Principle Investigator: Corboy

A double-blind, placebo controlled trial of estriol treatment in women with multiple sclerosis: effect on cognition.
Principle Investigator: Corboy

Rocky Mountain MS Center Tissue Bank
Principle Investigator: Corboy

A double-blind, randomized, multicenter, placebocontrolled, parallel-group study comparing the efficacy and safety of 0.5 mg FTY720 administered orally once daily versus placebo in patients with primary progressive multiple sclerosis
Principle Investigator: Corboy

A Combination Trial of Copaxone plus Estriol in Relapsing Remitting Multiple Sclerosis
Principle Investigator: Corboy

Vestibular rehabilitation for persons with Multiple Sclerosis: what benefits are possible
Principle Investigator: Hebert

Hypothermia in Acute Stroke with Thrombolysis Imaging Evaluation of Revascularization (HASTIER): An ancillary imaging study to the Intravascular Cooling in the Treatment of Stroke 2 (ICTuS 2) trial, an NIH-funded project on the safety and efficacy of hypothermia combined with thrombolysis
Principle Investigator: Jones

Stroke Hyperglycemia Insulin Network Effort (SHINE) Trial
Principle Investigator: Jones

Phase 2/3 Study of Intravenous Thrombolysis and Hypothermia for Acute Treatment of Ischemic Stroke
Principle Investigator: Jones

Review of number of microelectrode recording passes performed during subthalamic nucleus deep-brain stimulation surgery
Principle Investigator: Klepitskaya

The Burden of Cerebral Diffuse Ischemic White Matter Disease, Measured Quantitatively on MRI, as a Possible Predictive Factor of Cognitive Outcomes after STN DBS Surgery for Parkinson Disease
Principle Investigator: Klepitskaya

A Phase 3b, Prospective, Multicenter, Open-Label Extension Study to Assess Long Term Safety and Effectiveness of DYSPORT Using 2mL Dilution in Adults with Cervical Dystonia
Principle Investigator: Klepitskaya

A Phase 3b, Multicenter, Randomized, Double-Blind, Placebo-Controlled Study Evaluating the Efficacy and Safety of DYSPORT Using 2mL Dilution in Adults with Cervical Dystonia
Principle Investigator: Klepitskaya

A Phase 3, Multicenter, Double-Blind, Placebo-Controlled, Single-Treatment Efficacy and Safety Study of MYOBLOC (Part A) Followed by and Open-Label, Multiple-Treatment Study with MYOBLOC (Part B) in the Treatment of Troublesome Sialorrhea in Adult Subjects
Principle Investigator: Klepitskaya

Using Multiplex Families to Map Genes that Modify Susceptibility and Age at Onset in Parkinson's Disease (also known as "The PaGeR Study") Parkinson's Genetic Research Study- NIH
Principle Investigator: Klepitskaya

An objective double blind evaluation of bupropion and citalopram in an individual with Friedreich ataxia
Principle Investigator: Klepitskaya

DYSPORT™ for Injection AbobotulinumtoxinA Neurotoxin Clinical & Health Economics Outcomes Registry in Cervical Dystonia (ANCHOR-CD)
Principle Investigator: Klepitskaya

Clinical Research Database for University of Colorado Health System's Outpatient Palliative Care Programs
Principle Investigator: Kluger

Pilot Investigation of Transcranial Magnetic Stimulation (TMS) as Treatment for Cortical Hyperexcitability Syndromes
Principle Investigator: Kluger

Study of the Neurophysiology of Central Fatigue
Principle Investigator: Kluger

Fatigability of Cognitive Performance in Older Adults: Objective Measures and the Impact on Quality of Life and Activity Level
Principle Investigator: Kluger

Cortical Physiology as a Therapeutic Target in Parkinson's Disease-related Dementia and Cognitive Dysfunction
Principle Investigator: Kluger

Movement Disorders and Behavioral Neurology Research Database
Principle Investigator: Kluger

Acupuncture as a Symptomatic Treatment for Fatigue in
Parkinson's Disease
Principle Investigator: Kluger

Cognitive Dysfunction in Parkinson's Disease
Principle Investigator: Kluger

Accuracy of PET Scans in the Diagnosis of Dementia in the
Community Setting
Principle Investigator: Kluger

Defining Palliative Care Needs in Parkinson's Disease. Aim 1:
Compare the level of palliative care needs of PD patients to patients
with advanced cancer. Aim 2: PD patients from Aim 1 will complete
the Parkinson Disease Questionnaire (PDQ-39) measure of HRQOL
to determine how palliative care needs correlate with HRQOL using
linear regression to control for age and motor symptom severity
Principle Investigator: Kluger

University of Colorado Denver Depression Center Repetitive
Transcranial Magnetic Stimulation (RTMS) Research Registry
Principle Investigator: Kluger

Test of a novel TMS method
Principle Investigator: Kluger

Functional Neuroimaging of Volitional Action Using
Magnetoencephalography and Functional MRI
Principle Investigator: Kluger

Does prior acupuncture experience bias subjects' perception of real
versus sham acupuncture treatments?
Principle Investigator: Kluger

Trajectories and Markers of Neurodegeneration in Fragile X
Premutation Carriers
Principle Investigator: Leehey

Memantine Treatment in Fragile X-Associated Tremor/Ataxia Syndrome
Principle Investigator: Leehey

A Multicenter, Double-Blind, Parallel Group, Placebo Controlled Study
of Creatine in Subjects with Treated Parkinson's Disease LS-1 (NET-PD)
Principle Investigator: Leehey

Multi-Center, Double-Blind, Placebo-Controlled Phase II Study of
Pioglitazone in Early Parkinson's Disease (FS-ZONE)
Principle Investigator: Leehey

HDE Post-Approval Study (PAS) of NeuRX DPS (TM) for ALS
Principle Investigator: Liewluck

Protocol no. Mn-166-neuronext. A randomized, double-blind, placebo
controlled study to evaluate the safety, tolerability and activity of
ibudilast (mn-166) in subjects with progressive multiple sclerosis
Principle Investigator: Miravalle

A Multicenter, Open-label, Extension Study to Evaluate the Long-
Term Safety and Efficacy of B1B019, Daclizumab High Yield Process
(DAC HYP), Monotherapy in Subjects with Multiple Sclerosis who
have Completed Study 205MS301
Principle Investigator: Miravalle

Improving bladder care for patients with Multiple Sclerosis.
Developing a systematic approach for the assessment and diagnosis of
neurogenic bladder in Multiple Sclerosis (MS) patients will result in
improved bladder care and health related outcomes
Principle Investigator: Miravalle

Multicenter, double-blind, randomized, parallel-group, monotherapy,
active-control study to determine the efficacy and safety of
Daclizumab High Yield Process (DAC HYP) versus Avonex in patients
with relapsing-remitting multiple sclerosis
Principle Investigator: Miravalle

A Multicenter, Randomized, Double-Blind, Placebo-Controlled Study
of the Efficacy of Natalizumab on Reducing Disability Progression in
Subjects With Secondary Progressive Multiple Sclerosis
Principle Investigator: Miravalle

A Randomized, Double-Blind, Parallel Group Study to Compare the
Safety and Efficacy of Increasing Doses of Arbaclofen Extended
Release Tablets to Placebo and Baclofen Tablets, USP for the
Treatment of Spasticity in Patients with Multiple Sclerosis
Principle Investigator: Miravalle

A Phase III, Multicentre, Randomized, Parallel-Group, Double-Blind,
Placebo-Controlled Study to Evaluate the Efficacy and Safety of
Ocrelizumab in Adults with Primary Progressive Multiple Sclerosis
Principle Investigator: Miravalle

A Randomized, Double-Blind, Double-Dummy, Parallel-Group Study
to Evaluate the Efficacy and Safety of Ocrelizumab in Comparison to
Interferon-Beta-1a (Rebif) in Patients with Relapsing Multiple Sclerosis
Principle Investigator: Miravalle

A multinational, multicenter, randomized, parallel-group study
performed in subjects with relapsing remitting multiple sclerosis
to assess the efficacy, safety and tolerability of Glatiramer Acetate
(GA) injection 40 mg administered three times a week compared to
placebo in a double-blind design
Principle Investigator: Miravalle

Effectiveness Analysis of Natalizumab versus Fingolimod using
Patient-Reported Outcomes in Patients with Multiple Sclerosis
Principle Investigator: Nair

Spinal Muscular Atrophy (SMA) Biomarkers in the Immediate
Postnatal Period of Development
Principle Investigator: Parsons

Virtual Reality Assessment of Visuospatial Disorientation in
Alzheimer's Disease
Principle Investigator: Pelak

Lumbar Puncture Simulation Training for University of Colorado
Hospital Residents in Post-Graduate Year 1 (PGY-1) Training
Principle Investigator: Pelak

Neuroadaptation of Multifocal Intraocular Lenses After Cataract Surgery
Principle Investigator: Pelak

Functional and Neuroanatomical MRI Correlates of Spatial and
Other Cognitive Domain Changes Associated with Testosterone
Supplementation in Healthy Older Men
Principle Investigator: Pelak

Development of Visual Perception Tests for Normal Aging, Mild
Cognitive Impairment, and Alzheimer's Disease Using Computer
Based Graphics and Virtual Reality Applications
Principle Investigator: Pelak

Virtual Reality Assessment of Visuospatial Disorientation in Patients
Undergoing Deep Brain Stimulation (DBS)
Principle Investigator: Pelak

Pilot Phase 2 Double Blind Trial of the Safety and Efficacy of GM-CSF
(Leukine) in the Treatment of Alzheimer's Disease
Principle Investigator: Potter/Woodcock

A Phase II Trial of Rituximab In Myasthenia Gravis: The specific
primary objective of this study is to determine whether rituximab is a
safe and beneficial therapeutic for MG that warrants further study in
a phase III efficacy trial
Principle Investigator: Quan

ALN-TTR02-004 Titled "APOLLO: A Phase 3 Multicenter,
Multinational, Randomized, Double-blind, Placebo-controlled Study to
Evaluate the Efficacy and Safety of ALN-TTR02 in Transthyretin (TTR)-
Mediated Polyneuropathy (Familial Amyloidotic Polyneuropathy)"
Principle Investigator: Quan

Use of 3,4-Diaminopyridine, and Investigational new drug, in Lambert-Eaton Syndrome
Principle Investigator: Ringel

Multicenter Als Cohort Study Of Oxidative Stress And Disease Progression
Principle Investigator: Rollins

A two-year, open-label, rater-blinded, randomized, multicenter, active-controlled study to evaluate the safety and efficacy of fingolimod administered orally once daily versus interferon b-1a i.m. once weekly in pediatric patients with multiple sclerosis
Principle Investigator: Schreiner

A Multicenter, Observational, Open-Label, Single-Arm Study of Tysabri in Early Relapsing-Remitting Multiple Sclerosis in Anti-JCV Antibody Negative Patient
Principle Investigator: Schreiner

Cross-Sectional Study of MSDx Complex-1 Association with Gadolinium Enhancing Lesions in Relapsing-Remitting Multiple Sclerosis
Principle Investigator: Schreiner

Environmental and Genetic Risk Factors for Pediatric Multiple Sclerosis
Principle Investigator: Schreiner

Pediatric Multiple Sclerosis and other Demyelinating Diseases Database (PeMSDD Database)
Principle Investigator: Schreiner

Platelet-Oriented Inhibition in New TIA Platelet-Oriented Inhibition in New TIA (POINT) Trial
Principle Investigator: Simpson

The Accuracy of Seizure Descriptions from Patients and Eyewitnesses
Principle Investigator: Spitz

A Double-blind, Randomized, Placebo-controlled, Multicenter, Parallel-group Study with an Open-label, Extension Phase to Evaluate the Efficacy and Safety of Adjunctive Perampanel in Primary Generalized Tonic-Clonic Seizures
Principle Investigator: Spitz

A Multicenter, Open-label Extension Trial to Assess the Long-term Use of Lacosamide Monotherapy and Safety of Lacosamide Monotherapy and Adjunctive Therapy in Subjects with Partial-onset Seizures
Principle Investigator: Spitz

A Multicenter, Double Blind, Randomized, Placebo-Controlled Trial to Determine the Efficacy and Safety of Ganaxolone as Adjunctive Therapy for Adults with Drug-Resistant Partial-Onset Seizures Followed by Long-term Open-Label Treatment
Principle Investigator: Strom

An open-label, multicenter, follow-up study to evaluate the long-term safety and efficacy of brivaracetam used as adjunctive treatment in subjects aged 16 years or older with epilepsy
Principle Investigator: Strom

A randomized, double-blind, placebo controlled, multicenter, parallel group study to evaluate the efficacy and safety of brivaracetam in subjects (≥ 16 to 80 years old) with partial onset seizures
Principle Investigator: Strom

An Open-Label Safety Study of USL261 in the Outpatient Treatment of Subjects with Seizure Clusters
Principle Investigator: Strom

A Randomized, Double-Blind, Placebo-Controlled Study of the Safety and Efficacy of Intranasal Midazolam (USL261) in the Outpatient Treatment of Subjects with Seizure Clusters ARTEMIS-1: Acute Rescue Therapy in Epilepsy with Midazolam Intranasal Spray-1
Principle Investigator: Strom

Long Term Eslicarbazepine Acetate Extension Study
Principle Investigator: Strom

Efficacy and Safety of Eslicarbazepine acetate (BIA 2-093) as adjunctive therapy for refractory partial seizures in a double-blind, randomized, placebo-controlled, parallel-group, multicentre clinical trial
Principle Investigator: Strom

A Multicenter, Global, Observational Study to Collect Information on Safety and to Document the Drug Utilization of BG00012 When Used in Routine Medical Practice in the Treatment of Relapsing Multiple Sclerosis
Principle Investigator: Vollmer

Long Term Natalizumab Therapy and its Effect on Neocortical, Subcortical, and Whole Brain Atrophy Rates
Principle Investigator: Vollmer

Phase 3, multi-center, randomized, double-blind, parallel-group, placebo-controlled study followed by an active treatment period to test the safety and efficacy and tolerability of an oral treatment for patients with Relapsing Remitting Multiple Sclerosis
Principle Investigator: Vollmer

A Double-Blind, Placebo-Controlled, Single Ascending Intravenous Infusion Study of rHlgM22 in Patients with Multiple Sclerosis
Principle Investigator: Vollmer

Rocky Mountain Multiple Sclerosis Center (RMMSC) Biorepository for the Study of Neuroimmunological Disorders
Principle Investigator: Vollmer

A Phase 1 Randomized Study of MEDI-551 in Subjects with Relapsing Forms of Multiple Sclerosis
Principle Investigator: Vollmer

Retrospective study looking at various MS patients who have been taking Tysabri, Gilenya, Rituxan, Rebif, Avonex, and Betaseron for more than 2 years. Study has been submitted for exempt review to COMIRB
Principle Investigator: Vollmer

A Phase II, Double Blinded, Placebo Controlled, Randomized Study Comparing Rituximab Induction Therapy Followed by Glatiramer Acetate Therapy to Glatiramer Acetate Monotherapy in Patients with Relapsing Forms of Multiple Sclerosis
Principle Investigator: Vollmer

Phase 1, multi-center, randomized, double-blind, placebo-controlled, ascending single dose study of the safety, tolerability, and pharmacokinetics of intravenous VX15/2503 in patients with Multiple Sclerosis
Principle Investigator: Vollmer

JCV Antibody Program in Patients With Relapsing Multiple Sclerosis Receiving or Considering Treatment With Tysabri
Principle Investigator: Vollmer

The Global Observational Program on the Safety of Tysabri
Principle Investigator: Vollmer

An Extension Protocol for Multiple Sclerosis Patients Who Participated in Genzyme-sponsored Studies of Alemtuzumab
Principle Investigator: Vollmer

An exploratory study to evaluate potential virological and immunological markers for the identification of multiple sclerosis (MS) patients at risk of developing progressive multifocal leukoencephalopathy (PML) during continued treatment with natalizumab
Principle Investigator: Vollmer

A Safety and Efficacy Extension Study of ONO-4641 in Patients with Relapsing-Remitting Multiple Sclerosis IN PATIENTS WITH RELAPSING-REMITTING MULTIPLE SCLEROSIS

Principle Investigator: Vollmer

A multination, multicenter, open-label, single-assignment extension of the MS-LAQ-302 (BRAVO) study, to evaluate the long-term safety, tolerability and effect on disease course of daily oral laquinimod 0.6 mg in subjects with relapsing multiple sclerosis

Principle Investigator: Vollmer

Genetic Evaluation of Natalizumab-Treated Patients With Progressive Multifocal Leukoencephalopathy

Principle Investigator: West

NEURORADIOLOGY

Insular inhibitory neuromodulation to reduce cigarette craving and alter brain function in smokers

Principle Investigators: Regner/Tanabe

Effects of acetate and alcohol on brain function

Principle Investigators: Yamamoto/Tanabe

Multivariate pattern analysis approaches to predict Parkinson's Disease

Principle Investigators: Mohl/Tanabe/Berman

Neural Correlates of Avoidance Learning in Substance Abuse

Principle Investigator: Tanabe

Does Long Term Natalizumab Therapy Normalize Brain Atrophy Rates and Quality of Life in Relapsing Remitting Multiple Sclerosis.

Principle Investigators: Miravalle/Honce

Comparative Effectiveness of Long Term Fingolimod versus Glatiramer Acetate on Brain Atrophy Rates, Cognition and Patient Reported Outcomes in Patients with Multiple Sclerosis.

Principle Investigators: Alvarez/Honce

The Impact of Switching from Tysabri to Gilenya on Imaging and Clinical Effectiveness Outcomes.

Principle Investigator: Alvarez

Cross-Sectional Study of MSDx Complex-1 Association with Gadolinium Enhancing Lesions and Clinical Relapses in Relapsing-Remitting Multiple Sclerosis.

Principle Investigator: Schriener

Microstructural changes within the basal ganglia differ between Parkinson's disease subtypes

Principle Investigators: Berman/Nagae

DTI in blepharospasm

Principle Investigators: Berman/Nagae

Morphologic Volume and Shape Changes in Primary Focal Dystonia Patients vs. Controls

Principle Investigators: Nyberg/Berman.

NEUROSURGERY

Neuro-Marker Discovery for Accurate Localization of the Sub-Thalamic Nucleus for DBS

Principle Investigators: Abosch with Firat Ince (University of Houston)

A System that Wirelessly Reports Coordinates for Neurosurgery

Principle Investigators: Abosch/Achim Klug

Sensory Gating with a Microelectrode During Deep Brain Stimulation (DBS) Surgery

Principle Investigators: Abosch with Keeran Maharajh

Neurophysiology of Parkinson's Disease: From Mouse to Man

Principle Investigators: Abosch with Gidon Felsen

Cognitive and Neural Correlates of Inflammation in Healthy Older Adults

Principle Investigator: Bettcher

Deep Brain Stimulation for Schizophrenia

Principle Investigator: Gault

Metabolics of Primary and Recurrent High Grade Gliomas

Principle Investigator: Graner

Tumor Homing Exosomes for Drug Delivery

Principle Investigators: Graner with Tom Anchordoquy

Mechanisms of Glial Injury in Demyelinating Disorders

Principle Investigators: Graner/Wendy Macklin

Can Exosomes Induced by Breast Involution be Markers for the Poor Prognosis and Prevention of Postpartum Breast Cancer?

Principle Investigators: Graner/Virginia Borges

Advancing Treatment for Pediatric Craniopharyngioma

Principle Investigator: Hankinson

Phase II Clinical trial Evaluating DCVax®-Brain

Principle Investigator: Lillehei

CirQlator in Intrathoracic Pressure

Principle Investigators: Neumann/Cava

ME1100 Inhalation Solution Clinical Study

Principle Investigator: Neumann

Role of IL13RA2 as a Functional Biomarker in Breast Cancer Brain Metastasis

Principle Investigators: Ormond/Diana Cittelly

Apollo Onyx Delivery Micro Catherter Post Market Safety Study

Principle Investigator: Seinfeld

SPINE ORTHOPEDICS

Evaluation of the Association Between Melatonin Signaling Impairments with the Promotor of Melatonin Receptor 1b (MTNR1b) Gene Polymorphism, Calmodulin Expression in Osteoblasts and Lymphocytes, and Clinical Manifestation of the Disease in Patients with Adolescent Idiopathic Scoliosis (AIS)

Principle Investigator: Evalina Burger

Prospective Analysis of Cell Saver Related Morbidity and Coagulopathy in Spine Surgery

Principle Investigator: Evalina Burger

Pre-op Templating for TDR Alignment: Is it Clinically Relevant?

Principle Investigator: Christopher Cain

Retrospective Review of Minimally Invasive Placement of Pedicle Screws in Spine Surgery

Principle Investigator: Christopher Kleck

Prospective Analysis of Spine Surgery Outcomes

Principle Investigator: Emily Lindley

Reducing surgical site infections among spine patients through the implementation of an evidence-based bundle of care

Principle Investigator: Melanie Sandoval

Quantification of Pain Sensitivity to Controlled Objective Pain Stimuli

Principle Investigator: Vikas Patel

Retrospective Evaluation of 3D Scan Imaging to Define Normal Parameters of the SI Joint

Principle Investigator: Christopher Kleck

Effects of vitamin D deficiency on lumbar spine fusion and the role of rhBMP-2

Principle Investigators: Vikas Patel/Emily Lindley

Pedicle Screw Placement in Spine Surgery: A retrospective review of O-arm/Stealth vs Non-Computerized Navigation Techniques

Principle Investigators: Vikas Patel/Christopher Kleck

Retrospective Review of Outcomes in Complex Spine Surgery
Principle Investigator: Evalina Burger

The effects of system changes and implementation of an electronic medical record system on the complication rate of adult spinal deformity surgery
Principle Investigator: Evalina Burger

A Retrospective Examination of Vitamin D in the Spine Surgery Patient
Principle Investigator: Vikas Patel

Meta-analysis of the Outcomes and Complications in the Spinal Surgery Population Receiving Recombinant Human Bone Morphogenetic Protein-2 vs. Those Receiving Iliac Crest Bone Graft
Principle Investigator: Vikas Patel

The relationship between Sagittal plane correction and Quality of life in adult deformity patients treated with posterior instrumentation
Principle Investigator: Evalina Burger

DuraSeal™ Exact Spine Sealant System Post-Approval Study
Principle Investigator: Vikas Patel

Insite, Investigation of Sacroiliac Fusion Treatment
Principle Investigator: Vikas Patel

A Retrospective Study Evaluating the Efficacy of the Orthofix Cervical-Stim® Bone Growth Stimulator in Patients that Have Undergone Cervical Fusion Surgery and are at High-risk for Non-fusion
Principle Investigator: Vikas Patel

A Prospective, Multi-Center, Randomized Study Comparing the VertiFlex® Superion™ Interspinous Spacer (ISS) to the X-STOP® Interspinous Process Decompression (IPD®) System in Patients With Moderate Lumbar Spinal Stenosis
Principle Investigator: Vikas Patel

Validation of a New Sacroiliac-joint Specific Disability Questionnaire
Principle Investigator: Emily Lindley

Clinical Study to Evaluate the Safety and Effectiveness of the Aesculap Activ-L Artificial Disc in the Treatment of Degenerative Disc Disease
Principle Investigator: Vikas Patel

Prospective study of pedicle screw placement using the O-Arm and Navigated Instrumentation
Principle Investigator: Vikas Patel

SPINE PM&R

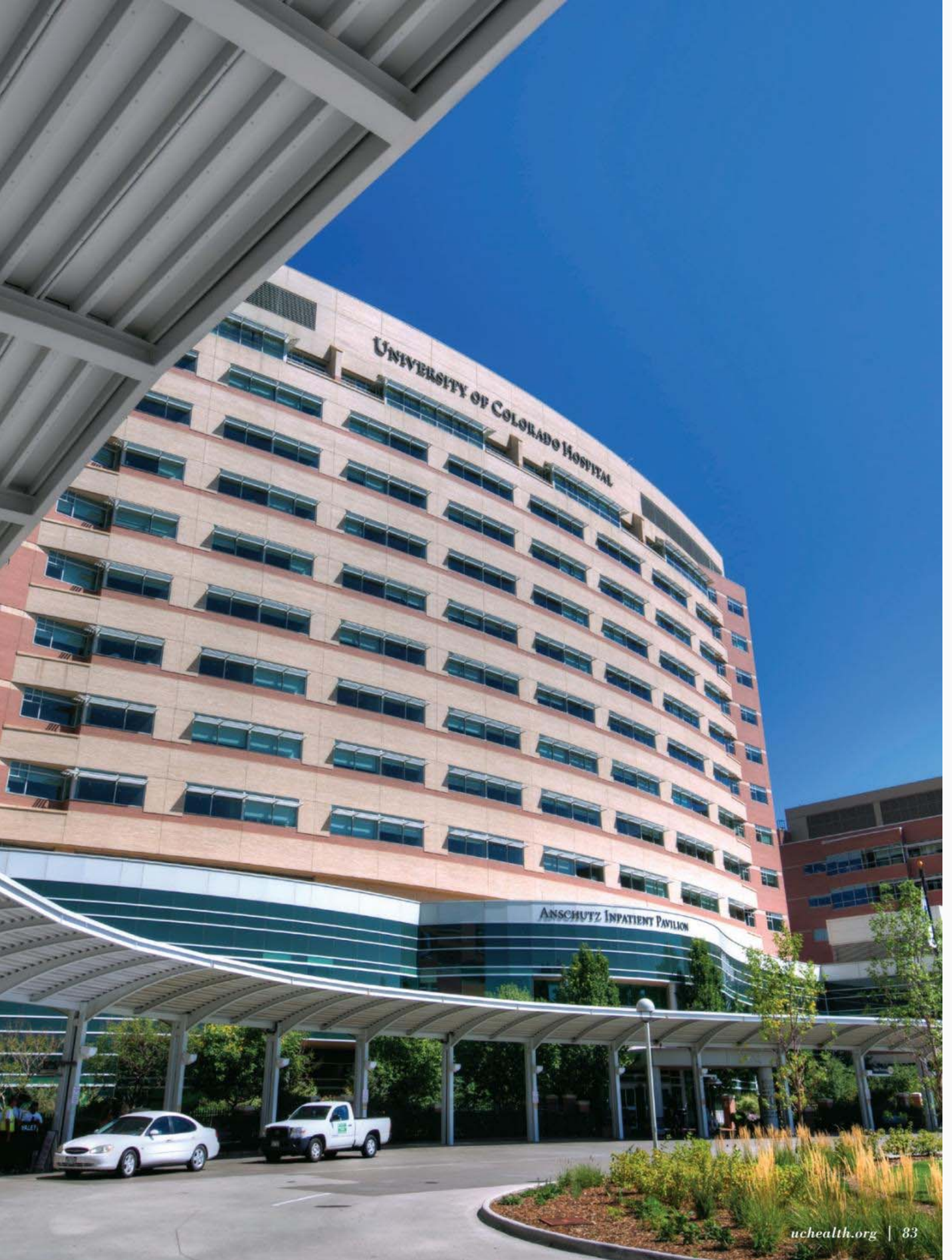
Clinical Course of Patients with Lumbar Radiculopathy with Motor Deficit
Principle Investigator: Venu Akuthota

Correlation of PROMIS Short Form to Legacy Functional & Pain Outcome Measures in Individuals Undergoing Interventions for Acute Low Back or Radicular Pain
Principle Investigator: Venu Akuthota

Lumbar Epidural Steroid Injections for Spinal Stenosis
Principle Investigator: Venu Akuthota

Long Term Outcomes of Lumbar Epidural Steroid Injections for Spinal Stenosis
Principle Investigator: Venu Akuthota

Does MRI affect physician treatment for patients presenting with Low Back Pain: A prospective analysis
Principle Investigator: Venu Akuthota



UNIVERSITY OF COLORADO HOSPITAL

ANSCHUTZ INPATIENT PAVILION

NEUROLOGY



Alvarez, Enrique, M.D., Ph.D.
Multiple Sclerosis/Neuroimmunology
Assistant Professor
Department of Neurology
University of Colorado School of Medicine



Anderson, C. Alan, M.D.
Behavioral Neurology
Professor, Neurology, Emergency Medicine,
and Psychiatry
Fellowship Program Director, Behavioral Neurology
and Neuropsychiatry
Department of Neurology
University of Colorado School of Medicine



Barr, Jessica P., PA-C
Movement Disorders
Instructor
Department of Neurology
University of Colorado School of Medicine

Bashore, Taylor, NP
Epilepsy

Instructor
Department of Neurology
University of Colorado School of Medicine



Bennett, Jeffrey L., M.D., Ph.D.
Neuro-Ophthalmology
Professor, Neurology and Ophthalmology
Department of Neurology
University of Colorado School of Medicine



Berman, Brian D., M.D., MS
Movement Disorders
Associate Professor
Department of Neurology
University of Colorado School of Medicine



Birlea, L. Marius, M.D.
Headache Medicine
Assistant Professor
Section Chief, Headache Medicine
Fellowship Program Director, Headache Medicine
Department of Neurology
University of Colorado School of Medicine



Bosque, Patrick J., M.D.
Consultative Neurology
Associate Professor
Department of Neurology
University of Colorado School of Medicine



Brown, Mesha-Gay, M.D.
Epilepsy
Assistant Professor
Department of Neurology
University of Colorado School of Medicine



Burke, Haley A., M.D.
Headache Medicine
Assistant Clinical Professor
Department of Neurology
University of Colorado School of Medicine



Corboy, John R., M.D.
Multiple Sclerosis/Neuroimmunology
Professor and Vice Chair, Faculty Affairs
Section Co-Chief, Neuroimmunology
Fellowship Program Co-Director, Neuroimmunology
Department of Neurology
University of Colorado School of Medicine

Co-Director, Rocky Mountain Multiple Sclerosis
Center at Anschutz Medical Campus
University of Colorado Hospital



Cornell, Shannon C., NP
Epilepsy
Instructor
Department of Neurology
University of Colorado School of Medicine



Coutts, Dana M., PA-C
Neurohospitalist
Instructor
Department of Neurology
University of Colorado School of Medicine



Damek, Denise M., M.D.
Neuro-Oncology and Consultative Neurology
Associate Professor
Fellowship Program Director, Neuro-Oncology
Department of Neurology
University of Colorado School of Medicine



Da Silva, Arnaldo, M.D., MBA
Headache Medicine
Assistant Clinical Professor
Department of Neurology
University of Colorado School of Medicine



Drees, Cornelia N., M.D.
Epilepsy
Assistant Professor
Department of Neurology
University of Colorado School of Medicine



Epstein, Christen H., NP
Movement Disorders
Instructor
Department of Neurology
University of Colorado School of Medicine



Filley, Christopher M., M.D.
Behavioral Neurology
Professor, Neurology and Psychiatry
Section Chief, Behavioral Neurology
Department of Neurology
University of Colorado School of Medicine



Finseth, Taylor A., M.D.
Movement Disorders
Instructor/Fellow, Movement Disorders
Department of Neurology
University of Colorado School of Medicine



Fleming, Jason B., M.D.
Movement Disorders
Fellow, Neuromuscular
Department of Neurology
University of Colorado School of Medicine



Frey, Lauren C., M.D.
Epilepsy
Associate Professor
Fellowship Program Director, Epilepsy
Department of Neurology
University of Colorado School of Medicine



Fridman, Vera, M.D.
Neuromuscular
 Assistant Professor
 Department of Neurology
 University of Colorado School of Medicine



Friedlander, Laura J., M.D.
Epilepsy
 Fellow, Epilepsy
 Department of Neurology
 University of Colorado School of Medicine



Gilden, Donald H., M.D.
Neurological Infectious Diseases and Consultative Neurology
 Louise Baum Endowed Professor
 Fellowship Program Director, Neuro-Virology
 Department of Neurology
 University of Colorado School of Medicine



Hadipour-Niktarash, Arash, M.D.
Epilepsy
 Assistant Professor
 Department of Neurology
 University of Colorado School of Medicine



Hennessy Carol, NP
Epilepsy
 Instructor
 Department of Neurology
 University of Colorado School of Medicine



Holden, Samantha K., M.D.
Behavioral Neurology
 Instructor/Fellow, Behavioral Neurology
 Department of Neurology
 University of Colorado School of Medicine



Hughes, Richard L., M.D.
Vascular Neurology
 Professor
 Department of Neurology
 University of Colorado School of Medicine



Jones, William J., M.D.
Vascular Neurology and Neurohospitalist
 Associate Professor
 Section Chief, Neurohospitalist Program
 Department of Neurology
 University of Colorado School of Medicine

 Director, Inpatient Neurosciences Services
 Director, Mobile Stroke Treatment Unit
 University of Colorado Hospital



Kandova, Marina, NP
Behavioral Neurology
 Instructor
 Department of Neurology
 University of Colorado School of Medicine



Kern, Drew S., M.D.
Movement Disorders
 Assistant Professor
 Department of Neurology
 University of Colorado School of Medicine



Klepitskaya, Olga S., M.D.
Movement Disorders
 Associate Professor
 Department of Neurology
 University of Colorado School of Medicine



Kluger, Benzi M., M.D.
Movement Disorders and Neuropalliative Care
 Associate Professor
 Director, Neuropalliative Care Clinic
 Department of Neurology
 University of Colorado School of Medicine



Korb, Pearce J., M.D.
Epilepsy and Neurohospitalist
 Assistant Professor
 Director, Medical Student Education
 Department of Neurology
 University of Colorado School of Medicine



Leehey, Maureen A., M.D.
Movement Disorders
 Professor
 Section Chief, Movement Disorders
 Department of Neurology
 University of Colorado School of Medicine



Leppert, Michelle H., M.D.
Vascular Neurology
 Instructor/Fellow, Vascular Neurology
 Department of Neurology
 University of Colorado School of Medicine



Maa, Edward H., M.D.
Epilepsy
 Associate Professor
 Department of Neurology
 University of Colorado School of Medicine



Magill, Ari, M.D.
Movement Disorders
 Instructor/Fellow, Movement Disorders
 Department of Neurology
 University of Colorado School of Medicine



Mahalingam, Ravi, Ph.D.
 Research Professor
 Department of Neurology
 University of Colorado School of Medicine



Miravalle, Augusto A., M.D.
Multiple Sclerosis and Neuroimmunology
 Associate Professor and Vice Chairman, Education
 Department of Neurology
 University of Colorado School of Medicine



Mohler, Alexander C., M.D.
Neuro-Oncology and Consultative Neurology
 Instructor/Fellow, Neuro-Oncology
 Department of Neurology
 University of Colorado School of Medicine



Nagel, Maria A., M.D.
Neurological Infectious Diseases and Consultative Neurology
 Associate Professor
 Department of Neurology
 University of Colorado School of Medicine



Ney, Douglas E., M.D.
Neuro-Oncology and Consultative Neurology
 Associate Professor
 Associate Director, Residency Training Program
 Department of Neurology
 University of Colorado School of Medicine



O'Brien, Chantal M., M.D.
Epilepsy and Consultative Neurology
Assistant Professor
Department of Neurology
University of Colorado School of Medicine



O'Reilly, Debra, MS, PA-C
Neuromuscular
Instructor
Department of Neurology
University of Colorado School of Medicine



Owen, Gregory P., Ph.D.
Research Professor
Department of Neurology
University of Colorado School of Medicine



Pastula, Daniel M., M.D., MHS
Neurological Infectious Diseases, Consultative Neurology, and Neurohospitalist
Assistant Professor
Associate Director, Medical Student Education
Department of Neurology
University of Colorado School of Medicine



Pelak, Victoria S., M.D.
Neuro-Ophthalmology
Professor, Neurology and Ophthalmology
Department of Neurology
University of Colorado School of Medicine



Persenaire, Michael J., M.D.
Behavioral Neurology
Instructor/Fellow, Behavioral Neurology
Department of Neurology
University of Colorado School of Medicine



Poisson, Sharon H., M.D.
Vascular Neurology and Neurohospitalist
Associate Professor
Fellowship Program Director, Vascular Neurology
Department of Neurology
Co-Director, Stroke Services
University of Colorado School of Medicine



Quan, Dianna, M.D.
Neuromuscular
Professor
Fellowship Program Director, Neuromuscular Medicine
Department of Neurology
University of Colorado School of Medicine



Reynek, Jeffrey D., NP
Headache Medicine
Instructor
Department of Neurology
University of Colorado School of Medicine



Ringel, Steven P., M.D.
Neuromuscular
Professor and Executive Vice Chairman
Section Chief, Neuromuscular
Department of Neurology
University of Colorado School of Medicine



Russell, Elana, NP
Movement Disorders
Instructor
Department of Neurology
University of Colorado School of Medicine



Schreiner, Teri L., M.D., MPH
Multiple Sclerosis/Neuroimmunology
Assistant Professor of Neurology and Pediatrics
Associate Director, Residency Training Program
University of Colorado School of Medicine



Seeberger, Lauren C., M.D.
Movement Disorders
Associate Professor of Neurology
Fellowship Program Director, Movement Disorders
Department of Neurology
University of Colorado School of Medicine



Shrestha, Archana A., M.D.
Epilepsy
Associate Professor of Neurology
Fellowship Program Director, Movement Disorders
Department of Neurology
University of Colorado School of Medicine



Sillau, Stefan H., Ph.D.
Instructor
Department of Neurology
University of Colorado School of Medicine



Simpson, Jennifer R., M.D.
Vascular Neurology and Neurohospitalist
Assistant Professor
Director, Quality Improvement
Department of Neurology
University of Colorado School of Medicine



Sladek, Jr., John R., Ph.D.
Professor Emeritus, Neurology, Pediatrics and Neuroscience
Department of Neurology
University of Colorado School of Medicine



Smith, Daniel E., M.D.
Neurological Infectious Diseases
Instructor/Fellow, Neuro Infectious Diseases & Neuroimmunology
Department of Neurology
University of Colorado School of Medicine



Spitz, Mark C., M.D.
Epilepsy
Professor
Section Chief, Epilepsy
Department of Neurology
University of Colorado School of Medicine



Stockman, Kristin E., NP
Multiple Sclerosis/Neuroimmunology
Instructor
Department of Neurology
University of Colorado School of Medicine



Strom, Laura A., M.D.
Epilepsy
Associate Professor
Department of Neurology
University of Colorado School of Medicine
Director, Outpatient Neurosciences Services
University of Colorado Hospital



Tsai, Jean C., M.D., Ph.D.
Sleep Medicine and Consultative Neurology
 Assistant Professor
 Department of Neurology
 University of Colorado School of Medicine



Tyler, Kenneth L., M.D.
Neurological Infectious Diseases
 Reuler-Lewin Family Professor and Chairman
 Department of Neurology
 Professor of Medicine and Immunology-Microbiology
 University of Colorado School of Medicine



Vollmer, Timothy L., M.D.
Multiple Sclerosis/Neuroimmunology
 Professor and Vice Chairman, Clinical Research
 Section Co-Chief, Neuroimmunology
 Fellowship Program Co-Director, Neuroimmunology
 Department of Neurology
 University of Colorado School of Medicine
 Co-Director, Rocky Mountain Multiple Sclerosis Center
 at Anschutz Medical Campus
 University of Colorado Hospital



Wall, Anastacia L., PA-C
Multiple Sclerosis/Neuroimmunology
 Instructor
 Department of Neurology
 University of Colorado School of Medicine

Wilson, Stacey, PA-C

Epilepsy
 Instructor
 Department of Neurology
 University of Colorado School of Medicine

Wines, Allison, NP

Headache Medicine
 Instructor
 Department of Neurology
 University of Colorado School of Medicine



Woodcock, Jonathan H., M.D.
Behavioral Neurology
 Assistant Professor of Neurology and Psychiatry
 Department of Neurology
 University of Colorado School of Medicine
 Director, Memory and Dementia Clinic
 Clinical Director, Alzheimer's Disease Research Center
 University of Colorado Hospital



Yale, Kendra L., PA-C
Multiple Sclerosis/Neuroimmunology
 Instructor
 Department of Neurology
 University of Colorado School of Medicine

NEUROLOGY RESEARCH

Baird, Nicholas L., Ph.D.

Research Instructor
 Department of Neurology
 University of Colorado School of Medicine

Blauth, Kevin, Ph.D.

Research Instructor
 Department of Neurology
 University of Colorado School of Medicine



Burgoon, Mark P., Ph.D.
 Associate Research Professor
 Department of Neurology
 University of Colorado School of Medicine



Clarke, Penelope, Ph.D.
 Research Professor
 Department of Neurology
 University of Colorado School of Medicine



Cohrs, Randall J., Ph.D.
 Research Professor
 Department of Neurology
 University of Colorado School of Medicine



Mahalingam, Ravi, Ph.D.
 Research Professor
 Department of Neurology
 University of Colorado School of Medicine



Owens, Gregory P., Ph.D.
 Research Professor
 Department of Neurology
 University of Colorado School of Medicine



Potter, Huntington, Ph.D.
 Professor and Vice Chairman, Basic Research
 Director, Alzheimer's Disease Research and
 Clinical Center
 Department of Neurology
 University of Colorado School of Medicine



Sillau, Stefan H., Ph.D.
 Instructor
 Department of Neurology
 University of Colorado School of Medicine



Sladek, John R., Jr., Ph.D.
 Professor Emeritus, Neurology, Pediatrics and
 Neuroscience
 Department of Neurology
 University of Colorado School of Medicine

NEUROSURGERY



Abosch, Aviva, M.D., Ph.D.
 Assistant Professor
 Department of Neurology
 University of Colorado School of Medicine

Anderson, Sheila, MS, PA-C

Instructor
 Department of Neurosurgery
 University of Colorado School of Medicine



Beauchamp, Kathryn, M.D.
 Assistant Professor
 Department of Neurosurgery
 University of Colorado School of Medicine
 Director, Neurosurgery at Denver Health



Bettcher, Brianne, M.D.
 Associate Professor
 Department of Neurosurgery
 University of Colorado School of Medicine



Breeze, Robert, M.D.
Professor & Vice-Chair
Department of Neurosurgery
University of Colorado School of Medicine

Director, Inpatient Neurosurgery Services
University of Colorado Hospital



Brega, Kerry, M.D.
Associate Professor
Director, Residency Program
Department of Neurosurgery
University of Colorado School of Medicine



Brill, Amanda, MSN, ACN.P.
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Catel, Colin, MS, PA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Cava, Luis, M.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine



Coon, John, M.D.
Associate Professor
Department of Neurology
University of Colorado School of Medicine



DeGrave, Michelle, MS, PA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Domen, Christopher, Ph.D.
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Duhon, Bradley, M.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine



Finn, Michael, M.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine



French, Helen, MS, PA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Greher, Michael, Ph.D., ABPP-CN
Associate Professor
Department of Neurosurgery
University of Colorado School of Medicine



Hoyt, Brian, Ph.D., ABPP-CN
Associate Professor
Department of Neurosurgery
University of Colorado School of Medicine



Humes, Elizabeth, MS, PA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Lillehei, Kevin, M.D.
Professor and Ogsbury-Kindt Chair
Director, Neuro-Oncology Program
Department of Neurosurgery
University of Colorado School of Medicine

Director, Outpatient Neurosurgery Services
University of Colorado Hospital



Neumann, Robert, M.D., Ph.D.
Associate Professor
Department of Neurosurgery
University of Colorado School of Medicine

Director, Neuro-Intensive Care Unit
Co-Medical Director, Stroke Program
University of Colorado Hospital



Ojemann, Steven, M.D.
Associate Professor
Director, Stereotactic & Functional Neurosurgery
Department of Neurosurgery
University of Colorado School of Medicine



Ormond, D. Ryan, M.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine
Co-Director, Brain Tumor



Phommatha, Sonemala, MS, PA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Rich, Jason, MS, PA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Roark, Christopher, M.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine



Roberson, Caryanne, MSN, ACNP/FNP
Instructor
Department of Neurosurgery
University of Colorado School of Medicine

Saiki, Robin, MSN, ACNP

Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Seinfeld, Joshua, M.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine



Shah, Rinku, RPA-C
Instructor
Department of Neurosurgery
University of Colorado School of Medicine



Winston, Ken, M.D.
Professor
Department of Neurosurgery
University of Colorado School of Medicine



Witt, J. Peter, M.D.
Associate Professor
Director, Spine Neurosurgery
Department of Neurosurgery
University of Colorado School of Medicine



Wodushek, Thomas, Ph.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine



Youssef, A. Samy, M.D., Ph.D.
Visiting Associate Professor
Department of Neurosurgery
University of Colorado School of Medicine
Director of Skull Base

NEUROSURGERY RESEARCH

Gault, Judith, Ph.D.
Associate Professor
Department of Neurosurgery
University of Colorado School of Medicine

Graner, Michael, Ph.D.
Associate Professor
Department of Neurosurgery
University of Colorado School of Medicine

Thompson, John, Ph.D.
Assistant Professor
Department of Neurosurgery
University of Colorado School of Medicine

RADIOLOGY, INTERVENTIONAL



Kumpe, David A., M.D., F.A.C.R.
Director of Interventional Neuroradiology
Professor of Radiology, Surgery, and Neurosurgery
Department of Radiology
University of Colorado School of Medicine

RADIOLOGY, MUSCULOSKELETAL



Strickland, Colin, M.D.
Assistant Professor
Chief of Musculoskeletal Radiology (MSK)
Department of Radiology
University of Colorado School of Medicine

SPINE-ORTHOPAEDICS



Burger, Evalina, M.D.
Professor/Vice Chair
Department of Orthopaedics
University of Colorado School of Medicine



Cain, Christopher, M.D.
Associate Professor
Department of Orthopaedics
University of Colorado School of Medicine



Cooley, Bob, PA-C
Instructor
Department of Orthopaedics
University of Colorado School of Medicine



Estes, Susan, N.P.
Instructor
Department of Orthopaedics
University of Colorado School of Medicine



Fattor, Jill, PA-C
Instructor
Department of Orthopaedics
University of Colorado School of Medicine



Kleck, Christopher, M.D.
Assistant Professor
Department of Orthopaedics
University of Colorado School of Medicine



Patel, Vikas, M.D., MA, BS
Mechanical Engineering Professor
Chief, Orthopaedic Spine Surgery and Fellowship
Director
Department of Orthopaedics
University of Colorado School of Medicine

SPINE-PHYSICAL MEDICINE AND REHABILITATION



Akuthota, Venu, M.D.
Vice Chair & Associate Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine
Medical Director, The Spine Center
University of Colorado Hospital



Brakke, Rachel, M.D.
Assistant Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine



Emig, Marshall, M.D.
Assistant Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine



Ene, Heather, M.D.
Associate Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine



Friedrich, Jason, M.D.
Assistant Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine



Goldstein-Smith, Lindsey, NP
Instructor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine



Isser-Sax, Mara, M.D.
Assistant Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine



Laker, Scott, M.D.
Associate Professor
Department of Physical Medicine and Rehabilitation
University of Colorado School of Medicine

SPINE RESEARCH

Boimbo, Sandra

Professional Research Assistant
Department of PM&R
University of Colorado School of Medicine

Sauerwein, Kelly

Research Instructor
Department of PM&R
University of Colorado School of Medicine





uchealth.org

