Neurological Institute

Cleveland Clinic

2016
Outcomes

Measuring Outcomes Promotes Quality Improvement

Measuring and understanding outcomes of medical treatments promotes quality improvement. Cleveland Clinic has created a series of Outcomes books similar to this one for its clinical institutes. Designed for a physician audience, the Outcomes books contain a summary of many of our surgical and medical treatments, with a focus on outcomes data and a review of new technologies and innovations.

The Outcomes books are not a comprehensive analysis of all treatments provided at Cleveland Clinic, and omission of a particular treatment does not necessarily mean we do not offer that treatment. When there are no recognized clinical outcome measures for a specific treatment, we may report process measures associated with improved outcomes. When process measures are unavailable, we may report volume measures; a relationship has been demonstrated between volume and improved outcomes for many treatments, particularly those involving surgical and procedural techniques.

In addition to these institute-based books of clinical outcomes, Cleveland Clinic supports transparent public reporting of healthcare quality data. The following reports are available to the public:

- Joint Commission Performance Measurement Initiative (qualitycheck.org)
- Centers for Medicare and Medicaid Services (CMS) Hospital Compare (medicare.gov/hospitalcompare), and Physician Compare (medicare.gov/PhysicianCompare)
- Cleveland Clinic Quality Performance Report (clevelandclinic.org/QPR)

Our commitment to transparent reporting of accurate, timely information about patient care reflects Cleveland Clinic's culture of continuous improvement and may help referring physicians make informed decisions.

We hope you find these data valuable, and we invite your feedback. Please send your comments and questions via email to:

OutcomesBooksFeedback@ccf.org.

To view all of our Outcomes books, please visit clevelandclinic.org/outcomes.

Dear Colleague:

Welcome to this 2016 Cleveland Clinic Outcomes book. Every year, we publish Outcomes books for 14 clinical institutes with multiple specialty services. These publications are unique in healthcare. Each one provides an overview of medical or surgical trends, innovations, and clinical data for a particular specialty over the past year. We are pleased to make this information available.

Cleveland Clinic uses data to manage outcomes across the full continuum of care. Our unique organizational structure contributes to our success. Patient services at Cleveland Clinic are delivered through institutes, and each institute is based on a single disease or organ system. Institutes combine medical and surgical services, along with research and education, under unified leadership. Institutes define quality benchmarks for their specialty services and report on longitudinal progress.

All Cleveland Clinic Outcomes books are available in print and online. Additional data are available through our online Quality Performance Reports (clevelandclinic.org/QPR). The site offers process measure, outcome measure, and patient experience data in advance of national and state public reporting sites.

Our practice of releasing annual Outcomes books has become increasingly relevant as healthcare transforms from a volume-based to a value-based system. We appreciate your interest and hope you find this information useful and informative.

Sincerely,

Delos M. Cosgrove, MD
CEO and President

what's inside

Chairman's Letter

Dear Colleagues,

I appreciate your interest in the Neurological Institute's 2016 outcomes. This annual publication is a testament to Cleveland Clinic's commitment to monitoring and reporting outcomes to continuously improve patient care.

Last year was an active one for the Neurological Institute. Noteworthy clinical and research accomplishments by our team in 2016 included the following:

- Leadership of a major new four-center study comparing ketamine with electroconvulsive therapy for patients with treatment-resistant depression; the trial attracted an $11.8 million award from the federal Patient-Centered Outcomes Research Institute (PCORI)
- Presentation of the first study of magnetic resonance fingerprinting in patients with multiple sclerosis (MS), with results demonstrating the technology's promise of unprecedented utility in defining tissue damage in MS and guiding future care
- Designation as the coordinating site for the newly formed Dementia with Lewy Bodies Consortium, funded by a $6 million, five-year NIH grant
- Continued growth of our virtual healthcare offerings to increase patient access, through expansion of our telestroke network and our ever-broadening teleneurology program
- Launch of the first-in-human trial of deep brain stimulation for stroke recovery, with support from an NIH BRAIN (Brain Research through Advancing Innovative Neurotechnologies) award
- Rollout of an ambitious population health pilot initiative for patients with chronic low back pain that prioritizes pain rehabilitation and functional outcomes

We welcome your feedback, questions, and ideas for collaboration. Please contact me via email at OutcomesBooksFeedback@ccf.org and reference the Neurological Institute book in your message.

Sincerely,

A. Machado

Andre Machado, MD, PhD
Chairman, Neurological Institute
The Charles and Christine Carroll Family Endowed Chair in Functional Neurosurgery

Institute Overview

Cleveland Clinic's Neurological Institute is consistently ranked among the top 10 neurology and neurosurgery programs in *U.S. News & World Report*'s "Best Hospitals" survey, and 2016 was no exception. The institute's specialists manage common to highly complex disorders of the nervous system in adults and children, advancing innovations such as the use of staged stereotactic radiosurgery for large brain metastases and magnetic resonance fingerprinting for assessing tissue damage in multiple sclerosis. This clinical expertise is complemented by research initiatives across hundreds of clinical trials and a wealth of laboratory and translational investigations.

The institute includes more than 300 professional staff and is structured into four departments — Neurology, Neurological Surgery, Physical Medicine and Rehabilitation, and Psychiatry and Psychology — that oversee training and coordinate services across 14 subspecialized centers through which patients access care. Each center promotes a multidisciplinary approach to the diagnosis and treatment of a particular disorder or group of diseases. Clinicians in these centers care for patients at Cleveland Clinic hospitals and family health centers across northeast Ohio as well as in Las Vegas and in Weston, FL. Access is further enhanced by the Neurological Institute's growing virtual healthcare offerings, including a mature telestroke network and an expanding teleneurology program.

Data-informed practice is central to Neurological Institute caregiving, as exemplified by the institute's Knowledge Program© platform for collecting patient-reported outcomes for real-time integration into clinical workflows. Together with an extensive collection of care paths and a broad healthcare mobile app strategy, this platform is advancing Cleveland Clinic toward use of predictive analytics to improve patient outcomes and enhance healthcare value across the spectrum of neurological disease.

Institute Overview

Neurological Institute Departments and Centers
Department of Neurology
Department of Neurological Surgery
Department of Physical Medicine and Rehabilitation
Department of Psychiatry and Psychology
Center for Behavioral Health
Lou Ruvo Center for Brain Health
Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center
Cerebrovascular Center
Concussion Center
Epilepsy Center
Mellen Center for Multiple Sclerosis Treatment and Research
Center for Neuroimaging
Center for Neurological Restoration
Neuromuscular Center
Center for Pediatric Neurology and Neurosurgery
Center for Regional Neurosciences
Sleep Disorders Center
Center for Spine Health

2016 Clinical and Research Staffing	
Staff physicians	244
Clinical residents and fellows	155
Research fellows	26
Advanced practice nurses	57
Physician assistants	41
Medical students (neurology rotation)	99

Inpatient Facilities (Cleveland Clinic Main Campus)	
Inpatient general neuro beds	50
Neuro ICU beds	24
Neuro step-down beds	16
Epilepsy monitoring unit beds — pediatrics	9
Epilepsy monitoring unit beds — adult	15
Inpatient rehabilitation beds	17

Inpatient Facilities (Cleveland Clinic Regional Hospitals)	
Epilepsy monitoring unit beds — adult	8
Psychiatric unit beds	265
Rehabilitation beds	122

Institute Overview

Initial Outpatient Visits[a] (by Center/Department)	12,525
Brain Health	1866
Brain Tumor and Neuro-Oncology	319
Cerebrovascular	340
Concussion	100
Epilepsy	709
Mellen Center/Multiple Sclerosis	753
Neurological Restoration	1474
Neurology	581
Neuromuscular	916
Pediatric Neurology[b]	563
Pediatric Neurosurgery[b]	64
Physical Medicine and Rehabilitation	173
Psychiatry and Psychology	553
Regional Neurosciences	1964
Sleep Disorders	142
Spine Health	2008

Total Outpatient Visits (by Center/Department)	228,548
Brain Health	11,293
Brain Tumor and Neuro-Oncology	6692
Cerebrovascular	3881
Concussion	775
Epilepsy	8355
Mellen Center/Multiple Sclerosis	7538
Neurological Restoration	21,632
Neurology	5563
Neuromuscular	6607
Pediatric Neurology[b]	7117
Pediatric Neurosurgery[b]	885
Physical Medicine and Rehabilitation	2791
Psychiatry and Psychology	60,940
Regional Neurosciences	47,275
Sleep Disorders	5912
Spine Health	31,292

[a]Numbers represent initial visits for patients new to Cleveland Clinic.

[b]Children and adolescents are also included under Epilepsy, Psychiatry and Psychology, and Sleep Disorders.

Admissions	16,289
Brain Tumor and Neuro-Oncology	743
Cerebrovascular	1361
Epilepsy	1546
Neurological Restoration	421
Neurology	579
Pediatric Neurosurgery[a]	144
Physical Medicine and Rehabilitation	380
Psychiatry and Psychology[b]	9766
Regional Neurosciences	75
Spine Health	1274

Inpatient Days	95,061
Brain Tumor and Neuro-Oncology	3812
Cerebrovascular	8100
Epilepsy	7947
Neurological Restoration	1857
Neurology	3504
Pediatric Neurosurgery[a]	867
Physical Medicine and Rehabilitation	4968
Psychiatry and Psychology[b]	56,935
Regional Neurosciences	361
Spine Health	6710

Surgical/Interventional Procedures	14,215
Brain Tumor and Neuro-Oncology	1225
Cerebrovascular	1619
Epilepsy	390
Neurological Restoration	602
Pediatric Neurosurgery[a]	181
Psychiatry[b]	1745
Regional Neurosciences	1784
Spine Health	6669

Neuroimaging Studies[c]	
Total CT brain scans	32,646
Total MR brain procedures	45,032
Total cerebral angiography procedures	5102

[a]Children and adolescents are also included under Epilepsy and Psychiatry/Psychology.

[b]Number includes totals from the following Cleveland Clinic regional hospitals: Euclid, Fairview, Hillcrest, Lutheran, Marymount, and South Pointe.

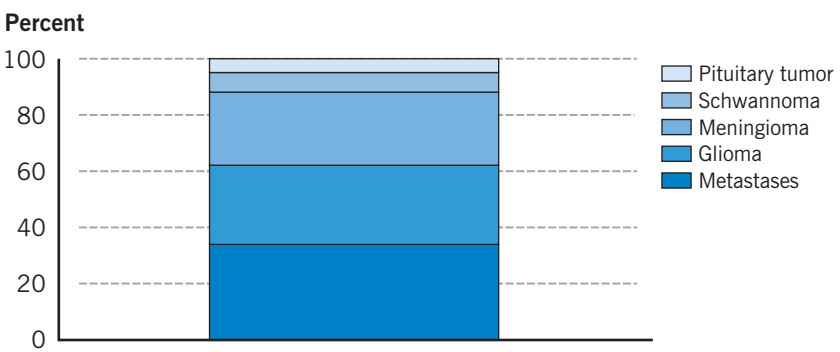
[c]Numbers represent studies performed at main campus, Cleveland Clinic satellites, and family health centers.

Brain Tumors

The Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center (BBTC) of the Neurological Institute is one of the largest and most comprehensive programs in the country and is dedicated to providing exceptional patient care including surgery, radiation, chemotherapy, and clinical research trials for brain tumor patients. Patient care is provided by a multidisciplinary team consisting of neurosurgeons, radiation oncologists, neuro-oncologists, medical oncologists, psychiatrists, and neuropsychologists, along with nurses, physician assistants, case managers, and social workers who all specialize in treating patients with brain tumors. The BBTC is dedicated to bringing patients novel treatment options emerging from the institute's extensive basic and translational research programs. The primary mission is to offer excellent care through surgical intervention, as well as conducting clinical research to enhance patient outcomes. The BBTC enrolled 342 patients in therapeutic research trials in the past 5 years (2012–2016).

Brain Tumor Diagnosis Distribution (N = 2015)

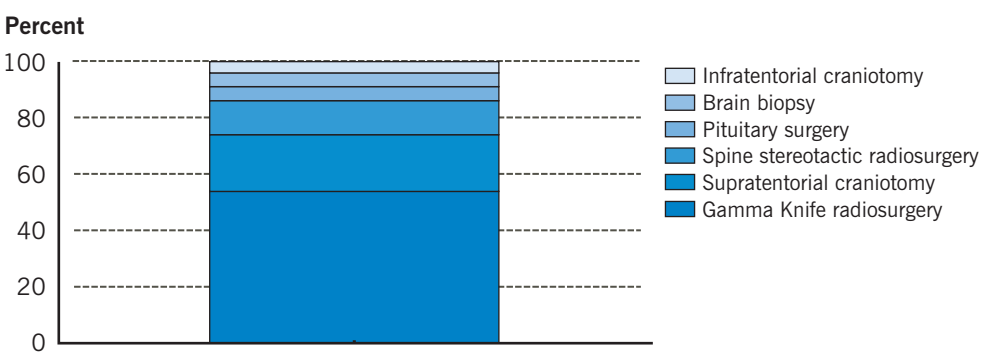
2016



In 2016, gliomas remain the most common brain tumor for patients treated in the BBTC.

Brain Tumor Procedures (N = 1136)

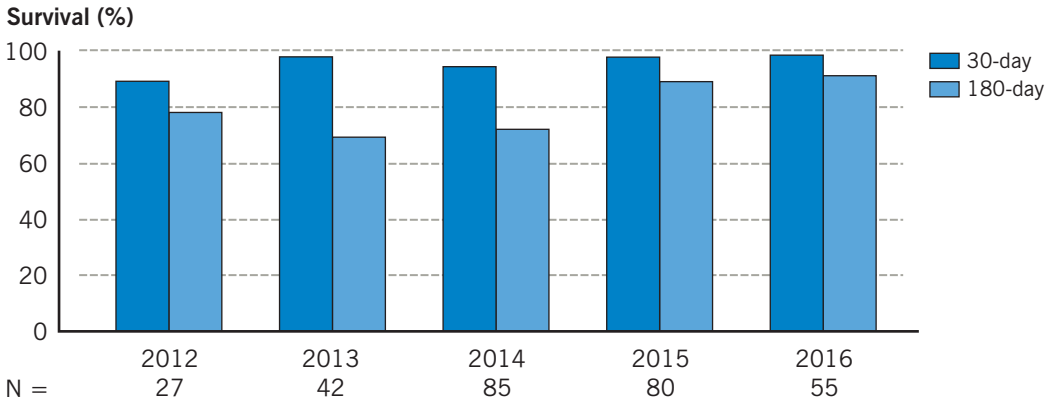
2016



Gamma Knife® radiosurgery is the most common procedure performed, followed by supratentorial craniotomy and spine stereotactic radiosurgery.

Brain Biopsy

Brain Biopsy: Survival

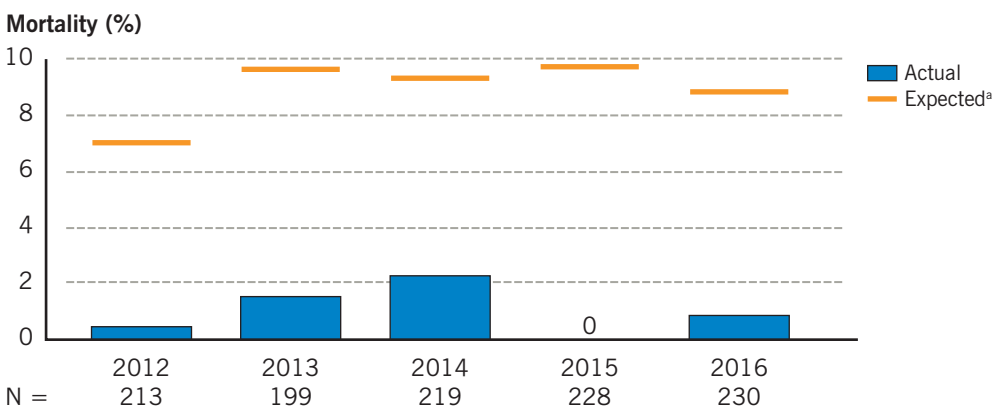


Thirty- and 180-day survival for brain biopsies was 98% and 91%, respectively (for the first 6 months of 2016).

For this and subsequent graphs, data have been updated from prior years.

Supratentorial Craniotomy

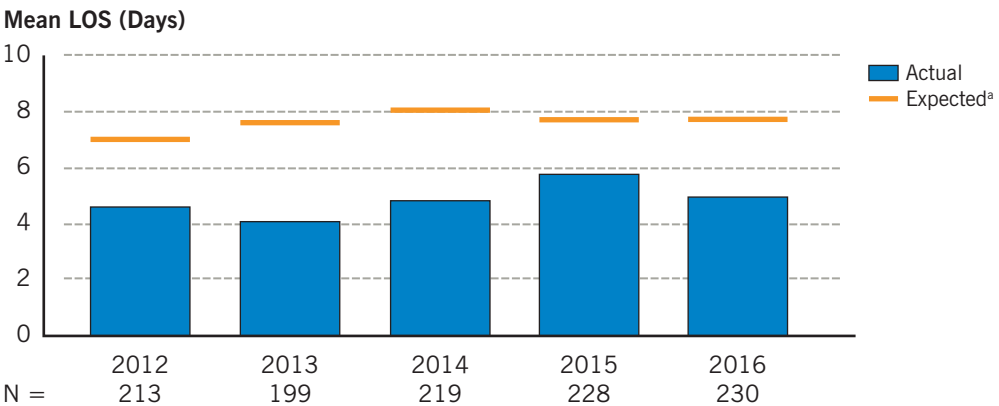
Supratentorial Craniotomy: Inpatient Mortality



Inpatient mortality remained significantly lower than expected, continuing the trend over the past 5 years. N = number of supratentorial craniotomies performed for brain tumor per year.

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Supratentorial Craniotomy: Length of Stay



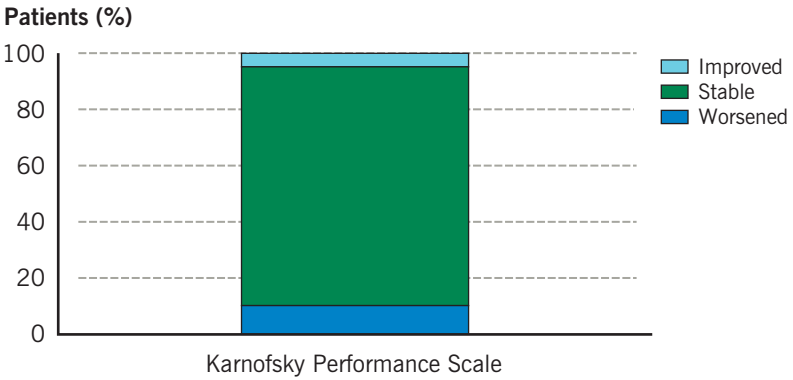
Mean length of stay (LOS) remained lower than predicted, continuing the trend over the past 5 years.

LOS = length of stay

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Supratentorial Craniotomy: Karnofsky Performance Scale (N = 146)

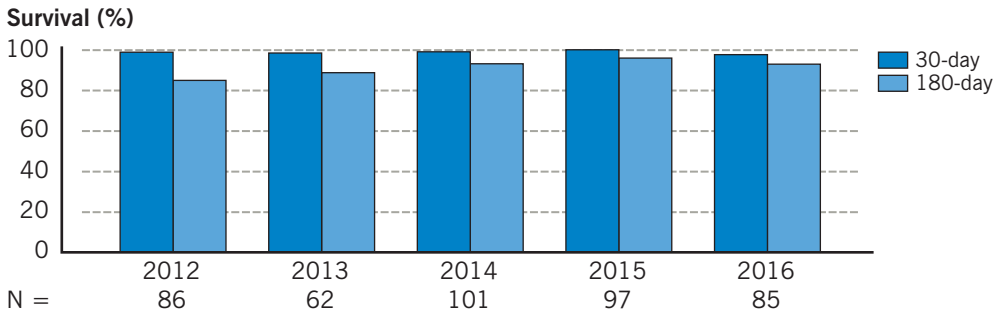
2016



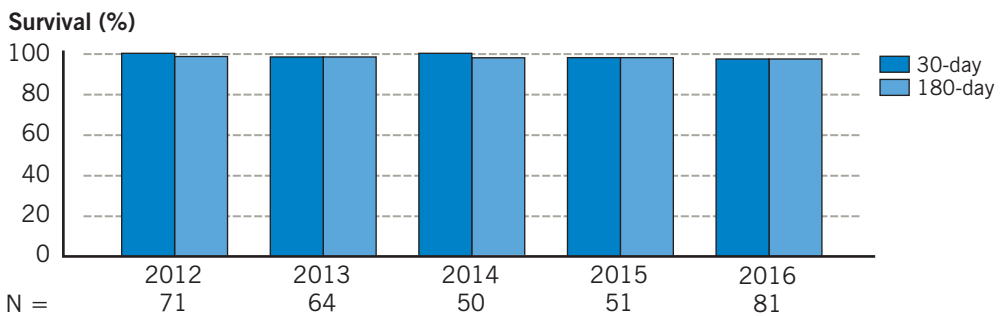
Functional status is measured by the Karnofsky Performance Scale (KPS), a widely used 11-point scale correlating to percentage values from 100% (no evidence of disease, no symptoms) to 0% (death). Performance status was stable or improved in approximately 90% of patients immediately after supratentorial craniotomy. Change in KPS status was defined as a change of ≥ 20 points.

Supratentorial Craniotomy: Survival by Tumor Type

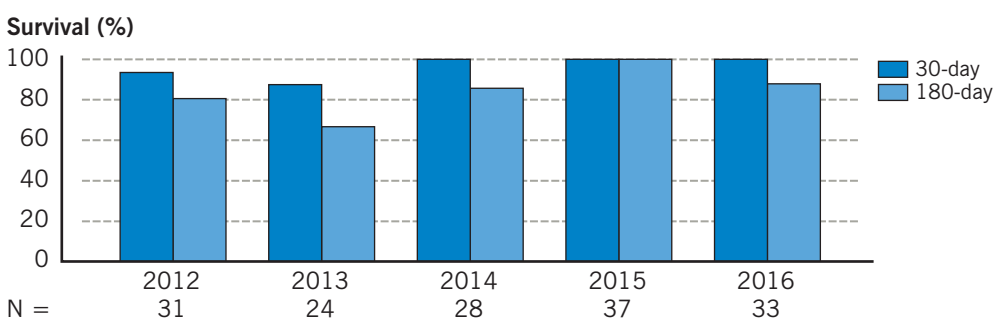
Glioma: Survival



Meningioma: Survival

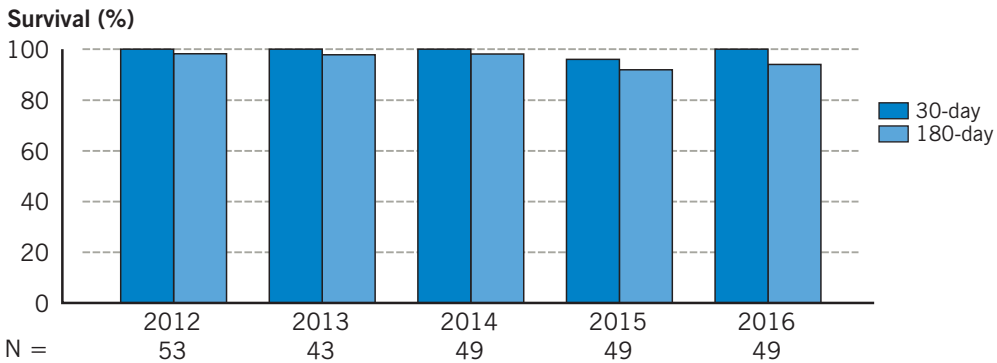


Metastasis: Survival



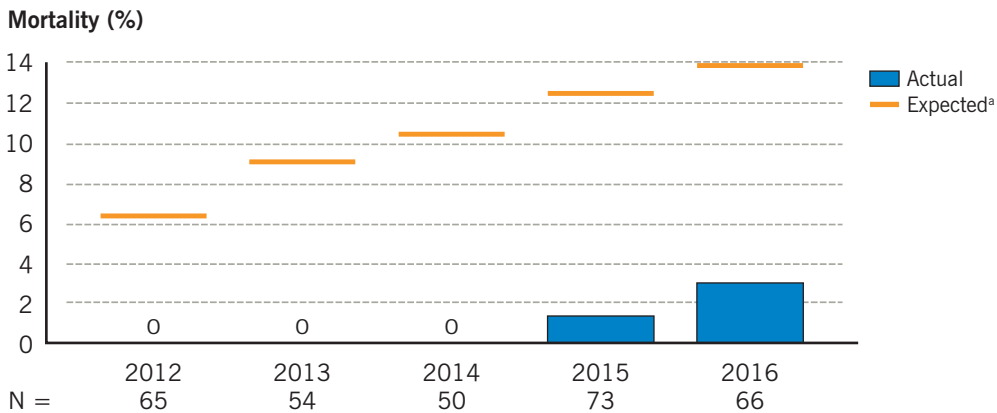
Infratentorial Craniotomy

Infratentorial Craniotomy: Survival



Thirty- and 180-day survival for infratentorial craniotomies was 100% and 94%, respectively (for the first 6 months of 2016).

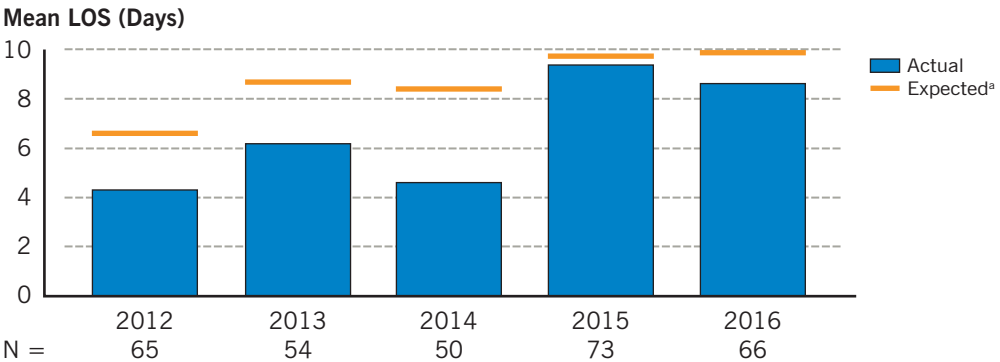
Infratentorial Craniotomy: Inpatient Mortality



There have been only 3 inpatient deaths in those undergoing infratentorial craniotomy for brain tumor at Cleveland Clinic in the past 5 years, which is below the expected number based on national normative data. N = number of infratentorial craniotomies performed for brain tumor per year.

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Infratentorial Craniotomy: Length of Stay

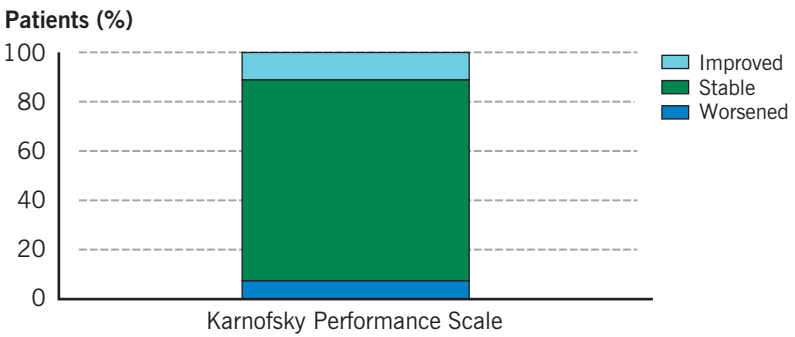


Mean LOS has remained lower than predicted over the past 5 years.

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Infratentorial Craniotomy: Karnofsky Performance Scale (N = 27)

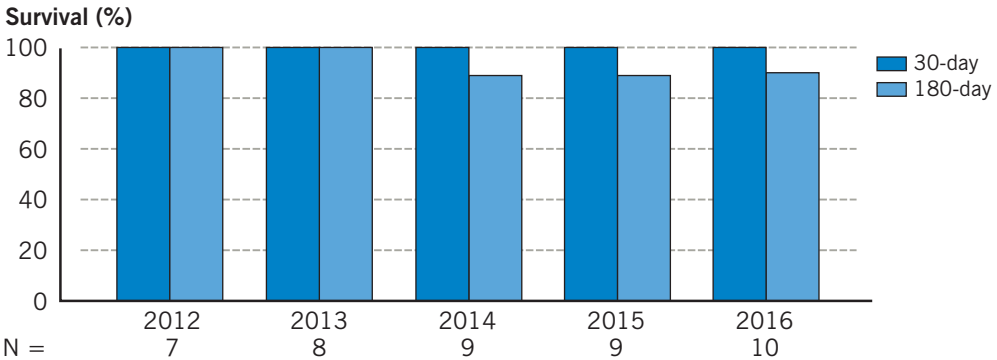
2016



Performance status, as measured by the KPS, was stable or improved in 93% of patients undergoing infratentorial craniotomy. Change in KPS status was defined as a change of ≥ 20 points.

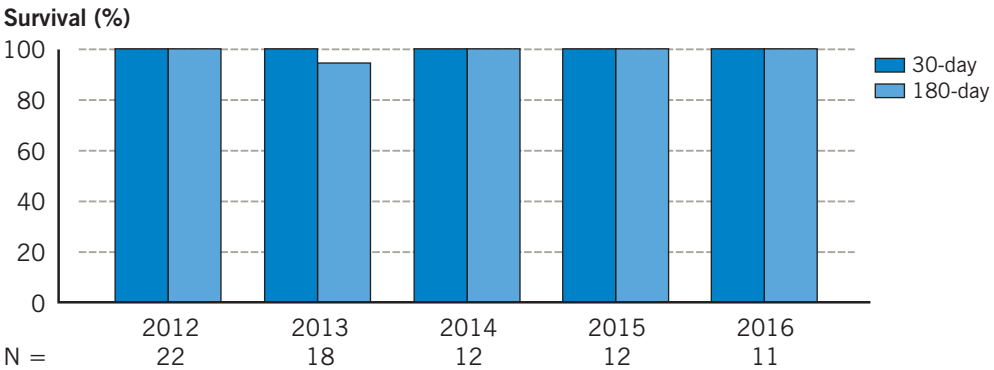
Infratentorial Craniotomy: Survival by Tumor Type

Glioma: Survival

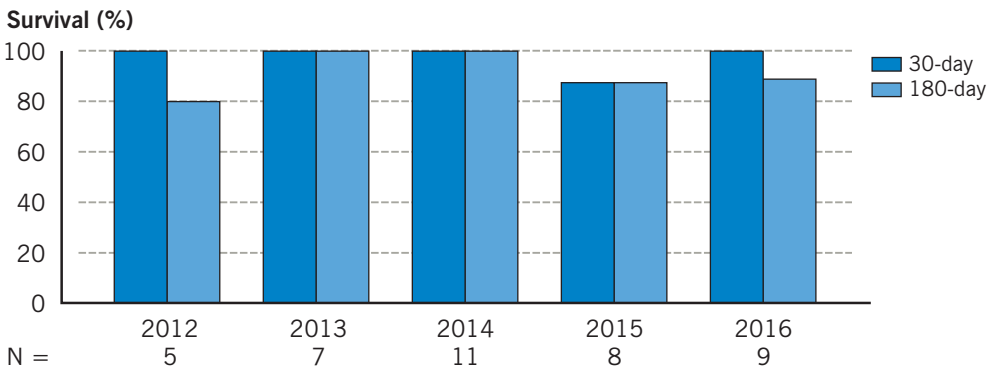


Thirty-day survival was 100% for infratentorial craniotomy for glioma, meningioma, metastases, and schwannoma (for the first 6 months of 2016).

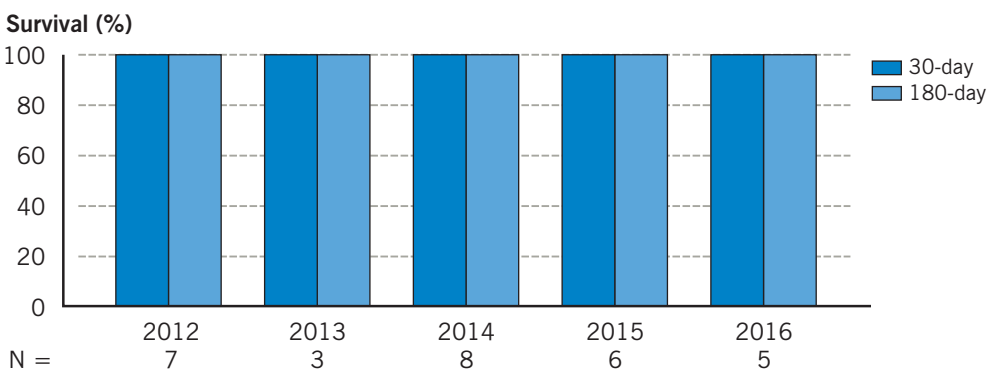
Meningioma: Survival



Metastasis: Survival

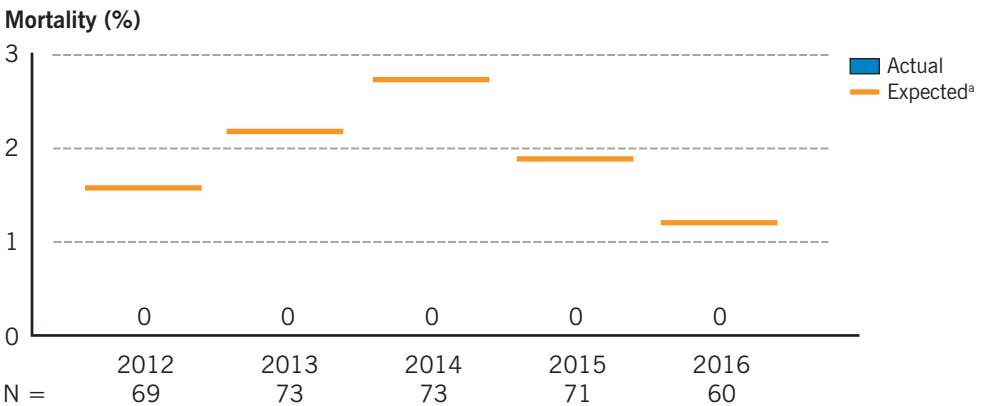


Schwannoma: Survival



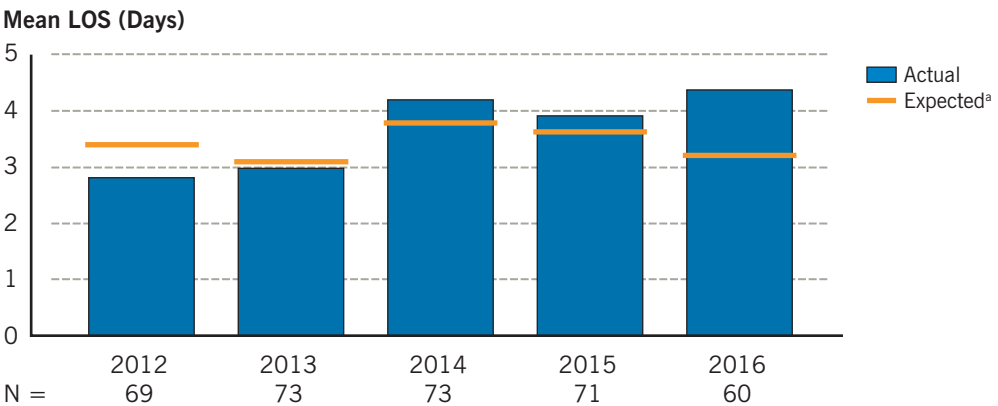
Pituitary Surgery

Pituitary Surgery: Inpatient Mortality



[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Pituitary Surgery: Length of Stay

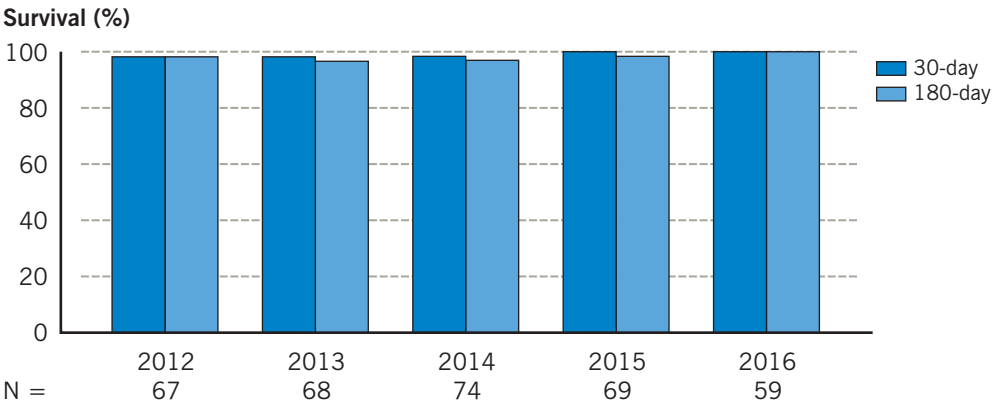


Following pituitary surgery, there have been no surgical inpatient deaths in the past 5 years, and actual LOS has been below or close to expected LOS.

LOS = length of stay

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

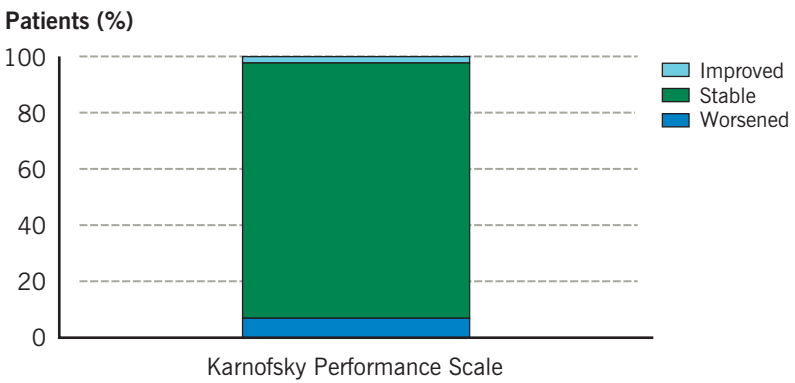
Pituitary Surgery: Survival



Thirty- and 180-day survival was 100% for pituitary surgery (for the first 6 months of 2016). N = number of pituitary tumor surgeries per year, based on available data.

Pituitary Surgery: Karnofsky Performance Scale (N = 44)

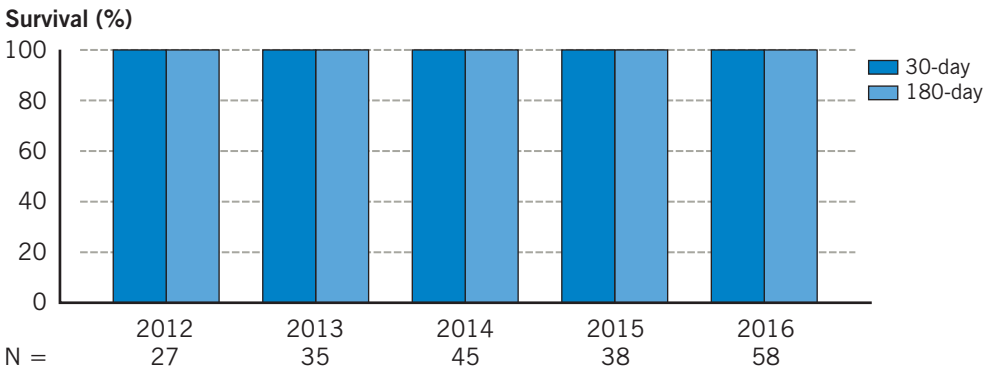
2016



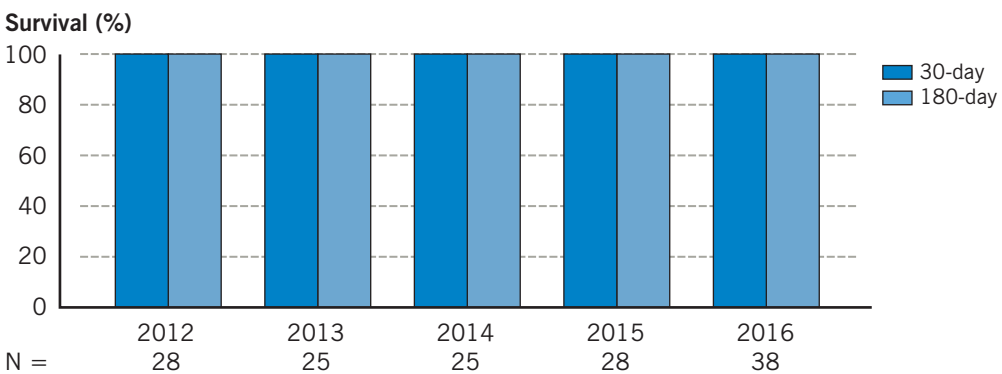
Performance status, as measured by the KPS, was stable or improved in 93% of patients within 30 days of pituitary surgery. Change in KPS status was defined as a change of ≥ 20 points.

Stereotactic Radiosurgery: Gamma Knife

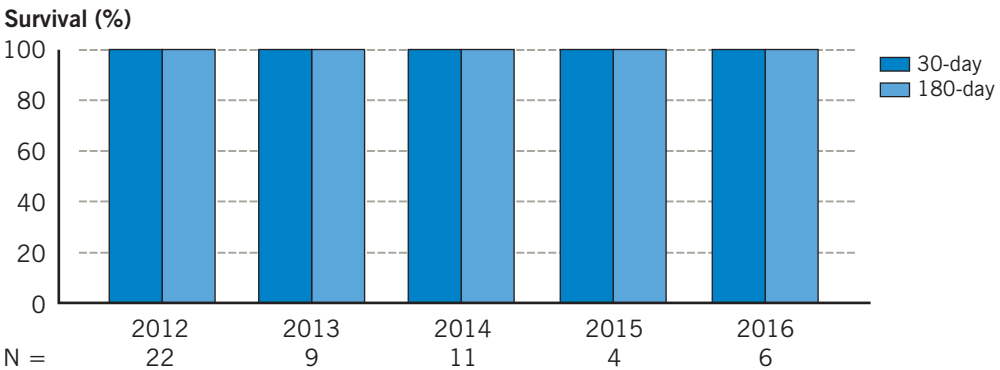
Gamma Knife Radiosurgery: Meningioma Survival



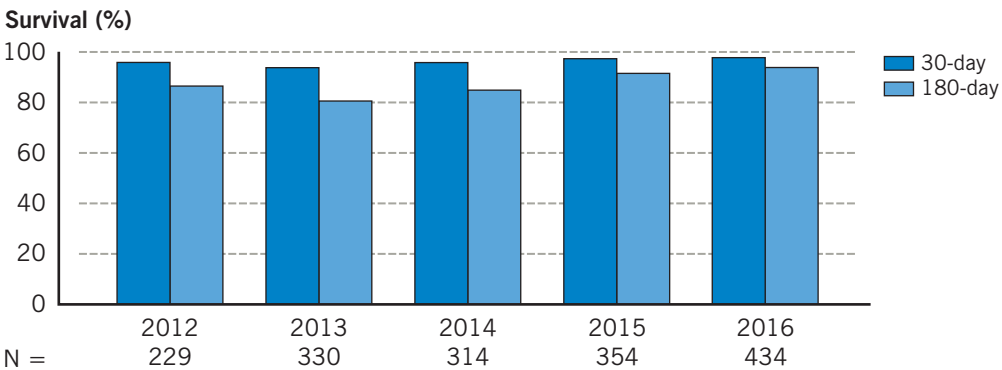
Gamma Knife Radiosurgery: Schwannoma Survival



Gamma Knife Radiosurgery: Pituitary Tumor Survival

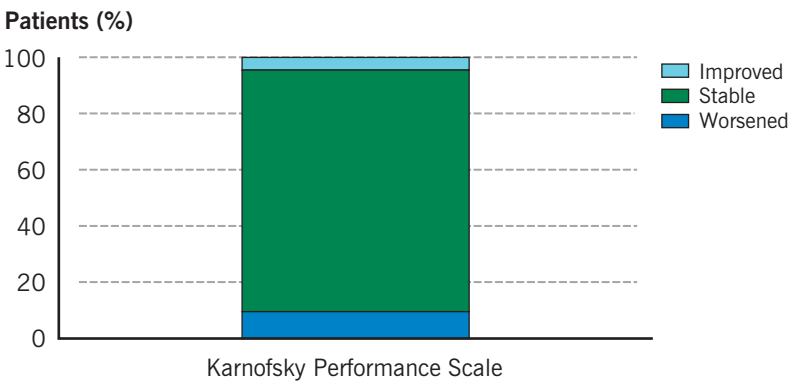


Gamma Knife Radiosurgery: Metastasis Survival



Gamma Knife Radiosurgery: Karnofsky Performance Scale (N = 221)

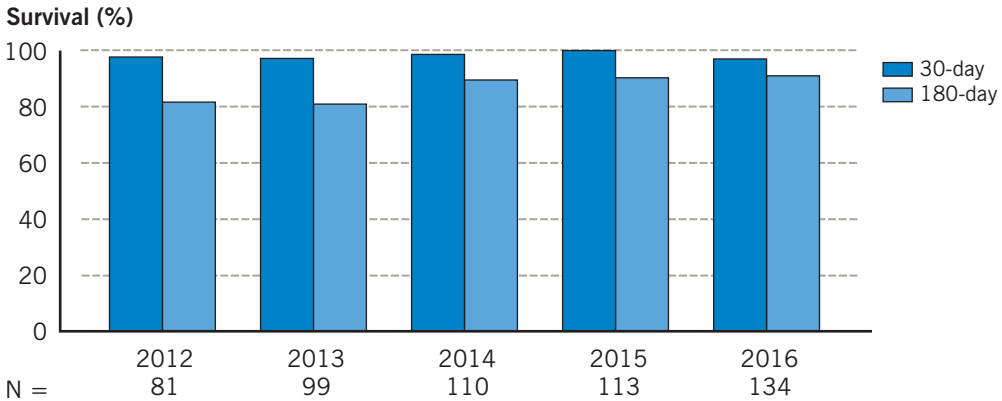
2016



Performance status, as measured by the KPS, remained stable or improved in 91% of patients after stereotactic radiosurgery. Change in KPS status was defined as a change of ≥ 20 points.

Spine Stereotactic Radiosurgery

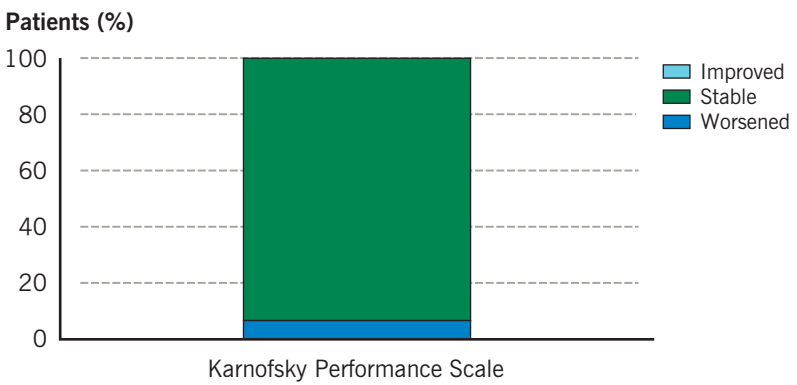
Spine Stereotactic Radiosurgery: Survival



In 2016, 134 patients were treated with spine stereotactic radiosurgery, which is mainly used to treat malignant and metastatic tumors of the spine. Thirty- and 180-day survival for these patients was 97% and 91%, respectively (for the first 6 months of 2016).

Spine Stereotactic Radiosurgery: Karnofsky Performance Scale (N = 30)

2016



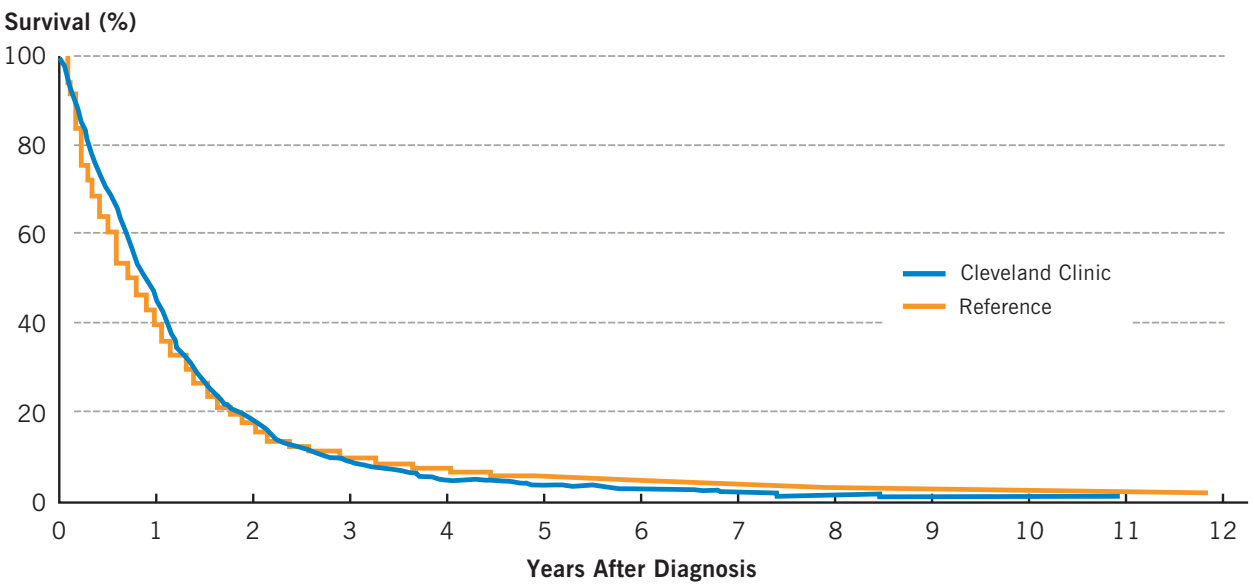
Performance status, as measured by the KPS, was stable in 93% of patients after spine stereotactic radiosurgery. Change in KPS status was defined as a change of ≥ 20 points.

Glioblastoma

In 2016, 76 patients with newly diagnosed glioblastoma, the most common type of malignant primary brain tumor, underwent initial surgical resection and treatment at Cleveland Clinic. Approximately 12,000 cases of glioblastoma are diagnosed each year in the United States.

Glioblastoma Treatment: Survival (N = 826)

2001 – 2012



Reference = Software: Surveillance Research Program, National Cancer Institute SEER*Stat software (seer.cancer.gov/seerstat) version 8.3.3. Data: Surveillance, Epidemiology, and End Results (SEER) Program (seer.cancer.gov) SEER*Stat Database: Incidence - SEER 18 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2015 Sub (1973-2013 varying) - Linked To County Attributes - Total U.S., 1969-2014 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Surveillance Systems Branch, released April 2016, based on the November 2015 submission.

Cerebrovascular Disease

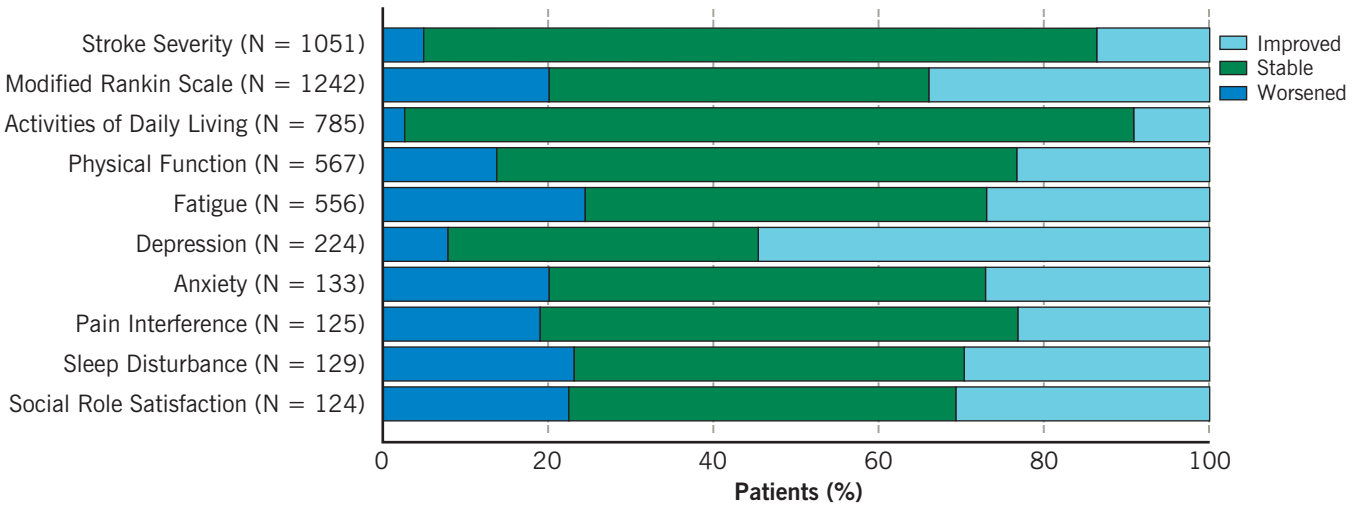
Clinical Measure	Measure Description	GWTG Stroke Performance Award Goal	2016 National Average	2012	2013	2014[a]	2015[a]	2016[a]
				Cleveland Clinic				
IV rt-PA 2 hour, treat by 3 hour	Acute stroke patients who arrive at the hospital within 120 minutes (2 hours) of time last known well and for whom IV rt-PA was initiated at this hospital within 180 minutes (3 hours) of time last known well.	85.0%	**90.0%**	100% (20/20)	86.7% (13/15)	81.3% (13/16)	100.0% (9/9)	**95.5% (21/22)**
Early antithrombotics	Patients with ischemic stroke or TIA who receive antithrombotic therapy by the end of hospital day 2.	85.0%	**98.1%**	92.4% (414/448)	95.7% (225/235)	99.1% (223/225)	96.3% (234/243)	**96.4% (187/194)**
Antithrombotics at discharge	Patients with ischemic stroke or TIA prescribed antithrombotic therapy at discharge (e.g., warfarin, aspirin, other antiplatelet drug).	85.0%	**99.4%**	99.4% (641/645)	99.7% (311/312)	99.7% (350/351)	100.0% (326/326)	**99.7% (289/290)**
Anticoagulation for atrial fibrillation/ atrial flutter	Patients with ischemic stroke or TIA with atrial fibrillation/ flutter who are discharged on anticoagulation therapy.	85.0%	**97.1%**	93.7% (74/79)	98.1% (51/52)	91.5% (54/59)	100.0% (48/48)	**98.4% (62/63)**
DVT prophylaxis	Patients with ischemic stroke, TIA, or a hemorrhagic stroke and who are nonambulatory who receive DVT prophylaxis by end of hospital day 2.	85.0%	**98.0%**	96.5% (744/771)	99.6% (467/469)	99.6% (481/483)	99.6% (452/454)	**99.8% (485/486)**
Lipids measure (statin at discharge)	Ischemic stroke or TIA patients with LDL > 100, or LDL not measured, or on cholesterol-reducer prior to admission, who are discharged on cholesterol-reducing drugs.	85.0%	**97.7%**	96.8% (454/469)	98.6% (208/211)	96.2% (250/260)	97.7% (251/257)	**99.3% (269/271)**
Stroke education	Patients with ischemic, TIA, or hemorrhagic stroke or their caregivers who were given education and/or educational materials during the hospital stay.	85.0%	**96.6%**	91.1% (344/366)	97.7% (169/173)	94.3% (215/228)	96.2% (203/211)	**93.3% (182/195)**
Rehabilitation considered	Patients with ischemic or hemorrhagic stroke who were assessed for rehabilitation services.	85.0%	**99.2%**	94.5% (724/766)	97.6% (439/450)	97.4% (454/466)	98.2% (437/445)	**99.4% (469/472)**

[a] In 2014, 2015, and 2016, Cleveland Clinic abstracted 50% of available patients for Get With the Guideline Stroke Performance goal compliance for all clinical measures.

Get With The Guidelines® (GWTG) is the premier hospital-based quality improvement program for the American Heart Association and the American Stroke Association, empowering healthcare provider teams to consistently treat stroke patients using current evidence-based guidelines. Cleveland Clinic uses the GWTG aggregate comparative data for internal quality improvement. 2016 rates are taken from the GWTG-Joint Commission Primary Stroke Center Reporting Tool, "STK Measure Set" as of February 2017.

Change in Outcomes After Acute Stroke

2009 – 2016



The graph illustrates changes between the first score after stroke and the last follow-up visit in patients treated for acute ischemic and hemorrhagic stroke. Stroke severity was measured by the National Institutes of Health Stroke Scale (NIHSS), a brief, reliable measure of severity of neurological impairment following stroke. Clinically meaningful change was defined as ≥ 2 points difference between measurements. The modified Rankin Scale is a global disability scale for overall assessment of disability. Any difference between measurements was considered clinically meaningful. Activities of daily living were measured by the Barthel Index, a measure of disability widely used for stroke. Clinically meaningful change was defined as ≥ 9 points difference between measurements. Physical function, fatigue, anxiety, pain interference, sleep disturbance, and social role satisfaction were measured by the Patient-Reported Outcomes Measurement Information System (PROMIS®)[1] set of measures. Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation. Depression was measured by the Patient Health Questionnaire (PHQ-9), a self-reported measure of depression. Only those with depression at early assessment (score ≥ 10 points) were included in the analysis. Meaningful change was defined as ≥ 5 points.

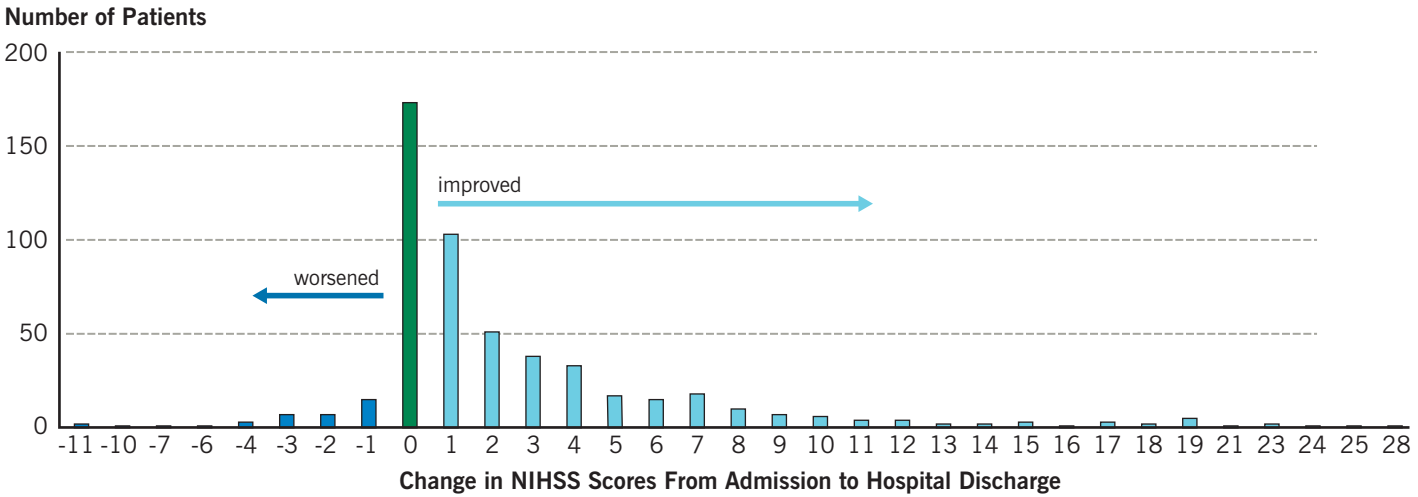
Median duration between assessments ranged from 358 to 371 days, depending on the outcome.

Reference

1. Cella D, Yount S, Rothrock N, Gershon R, Cook K, Reeve B, Ader D, Fries JF, Bruce B, Rose M, on behalf of the PROMIS Cooperative Group. The Patient-Reported Outcomes Measurement Information System (PROMIS). *Med Care*. 2007 May;45(5 Suppl 1):S3-S11.

Change in Neurological Impairment Over Acute Hospital Course for Ischemic Stroke (N = 540)

2016

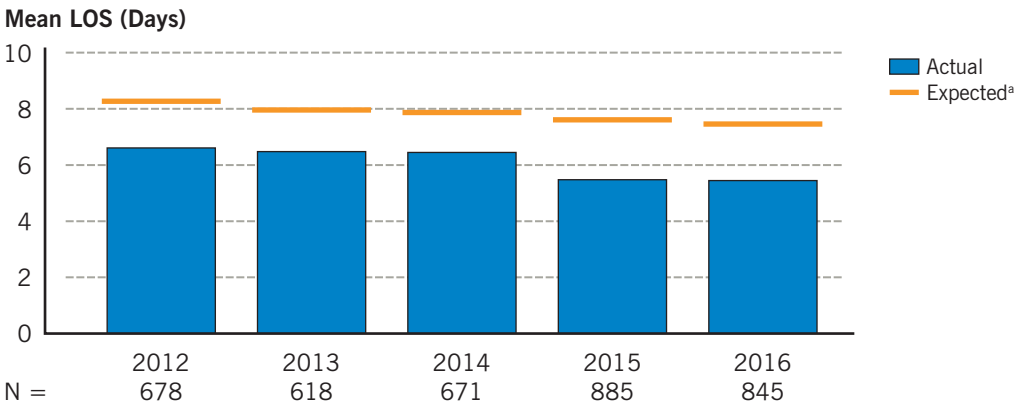


NIHSS = National Institutes of Health Stroke Scale

Change in NIHSS score is calculated as score at admission minus score at discharge. Lower scores on the NIHSS reflect less neurological impairment; therefore, positive changes reflect improvement. Overall, during 2016, 62% of patients improved, 32% remained stable, and 7% worsened over the acute hospital admission for stroke.

Ischemic Stroke

Ischemic Stroke: Length of Stay

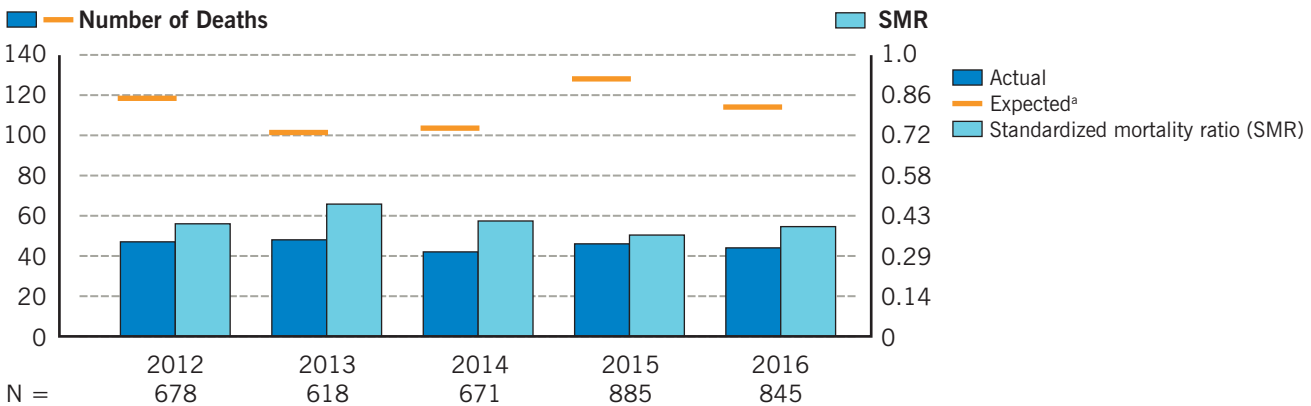


Actual mean length of stay is shorter than expected for patients treated for ischemic stroke at Cleveland Clinic.

LOS = length of stay

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Ischemic Stroke: Inpatient Mortality

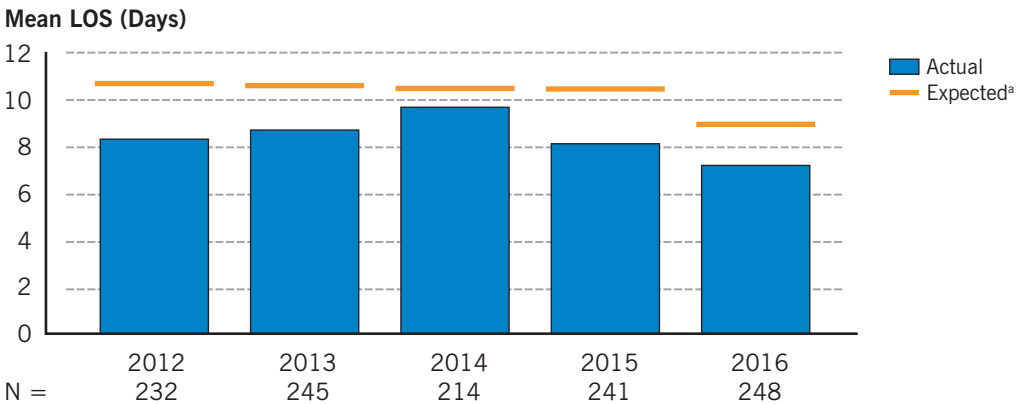


[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Among inpatients treated for ischemic stroke at Cleveland Clinic, actual mortality is below expected.

Hemorrhagic Stroke

Intracerebral Hemorrhage: Length of Stay

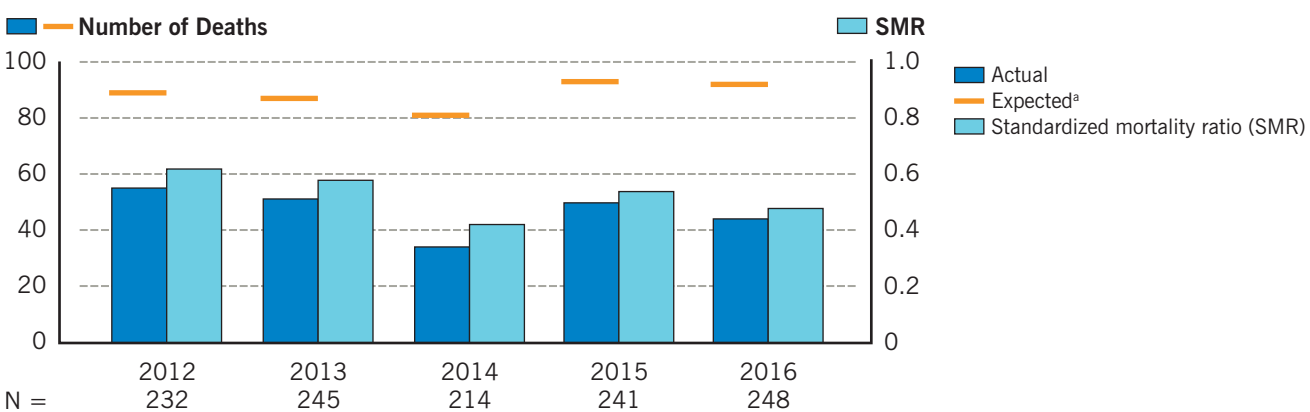


Among inpatients treated for intracerebral hemorrhage at Cleveland Clinic, mean LOS is shorter than expected.

LOS = length of stay

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Intracerebral Hemorrhage: Inpatient Mortality

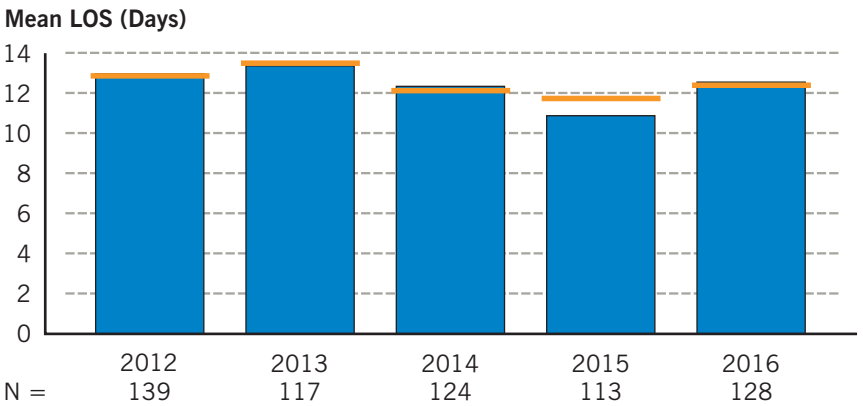


[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Inpatient mortality for intracerebral hemorrhage is below the expected rate.

Subarachnoid Hemorrhage

Subarachnoid Hemorrhage: Length of Stay

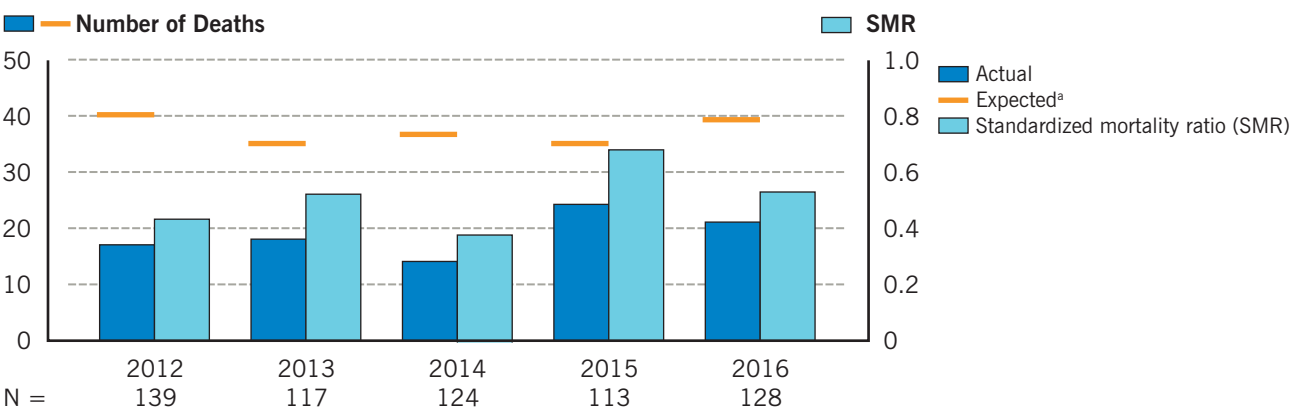


Among inpatients treated for subarachnoid hemorrhage at Cleveland Clinic, mean LOS was shorter than expected in 2015.

LOS = length of stay

[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Subarachnoid Hemorrhage: Inpatient Mortality



[a]The 3M™ All Patient Refined Diagnosis Related Groups (APR DRG) Classification System is used for adjusting data for severity of illness and risk of mortality. solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software.

Inpatient mortality due to subarachnoid hemorrhage is below the expected rate.

Ischemic Stroke, Intracerebral Hemorrhage, and Subarachnoid Hemorrhage: Discharge Status (N = 855)

2016

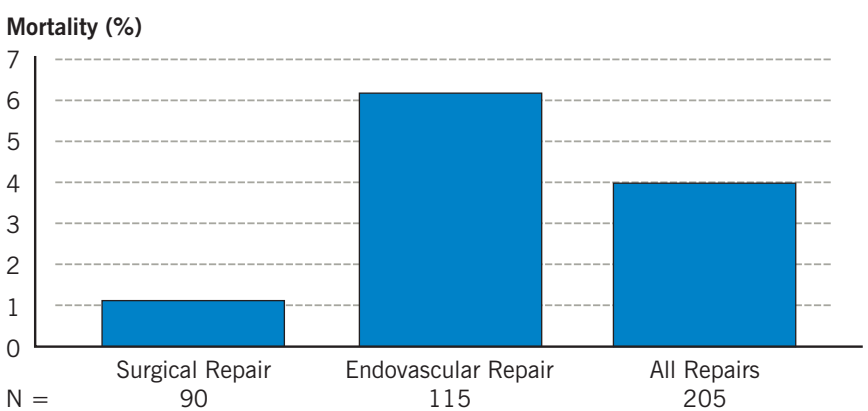
	Ischemic Stroke (N = 519)	Intracerebral Hemorrhage (N = 236)	Subarachnoid Hemorrhage (N = 100)
Home (%)	39	28	43
Acute rehabilitation (%)	28	28	18
Skilled nursing facility/interim care (%)	19	19	14
Long-term acute care hospital (%)	2	5	0
Inpatient death (%)	5	10	16[a]
Other (%)	7	10	9

[a]The national average for inpatient death following subarachnoid hemorrhage was 13.3% from 2001 to 2009, and 15.8% in those 50 years of age and older.[1] The average age of this Cleveland Clinic patient population in 2016 was 60 years.

Aneurysm Repair

Aneurysm Repair: Inpatient Mortality (N = 205)

2016



Brain aneurysms can be repaired either surgically or with a nonsurgical endovascular procedure. The Cerebrovascular Center performed a total of 205 aneurysm repairs in 2016, including both ruptured and unruptured aneurysms. Surgical aneurysm repair was identified as those procedures associated with CPT codes 61613, 61697, 61698, 61700, 61702, 61703, 61705, 61708, and 61710. Nonsurgical/endovascular aneurysm repair was identified as those procedures associated with CPT code 61624.

Reference

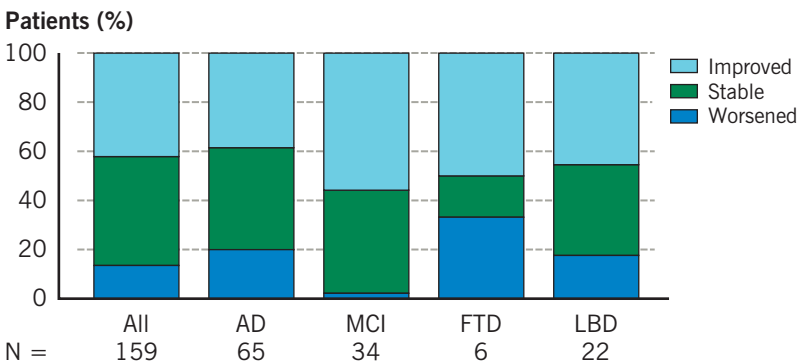
1. Brinjikji W, Lanzino G, Rabinstein AA, Kallmes DF, Cloft HJ. Age-related trends in the treatment and outcomes of ruptured cerebral aneurysms: a study of the nationwide inpatient sample 2001-2009. *AJNR Am J Neuroradiol*. 2013 May;34(5):1022-1027.

Cognitive Disorders

Cleveland Clinic's Lou Ruvo Center for Brain Health cares for patients with a variety of neurocognitive disorders, including mild cognitive impairment (MCI), Alzheimer disease (AD), Lewy body dementia (LBD), and frontotemporal dementia (FTD). Patients are evaluated for changes in cognition, as measured by the Montreal Cognitive Assessment (MoCA); depressive symptoms, as measured by the Patient Health Questionnaire (PHQ-9); and health-related quality of life, as measured by the Patient-Reported Outcomes Measurement Information System (PROMIS®).

Change in Depressive Symptoms in Patients With Cognitive Disorders (N = 159)

2015 – 2016



AD = Alzheimer disease, FTD = frontotemporal dementia, LBD = Lewy body dementia, MCI = mild cognitive impairment

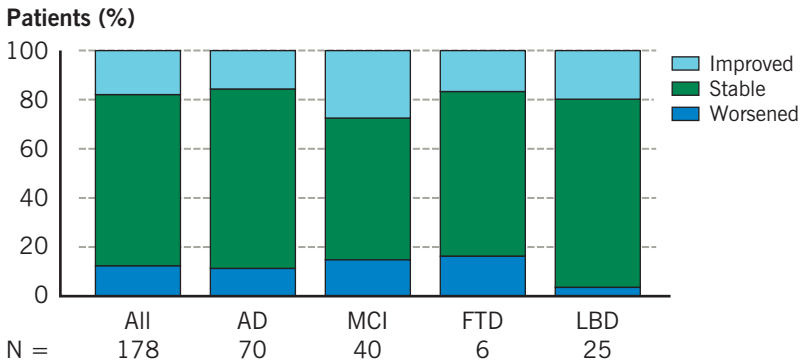
Many patients with neurocognitive disease have comorbid conditions such as depression. Depression is most common in FTD but affects about one-third of patients with AD and MCI. Depression is a treatable comorbidity, and depressive symptoms remained stable or improved in most patients. Data include all patients with at least moderate depressive symptoms, as defined by a PHQ-9 score ≥ 10, at their initial visit. Clinically meaningful change was defined as a total point change of 5 or more.[1] Median interval between assessments ranged from 356 to 404 days, depending on the diagnostic subgroup.

Reference

1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Change in Quality of Life (Mental Health) in Patients With Cognitive Disorders (N = 178)

2015 – 2016

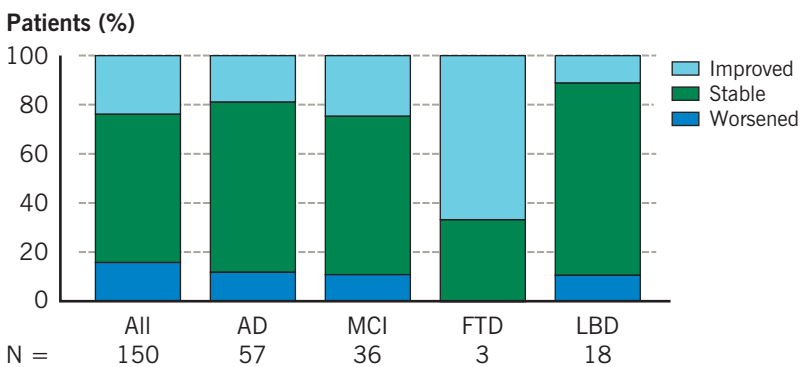


Quality of mental health, as measured by PROMIS Mental Health[1], remained stable or improved in most patients with a baseline score ≤ 45, despite stable or declining cognition. Median interval between assessments ranged from 254 to 286 days, depending on the diagnostic subgroup. Clinically meaningful change was defined as at least a 5-point change in T-score, based on one-half the standard deviation.[2]

AD = Alzheimer disease, FTD = frontotemporal dementia, LBD = Lewy body dementia, MCI = mild cognitive impairment

Change in Quality of Life (Physical Health) in Patients With Cognitive Disorders (N = 150)

2015 – 2016



Quality of physical health, as measured by PROMIS Physical Health[1], remained stable or improved in most patients with a baseline score ≤ 45, despite stable or declining cognition. Median interval between assessments ranged from 255 to 299 days, depending on the diagnostic subgroup. Clinically meaningful change was defined as at least a 5-point change in T-score, based on one-half the standard deviation.[2]

AD = Alzheimer disease, FTD = frontotemporal dementia, LBD = Lewy body dementia, MCI = mild cognitive impairment

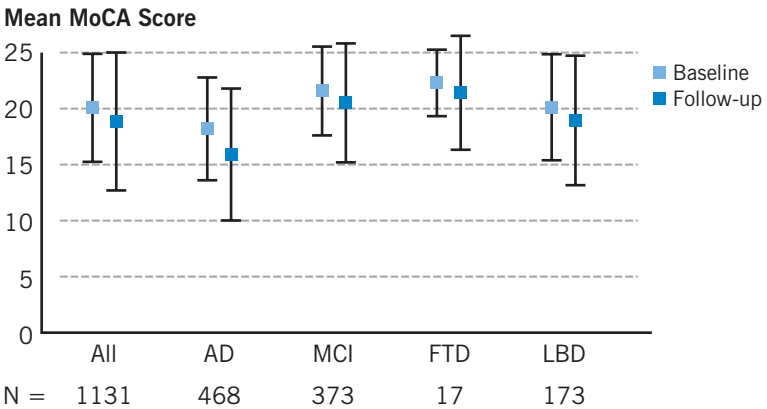
References

1. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Cognitive Functioning in Patients With Cognitive Disorders (N = 1131)

2013 – 2016

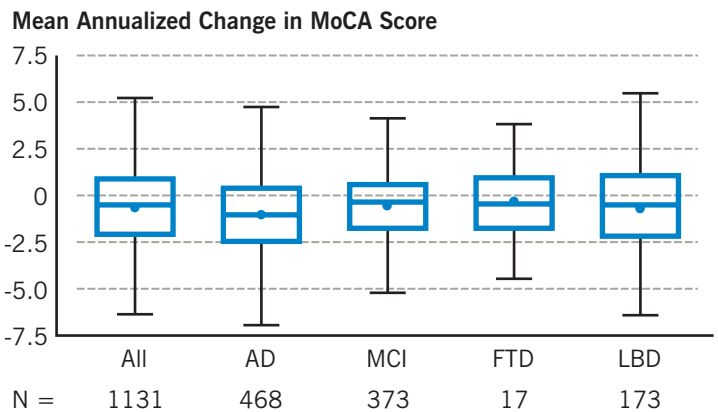


All patients undergo brief cognitive screening using MoCA. Typically, patients are given the MoCA during their initial visit and at various intervals afterward. Changes in MoCA score can be used to track disease progression.

AD = Alzheimer disease, FTD = frontotemporal dementia, LBD = Lewy body dementia, MCI = mild cognitive impairment

Annualized Change in MoCA Scores by Disease Group (N = 1131)

2013 – 2016



At the Lou Ruvo Center, 1131 patients had at least 2 visits between 2013 and 2016 and 1 visit in 2016 with MoCA data available for analysis. Annualized change by disease group ranged from -1 (AD) to -0.39 (FTD). Estimates are similar to those found in the literature, where a small study with 8 mild AD patients revealed a mean annualized change of -1.5[1] and another featuring 53 MCI patients reported a change of -0.52.[2] The standard boxplot represents the 25th, 50th (median), and 75th percentiles. Outliers are not displayed.

AD = Alzheimer disease, FTD = frontotemporal dementia, LBD = Lewy body dementia, MCI = mild cognitive impairment

References

1. Costa AS, Reich A, Fimm B, Ketteler ST, Schulz JB, Reetz K. Evidence of the sensitivity of the MoCA alternate forms in monitoring cognitive change in early Alzheimer's disease. *Dement Geriatr Cogn Disord*. 2014;37(1-2):95-103.

2. Krishnan K, Rossetti H, Hynan LS, Carter K, Falkowski J, Lacritz L, Cullum CM, Weiner M. Changes in Montreal Cognitive Assessment Scores over time. *Assessment*. 2016 Jun 18. pii: 1073191116654217.

Concussion

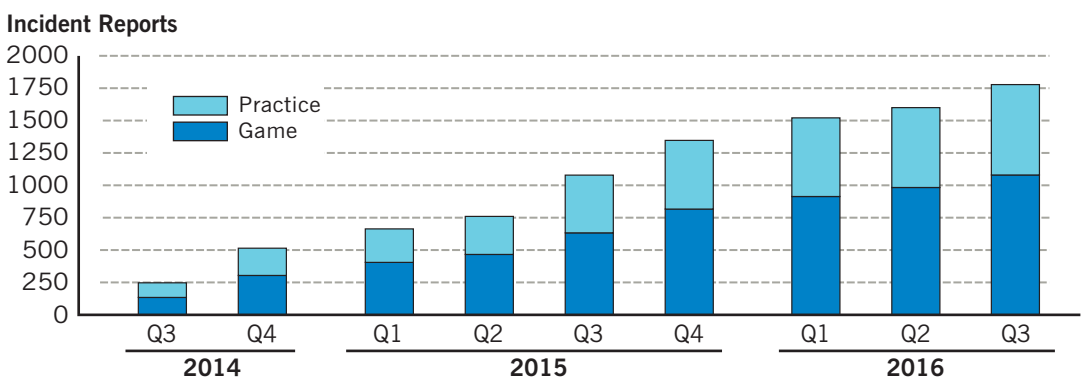
Concussion is a mild traumatic brain injury caused by a bump, blow, or jolt to the head that can present with a variety of symptoms. Cleveland Clinic's Concussion Center continues to be a leader in the evaluation and management of individuals with concussion, including amateur to professional athletes of all ages. In an effort to optimize community-based sports concussion care, the Concussion Center developed and implemented standardized methods of reporting, evaluating, and managing concussion injury in youth, high school, and college athletes. The following outcomes highlight sports concussion management using the Concussion Center's highly integrated, multidisciplinary approach.

Incident Reporting

The collection and reporting of the details associated with concussion (e.g., symptoms, date, time, location of injury, and action taken) facilitates the diagnosis and management of concussion through a standardized process of documentation. Further, common data outcomes and metrics unify the practice patterns of athletic trainers on the sideline and caregivers in the hospital and office. The development and deployment of the Concussion Incident Report module to a mobile device, iPad®, or iPhone® allows athletic trainers to document the key features of the injury and symptoms to facilitate triage and care decision-making in a standardized and rapid manner. The Concussion Incident Report is the first step in ensuring all caregivers are collecting, accessing, and using the same information about the patient. The universal adoption of the Concussion Incident Report by athletic trainers and physicians has provided important evidence, as opposed to opinion, regarding concussion incidence in a large population of athletes. This information is now being used to inform recommendations aimed at making sport participation safer.

Concussion Incident Reporting Over Time

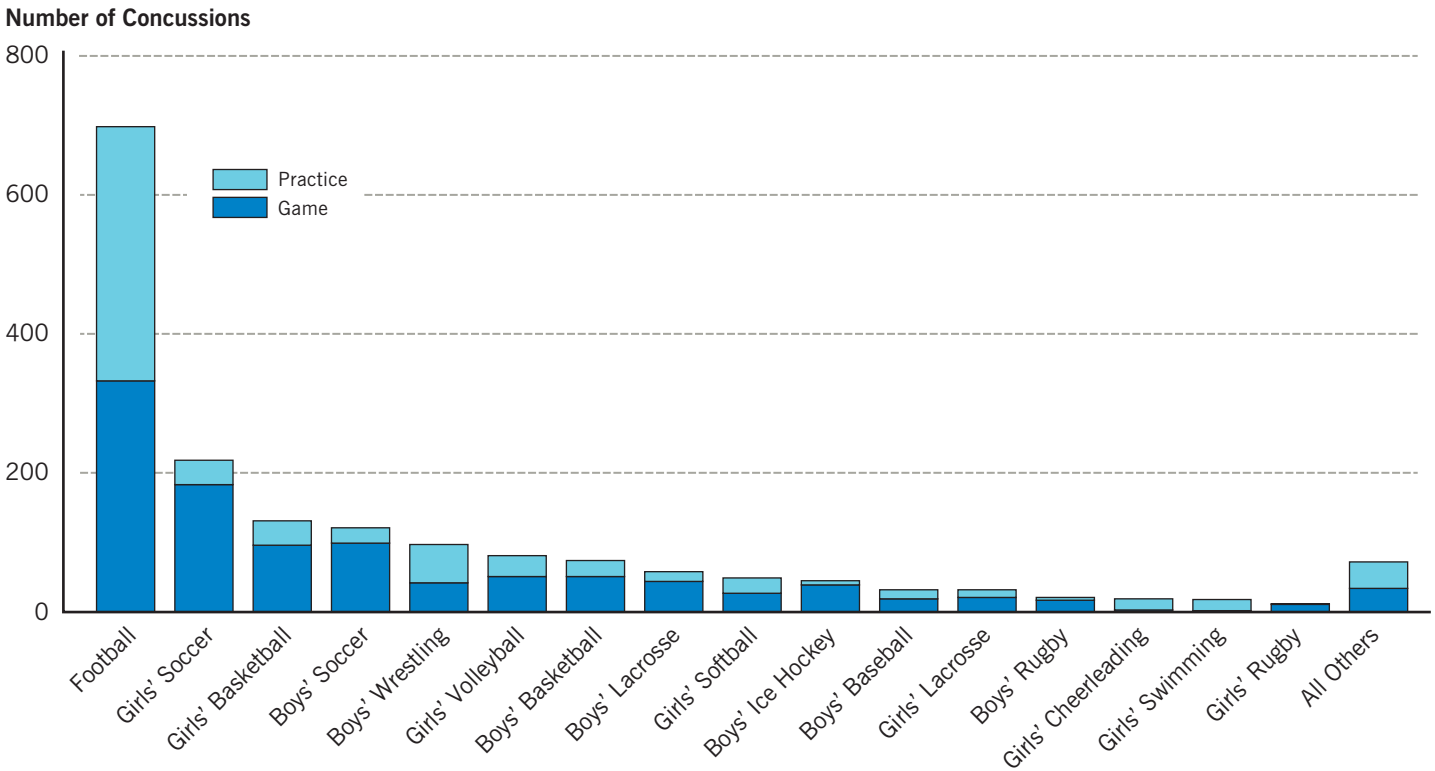
August 2014 – September 2016



The graph illustrates the historical use of the Concussion Incident Report from 2014 to 2016, broken down by venue (at practice or in games). On average, these data suggest that despite the greater time athletes spend practicing than competing, the incidence of concussion was greater during competition. These findings underscore the need for schools and athletic clubs to have appropriate medical personnel, such as athletic trainers, during event competitions. Data from the Concussion Incident Report were further examined to improve the access of care to those athletes who may be most at risk for sustaining a concussion in practice or in competition.

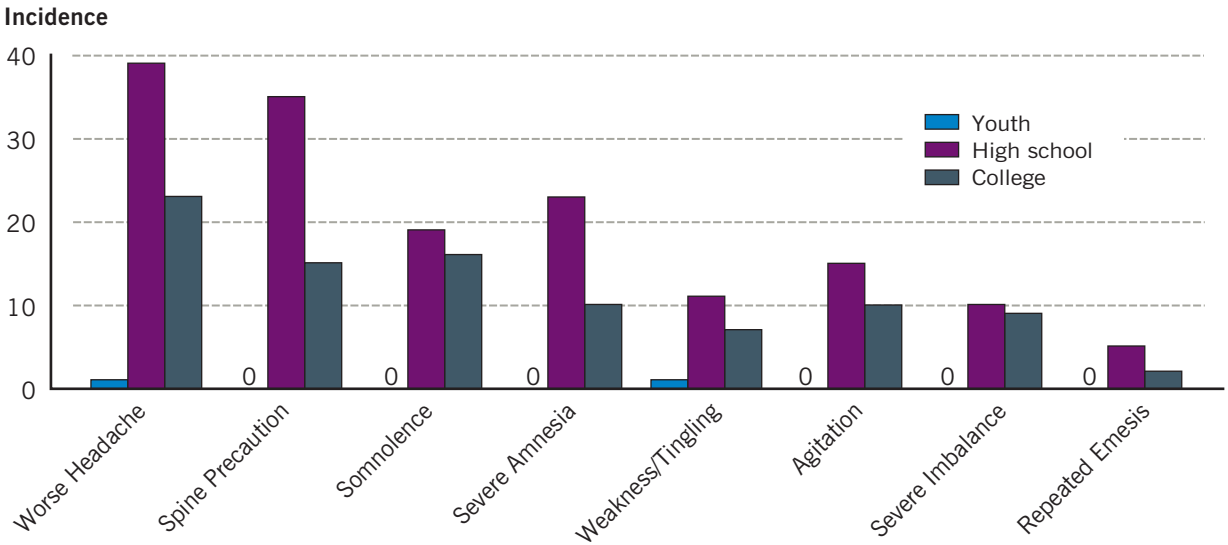
Concussion Rates by Sport and Venue for High School Athletes (N = 1800)

2016



Overall, concussion rates were significantly higher ($P < 0.05$) in competition compared with practice, with the notable exceptions of football, wrestling, cheerleading, and girls' swimming. Concussion rates in these sports were substantially higher in practice compared with competition. As a result, the Concussion Center has been working with high schools across northeast Ohio to stress the importance of having an athletic trainer present for football practice and competition, as well as recommending modifications to the structure, environment, and type of practice for cheerleaders.

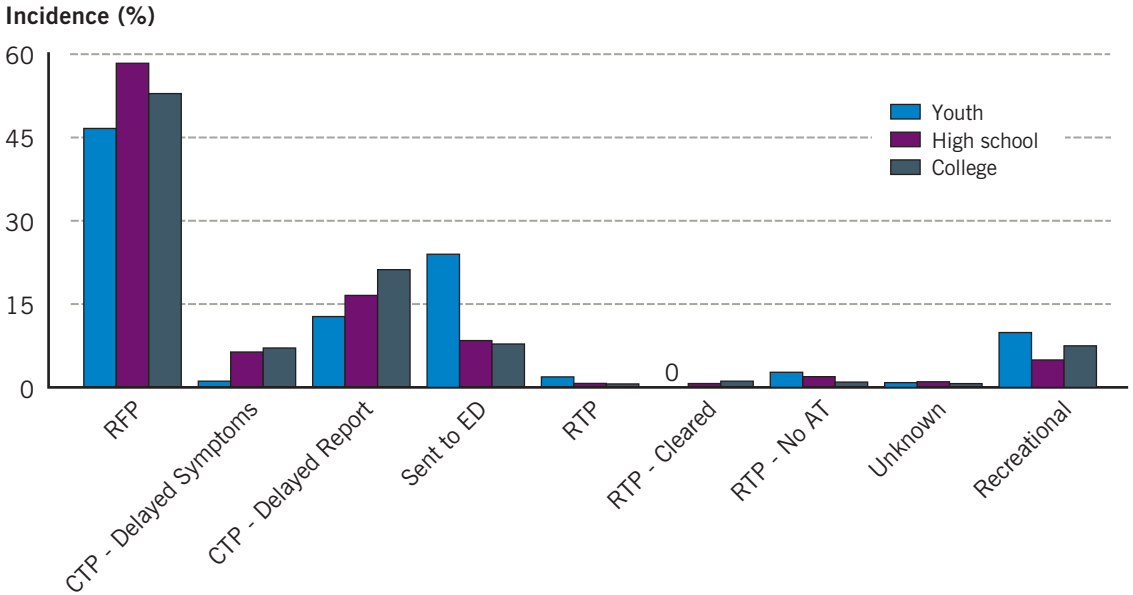
Frequency of Head Injury "Red Flags" Across Age Groups (N = 251)



Documentation of "red flags," or signs and symptoms that may indicate a more serious head injury, is critical to ensure that patients receive care consistent with the acuity of their injury. The incidence of each red flag category is shown as a function of youth (5–13 years), high school (14–18 years), and college (19–24 years). Only 2 youth patients had red flags, a significantly lower number ($P < 0.05$) compared with 157 in high school and 92 in college.

Athlete Disposition Following Head Injury (N = 1631)

2016



AT = athletic trainer, CTP = continued to play, RFP = removed from play, RTP = returned to play

Documenting what happens to an athlete after a head injury can lead to better understanding of how a standardized Concussion Incident Report influences patient care. Importantly, less than 1% of high school and college athletes were returned to play following the completion of the incident report, but youth athletes were returned to play at approximately twice that rate. Youth athletes also experienced a lower relative percentage of removal from play (47% vs 59% and 53% for high school and collegiate athletes, respectively). These disparities in management at the youth athlete level further justify the need for licensed personnel, such as athletic trainers, on the sideline. Additionally, youth athletes, despite lower incidence of red flags, were disproportionately sent to the emergency department and subsequently underwent CT scanning.

Cleveland Clinic Concussion (C3) App

More than 7000 student-athletes in northeast Ohio complete baseline concussion testing annually. Baseline evaluations allow caregivers within the Concussion Center to compare the athlete's performance on cognitive and motor tasks after a suspected concussion to their healthy baseline performance, thus improving diagnosis and treatment. In 2016, 181 student-athletes who were diagnosed with concussions were divided into 2 groups: those who recovered within 3 weeks of their injury (N = 92) and those who were still symptomatic 3 weeks after their injury (N = 89). The C3 app showed significant differences for simple reaction time, choice reaction time, the Trail Making Test, and postural sway during balance testing. Measuring balance using iPad sensors was more sensitive than subjective evaluations of balance. Predictive models are currently being built using clinical and C3 data to identify student-athletes who, after sustaining a concussion, may experience a delayed recovery. This use of predictive analytics will facilitate patient access to the appropriate provider to potentially reduce recovery time.

Measurement of Cognitive and Motor Function Following Concussion (N = 181)

2016

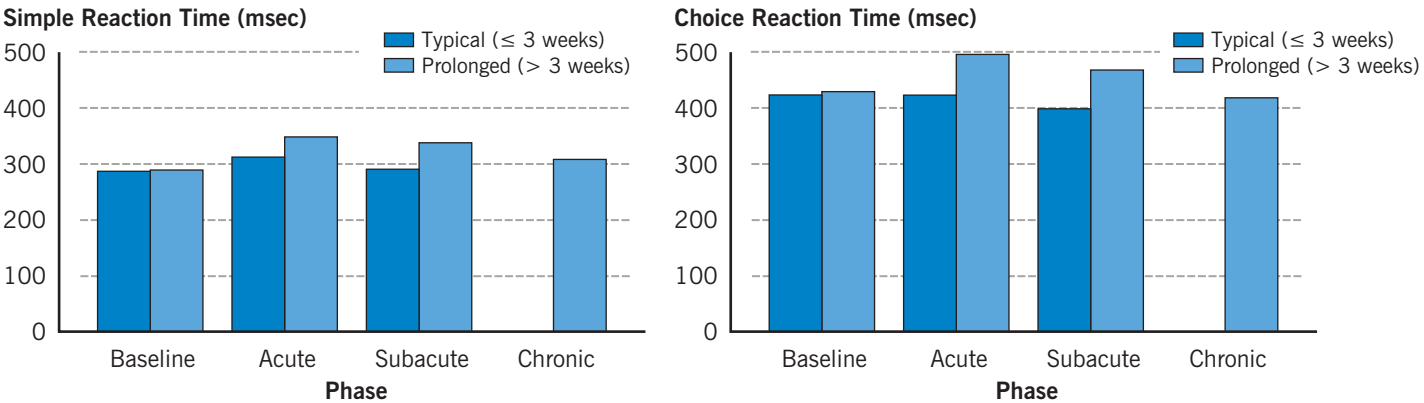
Module	Baseline	Postinjury	Difference Between Groups Postinjury[a] *P* Values
Graded symptom checklist		X	**0.0001**
Standardized assessment of concussion		X	0.17
Trail Making Test A	X	X	0.05
Trail Making Test B	X	X	**0.01**
Simple and choice reaction time	X	X	**0.0003**; **0.0009**
Processing speed test	X	X	0.17
BESS	X	X	0.26
Instrumented BESS	X	X	**0.02**–0.82

BESS = Balance Error Scoring System

[a]Bold type indicates statistical significance.

Measures of Information Processing Following Concussion (N = 181)

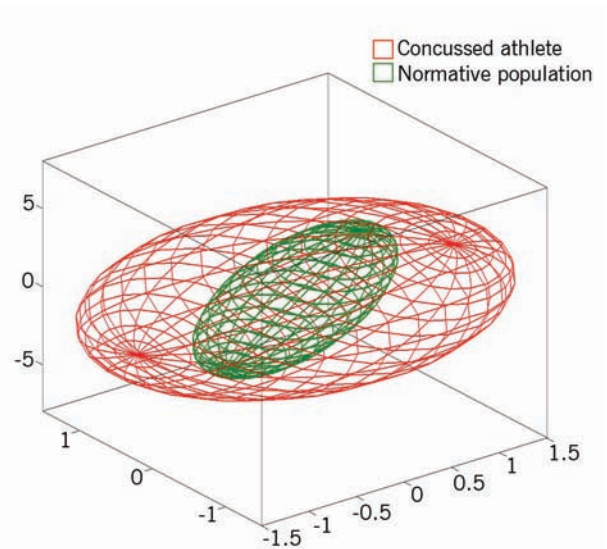
2016



The C3 App uses 2 reaction time tasks to measure the student-athlete's information processing abilities. At baseline, all student-athletes performed comparably on both reaction time tasks. However, at follow-up after injury, significant differences in simple reaction time ($P = 0.0003$) and choice reaction time ($P = 0.0009$) were evident when comparing student-athletes who recovered within 3 weeks with those who took longer than 3 weeks to recover. This difference was noted at all phases of recovery.

Postural Sway

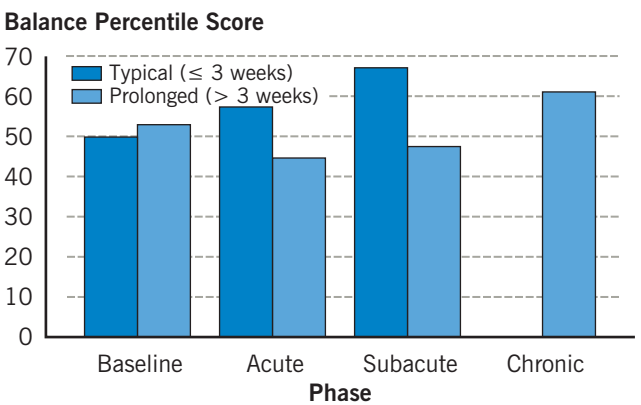
Deficits in postural stability are a hallmark finding after concussion. The clinically accepted test to measure balance is the Balance Error Scoring System (BESS), in which discrete losses of balance are measured while athletes complete six 20-second balance stances. While this traditional clinical approach to measuring balance using the BESS did not detect differences between the typical and prolonged recovery groups of student-athletes, the Instrumented BESS, in which the iPad inertial sensors are used to measure postural sway, did detect differences. The accelerometer and gyroscope native to the iPad are used to provide a 3-dimensional assessment of postural sway during the 6 BESS stances. This biomechanical metric proved to be more sensitive in detecting deficits in balance postinjury when comparing the typical recovery group of student-athletes with the prolonged recovery group.



Three-dimensional postural sway data from a representative concussed student-athlete. The red ellipse depicts postural sway for the injured athlete, while the green ellipse represents the mean postural sway of healthy age- and gender-matched peers.

Measures of Balance Following Concussion (N = 181)

2016



Measurements of balance, when compared to baseline, show that the prolonged recovery group of student-athletes had significantly (P = 0.03) lower scores compared with the group of student-athletes who recovered within the typical 3 weeks. These findings suggest that biomechanical approaches to measuring postural stability following concussion are more sensitive than traditional subjective measures.

Return-to-Play and Return-to-Learning Reporting

In addition to incident reporting, a critical aspect of understanding the outcomes of concussion care involves monitoring the progression of recovery along the pathway to return-to-learning (RTL) and return-to-play (RTP) after concussion. Consensus guidelines exist, which recommend a 6-phase graduated RTP protocol of exertional recovery after concussion, from initial rest (Phase 1) to eventual RTP (Phase 6).[1] However, less is understood about the impact of missed school days and RTL protocols. The development and deployment of the Concussion RTP module to a mobile device, iPad, or iPhone allows athletic trainers, who typically supervise recovery, to closely monitor and document the progress of each individual student-athlete.

Impact of Sports Concussion on School Days Missed (N = 549)

2016

Concussion RTP Module Data	
Percent of student-athletes with school days missed	21.3% (N = 117)
Average school days missed (N = 117)	1.7 days

The RTP module was used for 549 student-athletes. In addition to monitoring the exertional recovery aspects of RTP, athletic trainers used the Concussion RTP module to document the days missed from school by student-athletes. Among the 549 student-athletes, 117 missed a total of 197.5 days from school, for an average of 1.7 days per student-athlete. Absenteeism from school affects parents as well as students. Medical appointments and monitoring youths after a concussion often results in missed days from work. A conservative estimate of missed work time for adults due to their child's concussion is one-half day per missed school day. Therefore, based on a total of 197.5 school days missed and a day of work valued at $190, the financial impact for adults missing work can be estimated at $19,000. In 2015, student-athletes missed an average of 3.4 days of school, exactly double the 2016 rate. This decline in school days missed may have saved an estimated $19,000 for families/employers. The Concussion RTP module will continue to enable a deeper understanding of the impact of sports concussion on both RTL and RTP, and a family's financial situation. These data will be useful in providing patients with realistic expectations related to the projected number of days they may be absent from school and sport. Further, having these data will facilitate interactions with school administrators and school counselors to ensure appropriate accommodations are provided for the student-athlete.

Reference

1. McCrory P, Meeuwisse WH, Aubry M, et al. Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012. *Br J Sports Med*. 2013 Apr;47(5):250-258.

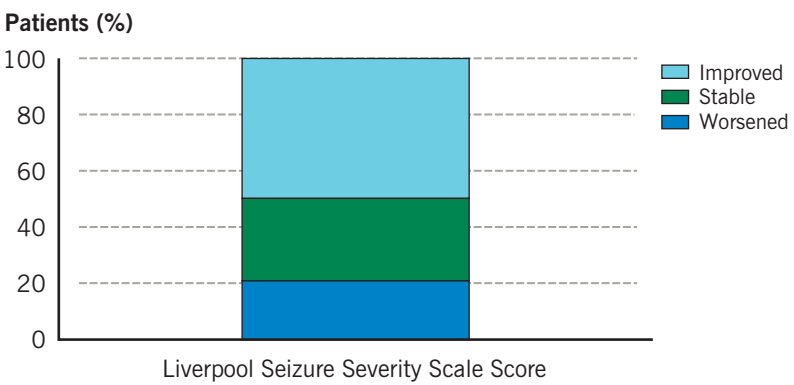
Epilepsy

Epilepsy is a chronic condition, with a wide array of symptoms and implications. Its main effects are determined by the recurrence, frequency, and severity of seizures. Cleveland Clinic's Epilepsy Center is a national and international leader in the diagnosis and management of patients with epilepsy. The following outcomes highlight treatment results using the Epilepsy Center's highly integrated, multidisciplinary approach. Seizure outcomes are reported both for the large subgroups of patients treated only with medications and for the relatively smaller subgroups treated also with epilepsy surgery.

Seizure Severity

Seizure Severity in Medically Treated Adult Epilepsy Patients (N = 4837)

2007 – 2016



The effect of medical treatment on seizure severity was assessed using the Liverpool Seizure Severity Scale (LSSS), a validated patient-completed questionnaire developed to quantify seizure severity. Of the 4837 patients seen from 2007 through 2016, 51% improved, 29% remained stable, and 20% had a worsening in seizure severity. Clinically meaningful change was defined as a total point change of ≥ 5.[1]

Reference

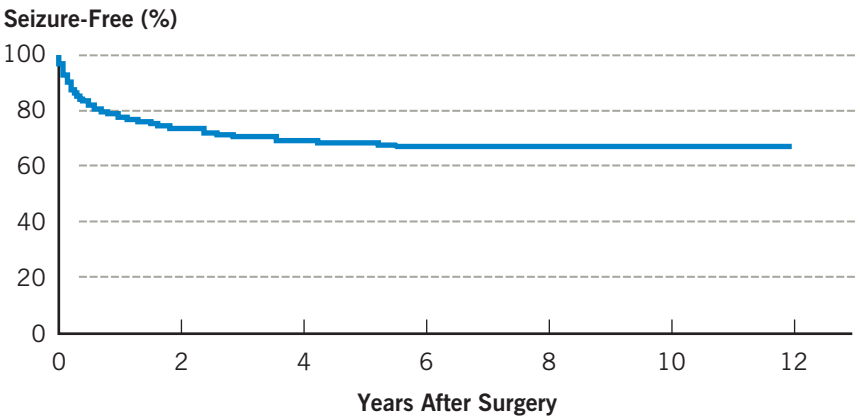
1. Scott-Lennox J, Bryant-Comstock L, Lennox R, Baker GA. Reliability, validity and responsiveness of a revised scoring system for the Liverpool Seizure Severity Scale. *Epilepsy Res*. 2001 Apr;44(1):53-63.

Seizure Outcomes in Surgically Treated Adult and Pediatric Epilepsy Patients

Long-term chances of achieving and maintaining seizure-freedom following various types of epilepsy surgery are shown in the following graphs. Whenever possible, the Epilepsy Center's data were compared with national published data. Seizure outcomes were classified using the widely accepted Engel classification[1] of seizure-freedom (seizure-free = Engel class 1).

Long-Term Seizure-Freedom Following *Temporal Lobe* Epilepsy Surgery (N = 772)

Surgical Dates: 2000 – 2014



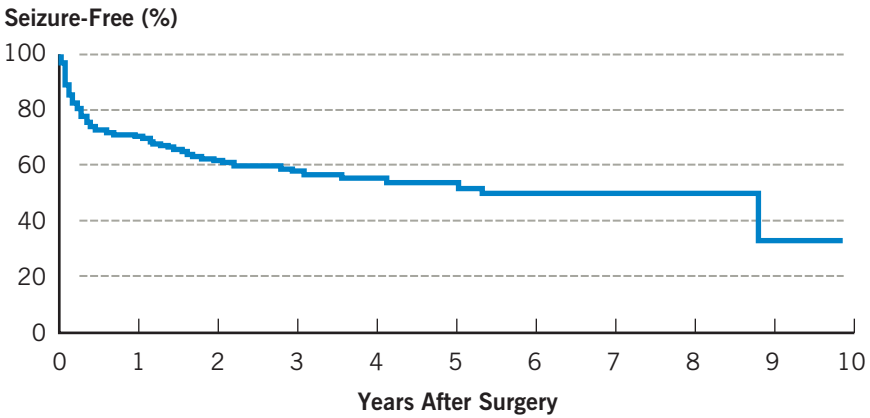
Temporal lobe resections are the most commonly performed epilepsy surgeries for medically intractable epilepsy. More than 65% of patients remain seizure-free a decade or more after surgery. Median duration of follow-up was 3.5 years (range, 0.5–16.7). The last follow-up for which data are available was Aug. 16, 2016.

Reference

1. Engel J, Jr., Van Ness PC, Rasmussen TB, Ojemann LM. Outcome with respect to epileptic seizures. In: Engel J, Jr., ed. *Surgical Treatment of the Epilepsies*. 2nd ed. New York, NY: Raven Press; 1993:609-621.

Long-Term Seizure-Freedom Following *Frontal Lobe* Epilepsy Surgery (N = 242)

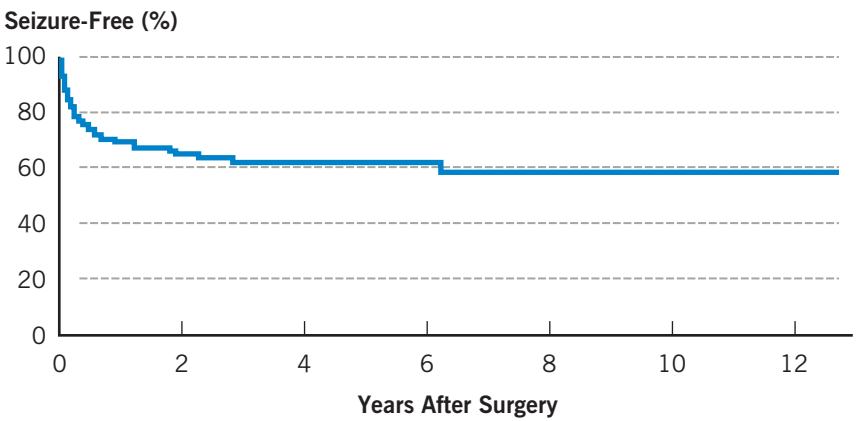
Surgical Dates: 2000 – 2014



Frontal lobe resection is the second most commonly performed epilepsy surgery. This type of epilepsy surgery is traditionally considered the most challenging. The graph reflects seizure outcome in adult and pediatric patients with previously medically intractable frontal lobe epilepsy operated on between 2000 and 2014. Median duration of follow-up was 2.9 years (range, 0.5–15.7). The last follow-up for which data are available was Mar. 8, 2015.

Long-Term Seizure-Freedom Following *Posterior Quadrant* Resections (N = 126)

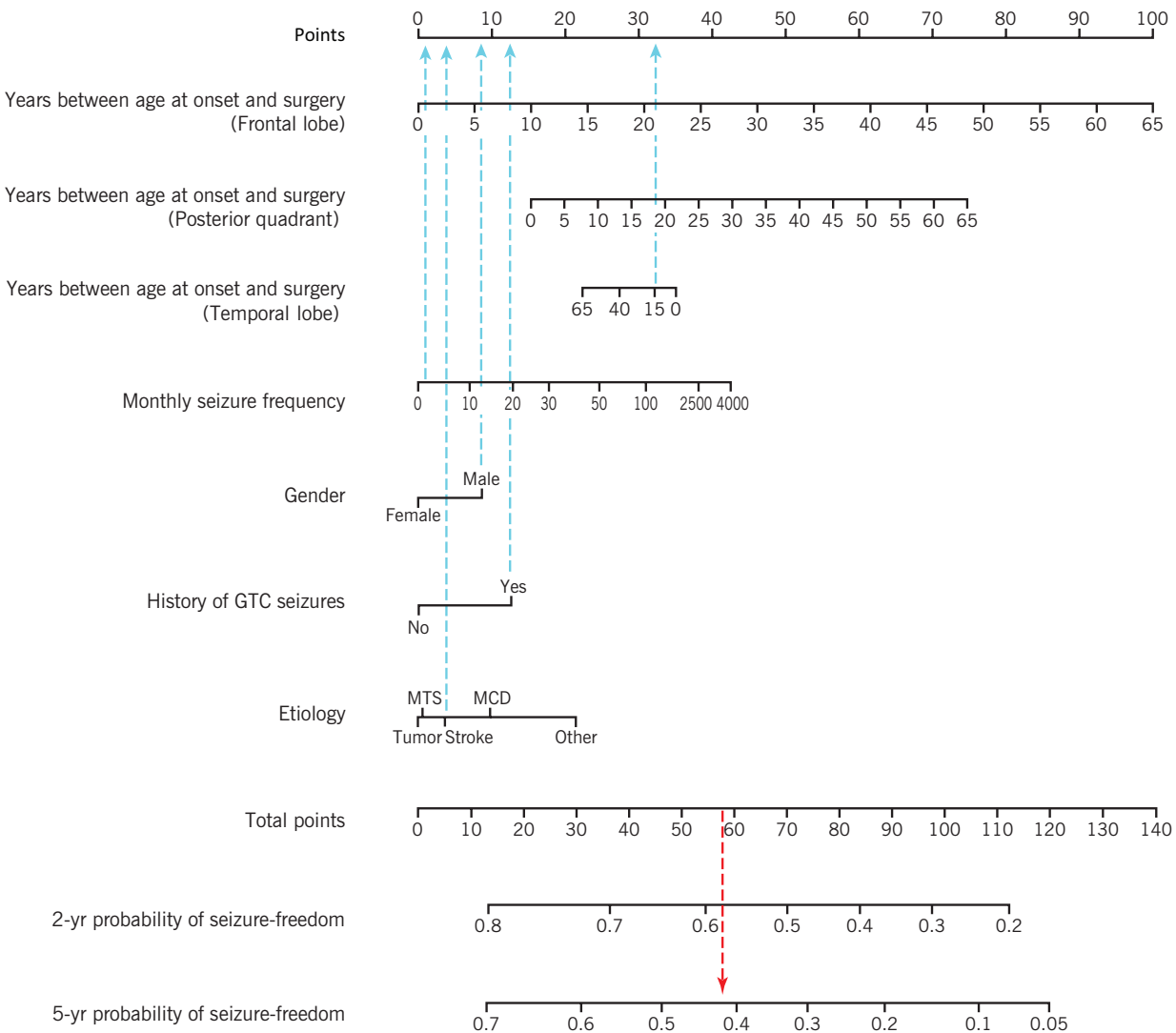
Surgical Dates: 2000 – 2014



Posterior quadrant resection is used to treat intractable epilepsy involving the posterior temporal, parietal, and/or occipital regions. The graph reflects the percentage of patients who continue to be completely seizure-free up to 12 years following a posterior quadrant resection. Median duration of follow-up was 2.3 years (range, 0.5–12.7). The last follow-up for which data are available was Apr. 9, 2015.

Individualizing Surgical Outcome Prediction

Epilepsy Surgery Nomogram



GTC = generalized tonic-clonic, MCD = malformation of cortical development, MTS = mesial temporal sclerosis

To help patients answer the question "How do *people like me* do when they have epilepsy surgery?" the Epilepsy Center is leading an international effort to improve individualized outcome prediction. The Epilepsy Surgery Nomogram is the preliminary product of this work.[1]

In this sample nomogram of a 30-year-old man who is considering resective epilepsy surgery for drug-resistant seizures, his age of onset was 15. He is currently having, on average, 2 partial seizures per month and 2 generalized tonic-clonic "grand mal" seizures per year. A presurgical evaluation led to a temporal lobe localization, and brain imaging suggested stroke as the cause of the epilepsy. The manual application of the nomogram to predict complete seizure-freedom requires drawing a vertical line (shown in blue) from the appropriate value of each outcome predictor up to the "Points" line on top. All the points are then added up to yield a total (in this case, 58.5 points). Another vertical line (shown in red) is then drawn from 58.5 on the "Total Points" line down to the last 2 lines to predict the 2-year (58%) and 5-year (41%) probability of seizure-freedom.

Reference

1. Jehi L, Yardi R, Chagin K, Tassi L, Russo GL, Worrell G, Hu W, Cendes F, Morita M, Bartolomei F, Chauvel P, Najm I, Gonzalez-Martinez J, Bingaman W, Kattan MW. Development and validation of nomograms to provide individualised predictions of seizure outcomes after epilepsy surgery: a retrospective analysis. *Lancet Neurol*. 2015 Mar;14(3):283-290.

Epilepsy Outcomes Beyond Seizure Frequency and Severity

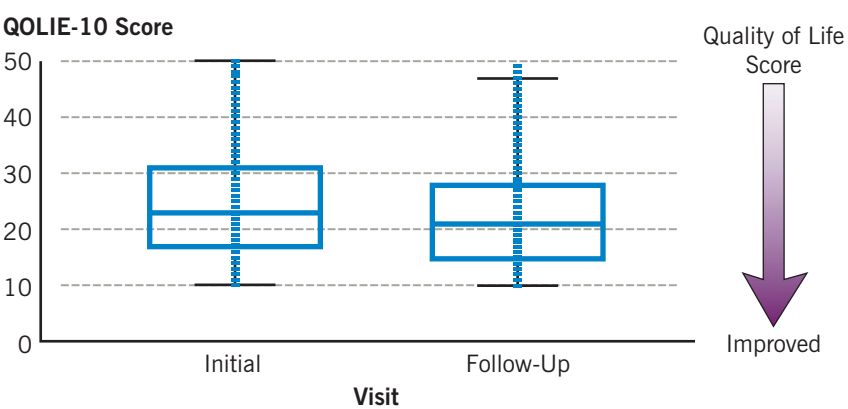
Clinicians in the Epilepsy Center strongly believe that the burden of epilepsy extends beyond a "seizure count" and that the effect of the multidisciplinary and highly integrated care provided (either medical or surgical) should be long-lasting and extend beyond simply treating seizures. As a result, the Outcomes Research Program was established in 2008 to provide systematic long-term follow-up of patients undergoing epilepsy surgery and to create a mechanism for a comprehensive assessment of treatment outcomes during every outpatient clinic visit, including an evaluation of quality of life, mood, and psychosocial functioning, in addition to seizure frequency and severity.

Adult Epilepsy: Effect of Treatment on Quality of Life

Successful epilepsy treatment should translate into a better quality of life. Patients' quality of life is assessed at every outpatient clinic visit using the Quality of Life in Epilepsy questionnaire (QOLIE-10), a 10-item, validated, patient-completed questionnaire covering general and epilepsy-specific domains: epilepsy effects (memory, physical and mental effects of medication), mental health (energy, depression, overall quality of life), and role functioning (seizure worry, work, driving, social limits). Lower scores reflect a better quality of life. QOLIE-10 scores improved in both the medical and surgical groups.

Improvement in Quality of Life in Medically Treated Patients (N = 3810)

2007 – 2016

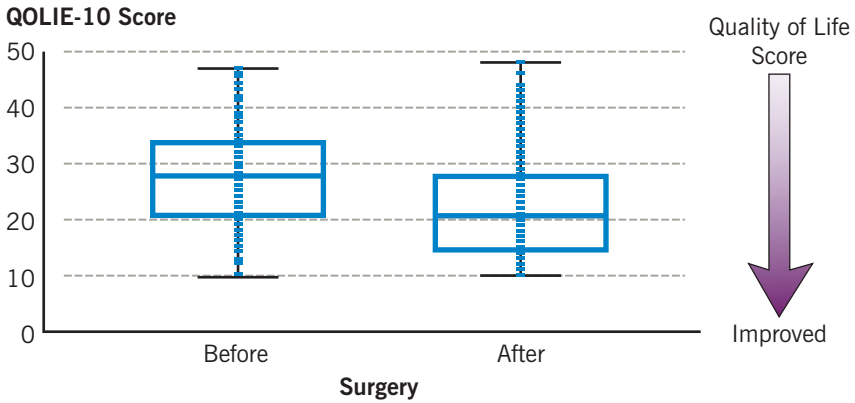


In medically treated patients, the mean QOLIE-10 score improved from 24.4 at initial visit to 22.5 at last follow-up ($P < 0.0001$). N = patients with at least 6 months of follow-up. Mean duration of follow-up was 42 months. The standard box plots reflect the median and the 25th and 75th quartiles.

QOLIE-10 = Quality of Life in Epilepsy questionnaire

Improvement in Quality of Life in Surgically Treated Patients (N = 461)

2007 – 2016



QOLIE-10 = Quality of Life in Epilepsy questionnaire

In surgically treated patients, the mean QOLIE-10 score improved from 27.9 at initial visit to 22.5 at last follow-up ($P < 0.0001$). N = patients with at least 6 months of follow-up. Mean duration of follow-up was 36.3 months. The standard box plots reflect the median and the 25th and 75th quartiles.

Clinically Meaningful Improvement in Quality of Life

2007 – 2016

	Patients Achieving Clinically Meaningful Improvement
Medically treated patients (N = 3810)	44%
Surgically treated patients (N = 461)	64%

Clinically meaningful improvement in quality of life is defined as a drop of at least 10% in the baseline QOLIE-10 score.[1-3]

References

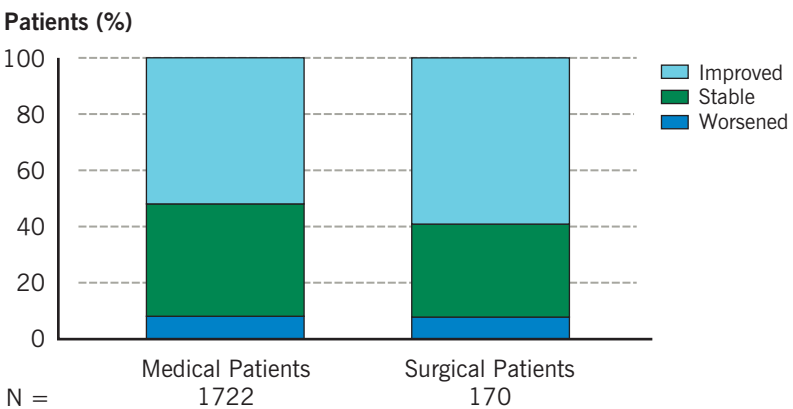
1. Cramer JA, Perrine K, Devinsky O, Meador K. A brief questionnaire to screen for quality of life in epilepsy: the QOLIE-10. *Epilepsia*. 1996 Jun;37(6):577-582.
2. Cramer JA, Arrigo C, Van Hammée G, Gauer LJ, Cereghino JJ. Effect of levetiracetam on epilepsy-related quality of life. N132 study group. *Epilepsia*. 2000 Jul;41(7):868-874.
3. Jehi L, Tesar G, Obuchowski N, Novak E, Najm I. Quality of life in 1931 adult patients with epilepsy: seizures do not tell the whole story. *Epilepsy Behav.* 2011 Dec;22(4):723-727.

Adult Epilepsy: Effect of Treatment on Mood

Mood disorders, especially depression, are common in patients with epilepsy. The Epilepsy Center routinely screens for depressive symptoms using the Patient Health Questionnaire (PHQ-9) to identify and treat depression as soon as possible, using Primary Care Depression Treatment Guidelines.[1] Early identification and treatment should result in improvement in patients' care, given the significant effect of depression on quality of life.

Change in Depressive Symptoms in Adult Epilepsy Patients

2016



For patients with at least moderate depressive symptoms (defined as PHQ-9 scores ≥ 10), a clinically meaningful improvement was seen in 58.8% of the surgical group and 51.4% of the medical group. Clinically meaningful change was defined as a total point change of ≥ 5 points.[2] The median duration of follow-up was 841 days (range, 43–2677) in the surgical group and 591 days (range, 3–2967) in the medical group.

References

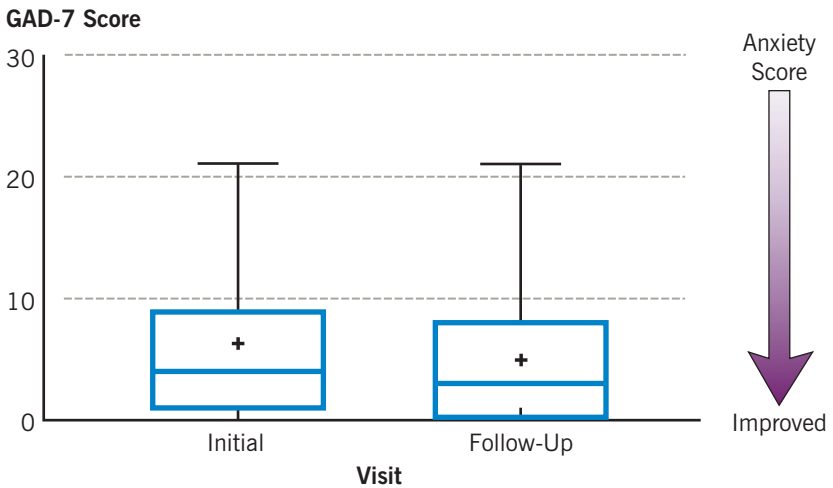
1. Pignone MP, Gaynes BN, Rushton JL, Burchell CM, Orleans CT, Mulrow CD, Lohr KN. Screening for depression in adults: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2002 May 21;136(10):765-776.

2. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Adult Epilepsy: Effect of Treatment on Anxiety

Improvement in Anxiety Symptoms in Medically Treated Adult Epilepsy Patients (N = 3671)

2009 – 2016



GAD-7 = Generalized Anxiety Disorder questionnaire

Anxiety symptoms were assessed using the Generalized Anxiety Disorder questionnaire (GAD-7),[1] a patient-completed, validated screening measure for symptoms of anxiety. The mean GAD-7 score improved from 5.8 at the initial visit to 5.0 at the last follow-up visit in patients treated with antiepileptic medications only ($P < 0.0001$). N = adult epilepsy patients with at least 6 months of follow-up. Mean duration of follow-up was 38.2 months. The standard box plots reflect the median and the 25th and 75th quartiles.

Clinical Context:

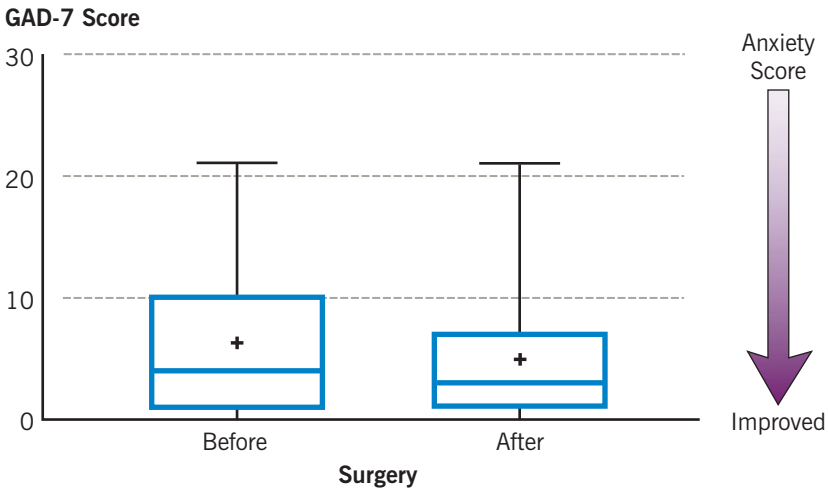
In the medical group, 23.8% of patients had moderate to severe anxiety symptoms at their initial visit, as defined by GAD-7 score ≥ 10. Anxiety symptoms resolved (GAD-7 score < 5) by the last follow-up in 26.5% of this symptomatic group. In another 29.2% of patients, the severity of anxiety was significantly lessened (GAD-7 scores = 5–10), while the rest remained stable. However, anxiety worsened from mild to moderate/severe in 22.6% and developed de novo in 21.1% during follow-up.

Reference

1. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006 May 22;166(10):1092-1097.

Improvement in Anxiety Symptoms in Surgically Treated Adult Epilepsy Patients (N = 382)

2009 – 2016



GAD-7 = Generalized Anxiety Disorder questionnaire

Anxiety symptoms also improved in adult patients treated with surgery. The mean GAD-7 score at the initial visit was 6.4, significantly higher than the mean score of 5.0 seen at last follow-up ($P < 0.0001$). N = adult epilepsy patients with at least 6 months of follow-up. Mean duration of follow-up was 34 months. The standard box plots reflect the median and the 25th and 75th quartiles.

Clinical Context:

In the surgical group, 26.7% of patients had moderate to severe anxiety symptoms before surgery, as defined by GAD-7 score ≥ 10. After surgery, anxiety symptoms resolved (GAD-7 score < 5) by the last follow-up in 33.3% of this symptomatic group. In 24.5%, the severity of anxiety was significantly lessened (GAD-7 scores = 5–10). The rest remained stable by the last follow-up. Of note, anxiety worsened from mild to moderate/severe in 21.7% and developed de novo in 21.2% during follow-up.

Adult Epilepsy: Management of Antiepileptic Drugs

Effect of Epilepsy Surgery on Number of Antiepileptic Drugs Needed (N = 731)

Surgical Dates: 2007 – 2016

	Surgically Treated Patients
Mean number of AEDs prior to surgery	2.4
Mean number of AEDs 1 year after surgery	2.0

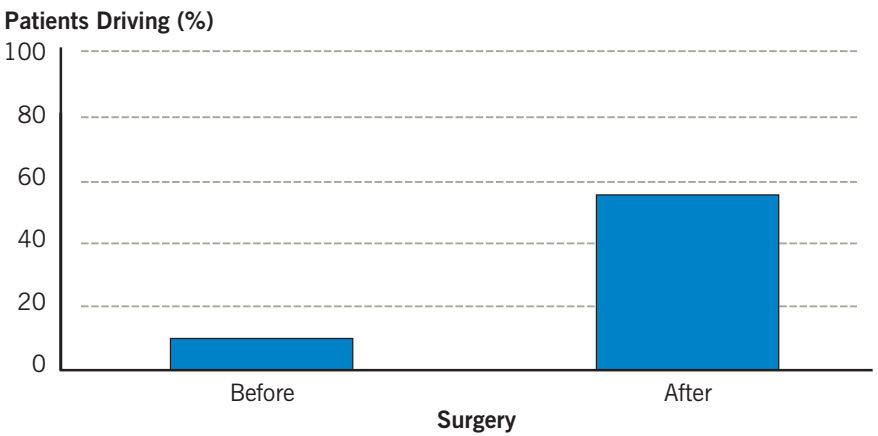
AEDs = antiepileptic drugs

The elimination of antiepileptic drugs (AEDs) is a major goal for patients with medically intractable chronic epilepsy. The mean number of AEDs taken by patients operated on between 2007 and 2016 was reduced from 2.4 before surgery to 2.0 by 1 year after ($P < 0.0001$). This improvement was sustained until 5 years after surgery.

Adult Epilepsy: Effect of Treatment on Driving Status

Driving Status in Surgically Treated Epilepsy Patients (N = 610)

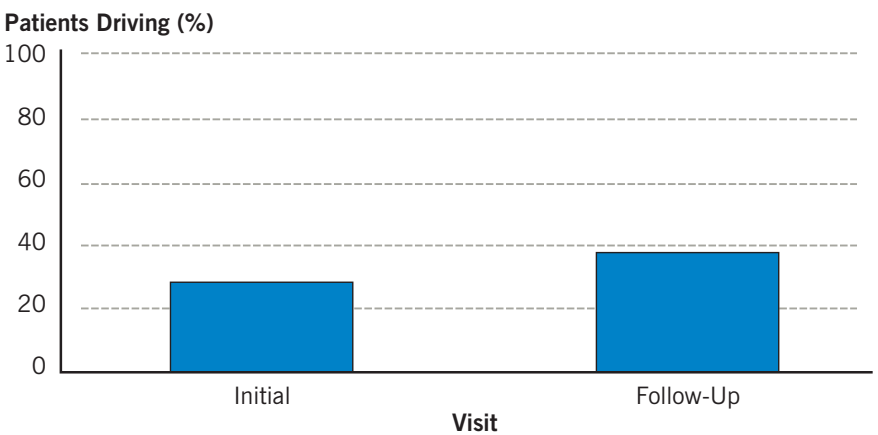
2008 – 2016



Driving restrictions are a significant limitation for patients with uncontrolled epilepsy. Recovering the ability to drive is mostly dependent on the ability to regain seizure control. While only 10% of surgical patients were driving before surgery, 55% were driving ≥ 6 months after surgery ($P < 0.0001$). N = adult epilepsy patients with at least 6 months of follow-up.

Driving Status in Medically Treated Epilepsy Patients (N = 4428)

2008 – 2016



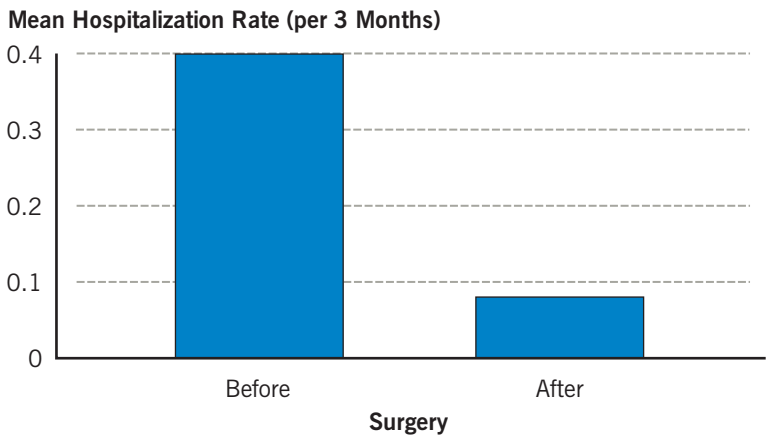
In the medically treated epilepsy patients, 28% were driving at their first visit as opposed to 37% at last follow-up ($P < 0.0001$). Mean duration of follow-up was 46 months.

Pediatric Epilepsy: Effect of Treatment on Healthcare Utilization

Treatment benefits for patients in the pediatric age group extended beyond the improvements seen in seizure frequency and severity.

Hospitalization Rates in Surgically Treated Pediatric Epilepsy Patients (N = 900)

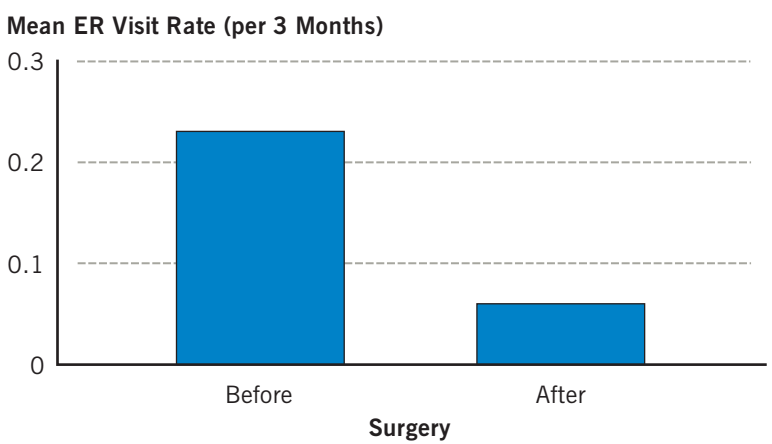
2009 – 2016



Healthcare utilization improved significantly with epilepsy surgery. The number of hospitalizations decreased from a mean of 0.4 in the 3 months preceding surgery to a mean of 0.08 after surgery ($P < 0.0001$), an 80% reduction in frequency of hospitalizations. N = pediatric patients with at least 6 months of follow-up. Mean duration of follow-up was 23 months.

Emergency Room Visits in Surgically Treated Pediatric Epilepsy Patients (N = 904)

2009 – 2016



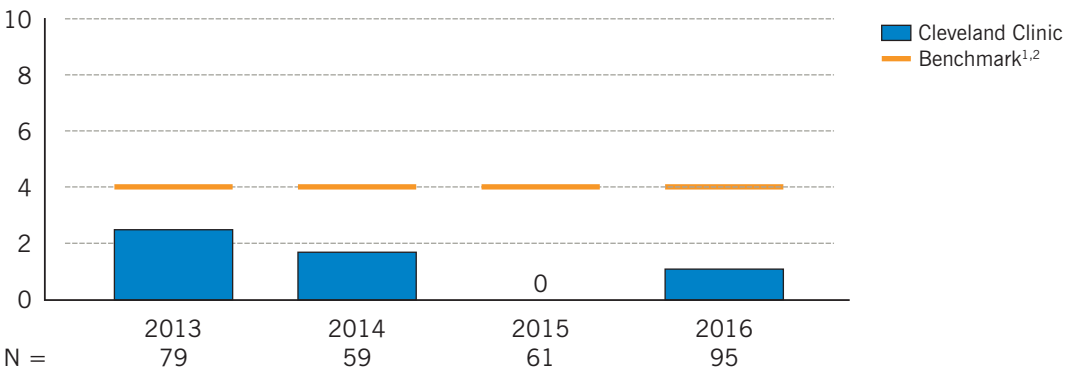
There was a significant reduction in the frequency of emergency room visits, from a mean of 0.23 visits in 3 months preceding surgery to 0.06 after surgery ($P < 0.0001$), a more than 74% reduction in frequency of emergency room visits. N = pediatric patients with at least 6 months of follow-up. Mean duration of follow-up was 23 months.

Spinal Cord Stimulation

Surgical Site Infections Following Spinal Cord Stimulator Implantation for Chronic Pain

2013 – 2016

Infections per 100 Clean Cases



Annual surgical site infection (SSI) rates for all spinal cord stimulator-related procedures performed within the Center for Neurological Restoration are compared with a benchmark derived from the published literature.[1-2] N = number of clean cases per year. Per the 2013 revised Centers for Disease Control and Prevention guidelines, a superficial SSI will be counted if signs and symptoms appear within 30 days of the operative procedure. A deep or organ space infection will be counted within 90 days of surgery. "Clean cases" are defined as uninfected operative wounds in which no inflammation is encountered and, in the case of neurosurgery, neither the respiratory nor the alimentary tract is entered.

References

1. Cameron T. Safety and efficacy of spinal cord stimulation for the treatment of chronic pain: a 20-year literature review. *J Neurosurg*. 2004 Mar;100(3 Suppl Spine):254-267.

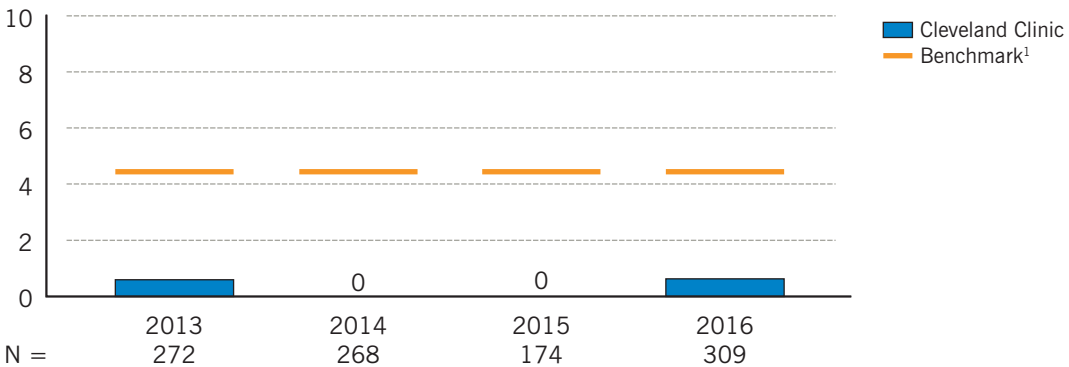
2. Turner JA, Loeser JD, Deyo RA, Sanders SB. Spinal cord stimulation for patients with failed back surgery syndrome or complex regional pain syndrome: a systematic review of effectiveness and complications. *Pain*. 2004 Mar;108(1-2):137-147.

Deep Brain Stimulation

Surgical Site Infections Following Deep Brain Stimulator Implantation for Movement Disorders

2013 – 2016

Infections per 100 Clean Cases



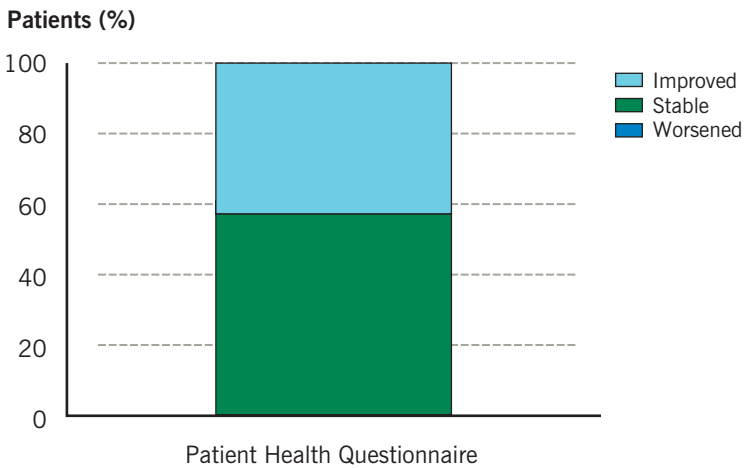
Annual SSI rates are low for all deep brain stimulation (DBS) procedures (intracranial electrode and pulse generator implantations) performed within the Center for Neurological Restoration. There were 2 DBS-related infections per year in 2013 and 2016 and none in 2014 or 2015, compared with a benchmark infection rate of 4.5% following DBS implantation.[1] N = number of clean cases per year.

Reference

1. Sillay KA, Larson PS, Starr PA. Deep brain stimulator hardware-related infections: incidence and management in a large series. *Neurosurgery*. 2008 Feb;62(2):360-366.

Change in Depression Symptoms Following Deep Brain Stimulation for Parkinson Disease (N = 24)

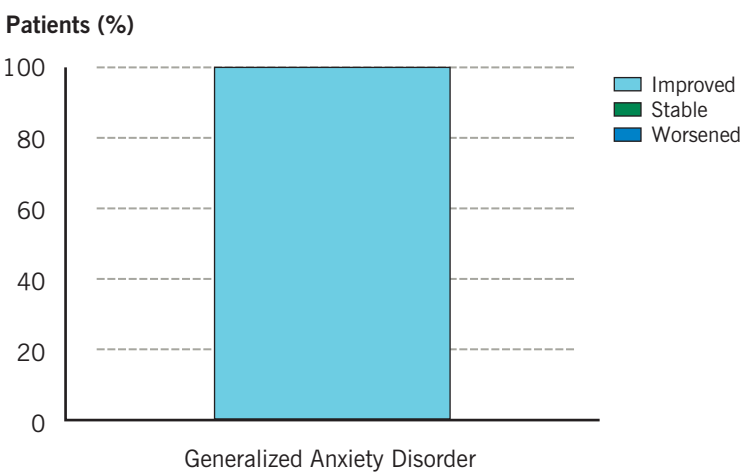
2016



In 2016, 24 Parkinson disease (PD) patients who underwent DBS completed the Patient Health Questionnaire (PHQ-9) both before and after surgery. Median duration of follow-up was 153 days after surgery (range, 58–287). Clinically meaningful change was defined as a total point change of 5.[1] Of the 7 patients with baseline PHQ-9 scores ≥ 10, 3 (43%) showed improvement, 4 (57%) remained stable, and none worsened. Of the 17 patients who scored < 10 prior to surgery, none reported clinically meaningful depression at follow-up.

Change in Anxiety Symptoms Following Deep Brain Stimulation for Parkinson Disease (N = 13)

2016



In 2016, 13 PD patients who underwent DBS completed the Generalized Anxiety Disorder questionnaire (GAD-7) both before and after surgery. Median duration of follow-up was 152 days after surgery (range, 61–239). Clinically meaningful change for patients with a GAD-7 score ≥ 7 was defined as a total point change of 5.[2] All 3 patients with a baseline GAD-7 score ≥ 8 reported improved anxiety at follow-up. Among those patients with baseline GAD-7 score ≤ 7 (N = 10), 1 reported clinically meaningful anxiety at follow-up.

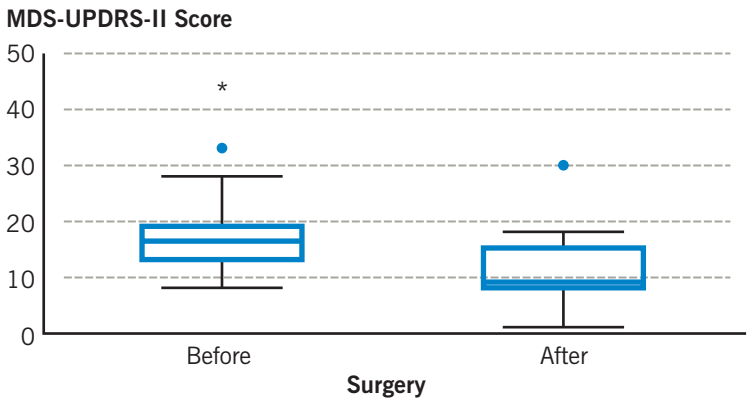
References

1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

2. Richards DA, Borglin G. Implementation of psychological therapies for anxiety and depression in routine practice: two year prospective cohort study. *J Affect Disord*. 2011 Sep:133(1-2):51-60.

Change in Motor Aspects of Activities of Daily Living Following Deep Brain Stimulation for Parkinson Disease (N = 14)

2016

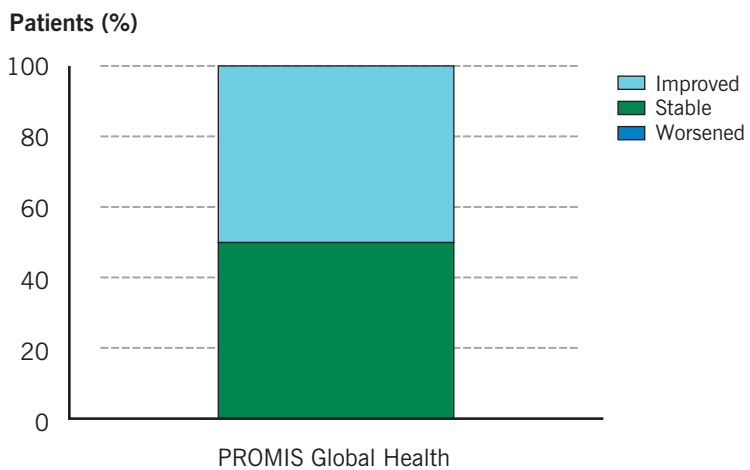


MDS-UPDRS-II = Movement Disorders Society – Unified Parkinson's Disease Rating Scale Part II

The Movement Disorders Society – Unified Parkinson's Disease Rating Scale Part II (MDS-UPDRS-II) is a self-administered scale with items covering the motor aspects of activities of daily living including speech, feeding, hygiene, handwriting, tremor, hobbies, mobility, and freezing. Higher numbers reflect worse symptoms. Fourteen PD patients who underwent DBS completed the UPDRS-II both before and after surgery (median time to follow-up was 158 days; range, 58–286). The box plots show median, 25th, and 75th percentiles, and symbols represent outliers. There was a statistically significant improvement in motor-related activity of daily living skills over the treatment period ($t_{13} = 2.8$, $P = 0.01$).

Change in PROMIS Global Health Ratings Following Deep Brain Stimulation for Parkinson Disease (N = 27)

2016



PROMIS = Patient-Reported Outcomes Measurement Information System

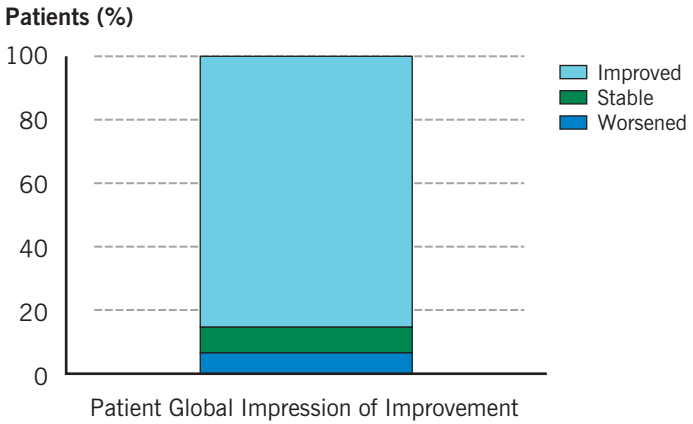
The Patient-Reported Outcomes Measurement Information System (PROMIS®) Global Health (PROMIS-10) is a self-reported measure of physical and emotional health status reflecting health-related quality of life. Twenty-seven PD patients completed the PROMIS-10 both before and after surgery. Median duration of follow-up was 152 days (range, 47–287). Clinically meaningful change was defined as a total change of > 5 T-score points.[1] Of the 20 patients who reported presurgical quality of life greater than 0.5 SD below the mean, 10 (50%) patients showed improvement, 10 (50%) remained stable, and none reported worsening.

Reference

1. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

Improvement Following Deep Brain Stimulation Treatment for Parkinson Disease (N = 47)

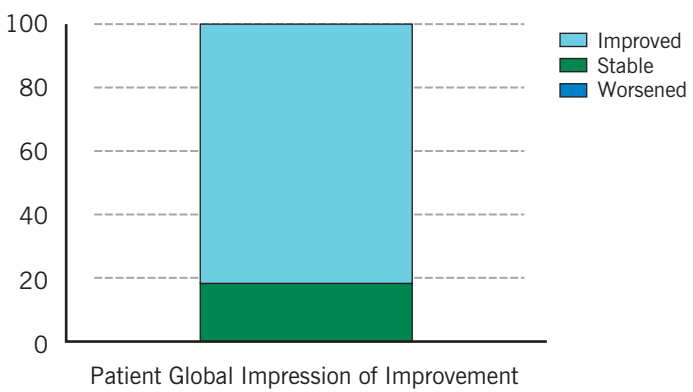
2016



In 2016, 47 PD patients completed the Patient Global Impression of Improvement (PGI-I) questionnaire after DBS. Median duration of follow-up was 113 days (range, 43–271). At follow-up, 85% rated their condition as improved, compared with their condition before surgery.

Improvement Following Deep Brain Stimulation for Essential Tremor (N = 16)

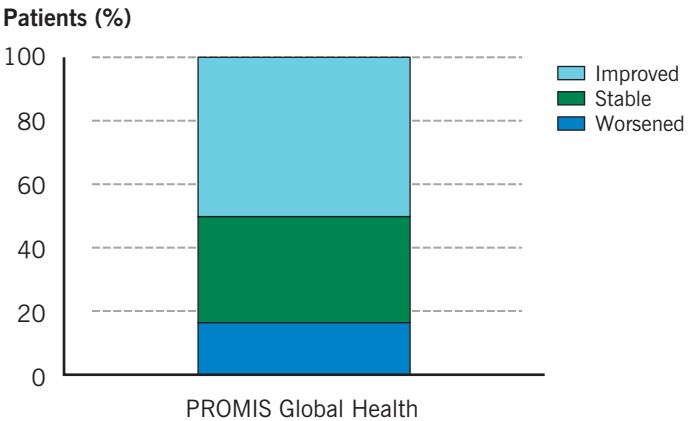
2016



In 2016, 16 ET patients completed the PGI-I questionnaire after DBS. Median duration of follow-up was 87 days (range, 34–216). Eighty-one percent (N = 13) rated their condition as improved, and none worsened compared with their condition before surgery.

Change in PROMIS Global Health Ratings Following Deep Brain Stimulation for Essential Tremor (N = 13)

2016



PROMIS = Patient-Reported Outcomes Measurement Information System

The PROMIS-10 questionnaire is a self-reported measure of physical and emotional health status reflecting health-related quality of life. Thirteen ET patients completed PROMIS-10 both before and after surgery. Median duration of follow-up was 115 days (range, 60–223). Clinically meaningful change was defined as a total change of > 5 T-score points.[1] Of the 6 patients who reported presurgical quality of life greater than 0.5 SD below the mean, 3 (50%) patients showed improvement, 2 (33%) remained stable, and 1 (17%) reported worsening.

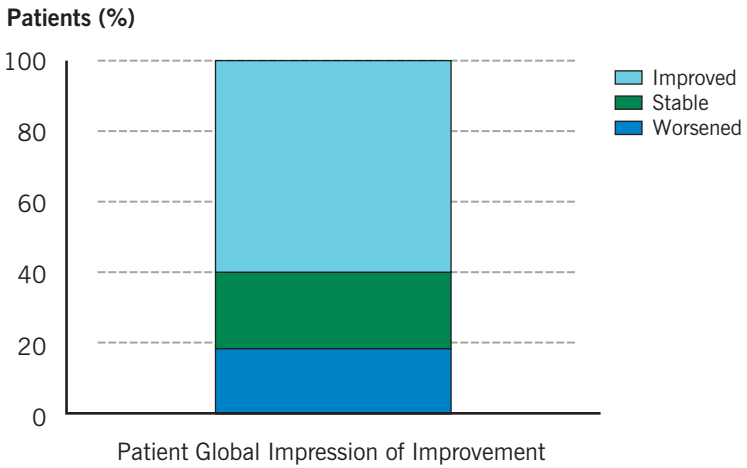
Reference

1. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

Botulinum Toxin Treatment

Improvement Following Botulinum Toxin Treatment for Cervical Dystonia (N = 135)

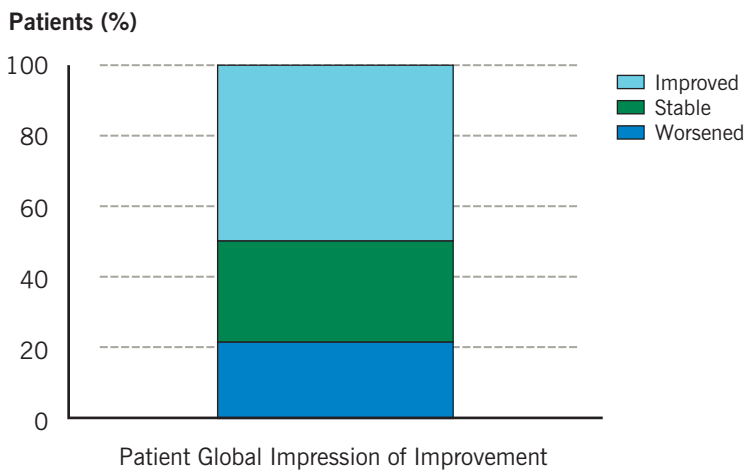
2016



In patients with cervical dystonia (spasmodic torticollis) treated with chemodenervation (botulinum toxin) in 2016, 60% rated their condition as improved, compared with their condition before beginning treatment, using the PGI-I questionnaire.

Improvement Following Botulinum Toxin Treatment for Movement Disorder (N = 258)

2016

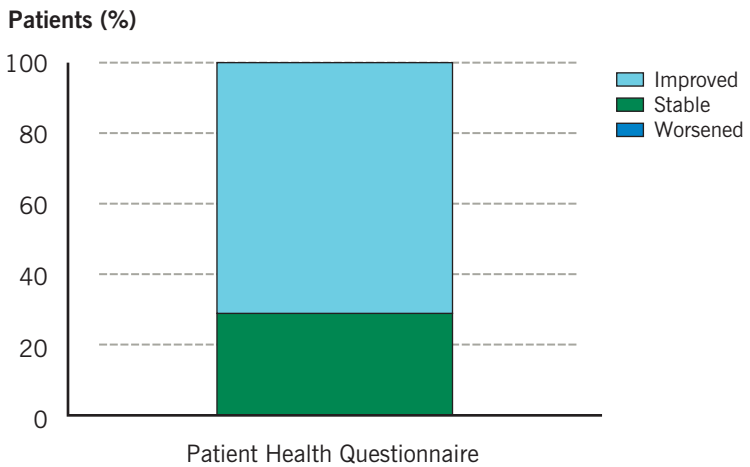


In all patients treated with chemodenervation (botulinum toxin) in 2016, 50% rated their condition as improved, compared with their condition before beginning treatment, using the PGI-I questionnaire. In addition to cervical dystonia, botulinum toxin is used to treat other forms of dystonia, tremor, hemifacial spasm, and spasticity.

Huntington Disease

Change in Depressive Symptoms in Huntington Disease (N = 14)

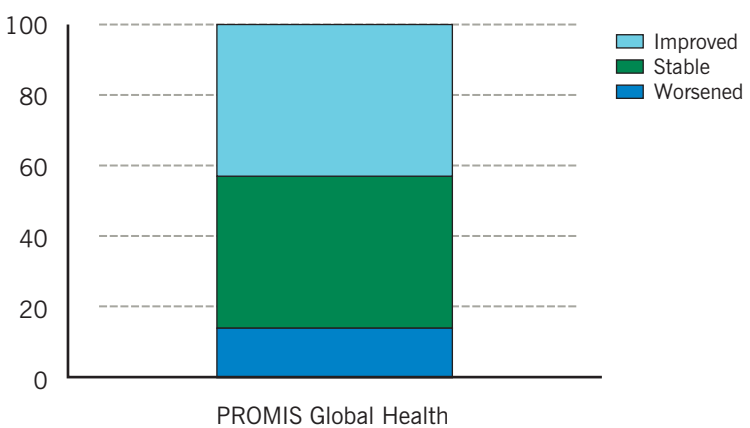
2015 – 2016



Fourteen patients with Huntington disease (HD) completed the PHQ-9 in 2 consecutive years (2015–2016). Of the 7 patients whose initial score was ≥ 10, 5 (71%) reported improved symptoms and 2 (29%) reported stable symptoms over 1 year. A change of 5 points is considered clinically meaningful in patients whose initial PHQ-9 is ≥ 10.[1] Of the remaining 7 patients with PHQ-9 < 10 in 2015, none reported clinically meaningful depression in 2016 (PHQ-9 ≥ 10). Median duration of follow-up was 356 days (range, 227–502).

Change in PROMIS Global Health Ratings Following Deep Brain Stimulation for Huntington Disease (N = 10)

2015 – 2016



PROMIS = Patient-Reported Outcomes Measurement Information System

The PROMIS-10 questionnaire is a self-reported measure of physical and emotional health status reflecting health-related quality of life. Ten HD patients completed the PROMIS-10 in 2 consecutive years. Median duration of follow-up was 369 days (range, 205–525). Clinically meaningful change was defined as a total change of > 5 T-score points.[2] Of the 7 patients who reported presurgical quality of life greater than 0.5 SD below the mean, 3 (43%) reported improvement, 3 (43%) remained stable, and 1 (14%) reported worsening. Of the 3 patients reporting average baseline PROMIS-10 scores, none reported worsening at follow-up.

References

1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.
2. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

Mellen Center for Multiple Sclerosis Patient Characteristics[a] (N = 5452)

2016

Characteristic	
Mean age	50 years (SD = 12.7)
Median age	51 years (range = 18–87)
Gender	
Male	1433 (26.3%)
Female	4019 (73.7%)
Race	
White	4456 (81.7%)
Black	652 (12.0%)
Multiracial	84 (1.5%)
Asian/Pacific Islander	21 (0.4%)
Native American	2 (0.1%)
Unknown	237 (4.3%)
Clinical course	
Relapsing-remitting	3848 (70.6%)
Secondary progressive	1060 (19.4%)
Primary progressive	392 (7.2%)
Clinically isolated syndrome	86 (1.6%)
Other/Unknown	66 (1.2%)
New	996
Established	4456
Lou Ruvo Center (Las Vegas)[b]	687

[a]Patients without a diagnosis of multiple sclerosis seen for consultation, rehabilitation, or spasticity management are not included.

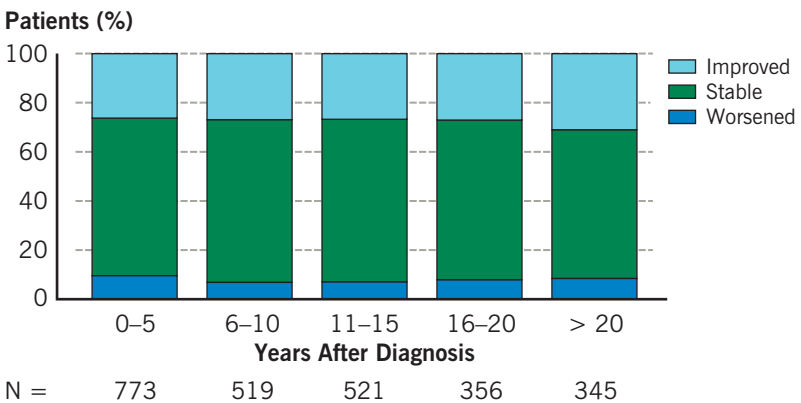
[b]Volume only is reported for the Lou Ruvo Center (Las Vegas).

Changes in Health Status With Disease Duration

Multiple sclerosis (MS) is a neurological disease that affects each individual differently. Impending physical disability is often the biggest concern for those who have been recently diagnosed with MS, and individual prognosis can be difficult to predict. The Mellen Center for Multiple Sclerosis Treatment and Research collects and analyzes a number of health status measures to better understand how quality of life, symptoms, and physical ability change over time. Persons with MS are generally expected to have a gradual worsening in physical function after diagnosis.

Change in Walking Speed in 5-Year Increments After MS Diagnosis

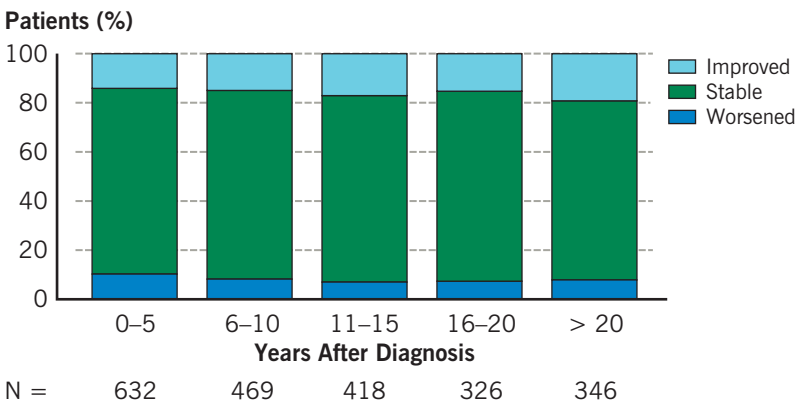
2016



The Timed 25-Foot Walk (T25FW), part of the Multiple Sclerosis Functional Composite, is an objective measure of mobility that is assessed at every Mellen Center visit. Clinically meaningful change in T25FW time was defined as a 20% change in the baseline measurement. Median time between visits was 364 days (range, 19–702). Patients with a relatively new diagnosis of MS (0–5 years after diagnosis) were just as likely as patients with long-standing MS (> 15 years after diagnosis) to have worsening in walking speed.

Change in Upper Extremity Function in 5-Year Increments After MS Diagnosis

2016



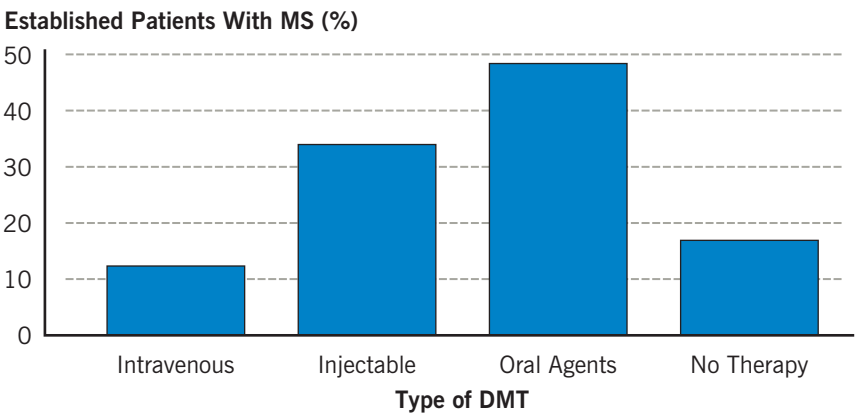
The 9-Hole Peg Test (9-HPT), also a part of the Multiple Sclerosis Functional Composite, is an objective measure of upper extremity function that is performed at each Mellen Center visit. Clinically meaningful change in dominant hand 9-HPT time was defined as a 20% change in the baseline measurement. Median time between visits was 365 days (range, 19–702). Patients with a relatively new diagnosis of MS (0–5 years after diagnosis) were just as likely as patients with long-standing MS (> 15 years after diagnosis) to have worsening in upper extremity function.

Disease Modifying Therapy for MS

The 2010 revision of the MS diagnostic criteria facilitated an earlier diagnosis of MS based on clinical and MRI findings. Because early disease activity appears to affect long-term disability, initiation of disease modifying therapy (DMT) should be considered as soon as the diagnosis of MS is established or in those patients with a single clinical event determined to have a high likelihood of having MS. The number of therapies approved for treatment of relapsing forms of MS has grown to 16 in 2016. Most newer therapies are administered either orally or intravenously. Although all available MS therapies are used to some extent, Mellen Center physicians have adopted the use of newer oral and intravenous agents.

Utilization of DMT in Patients With Relapsing Remitting MS (N = 3755)

2016



DMT = disease modifying therapy

Percentages total > 100% because patients who switched therapies during 2016 could be in more than 1 group. The No Therapy group includes patients who never received DMT in 2016.

Wellness in MS

Optimal health with MS involves more than treatment of relapses, monitoring of DMT, and symptom management. The American Academy of Neurology (AAN) released an MS quality measure set in 2015.[1] Only 3 of the 11 measures were specific to diagnosis of MS and monitoring of disease activity. The remaining measures are intended to encourage increased attention to symptoms that affect quality of life of MS patients.

Prevention and treatment of comorbid conditions are equally important. Mental comorbidity is common, with a lifetime prevalence of 50% for depression and 19% to 41% for anxiety following a diagnosis of MS. Common physical comorbidities include hypertension, hyperlipidemia, arthritis, osteoporosis, and sleep disorders.[2] These mental and physical comorbid conditions are associated with adverse outcomes. Smoking and vitamin D deficiency may increase disease activity and the risk for developing MS.

Mellen Center Wellness Dashboard

2016

Measure	2016	2015	Denominator[a]
BMI assessed	97.64%	92.94%	5464
BMI between 18.5 and 24.9 (healthy)	31.04%	29.08%	5464
Smoking status assessed	97.62%	95.88%	5464
Current smoker, any frequency	16.07%	16.77%	5464
Vitamin D level checked[b]	35.34%	33.21%	5464
Vitamin D level > 50 ng/mL	22.48%	15.80%	1642
Screened for fall[c]	91.70%	95.74%	5464
Screened for depression[c]	75.00%	84.49%	5464
Depression (PHQ-9) score maintained/improved over 12 months[c]	91.20%	46.32%	2033
Quality of life (PROMIS Physical Health[3]) score maintained/improved over 12 months[c]	86.00%	NA	950
Fatigue (Neuro-QoL fatigue) score maintained/improved over 12 months[c]	79.30%	NA	1088
Screened for cognitive impairment[c]	23.90%	NA	5452

BMI = body mass index, Neuro-QoL = Quality of Life in Neurologic Disorders, PHQ-9 = Patient Health Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

[a]The Denominator is the number of MS patients seen in 2016 and assessed for each measure.

[b]Data available only for lab tests processed by a Cleveland Clinic lab

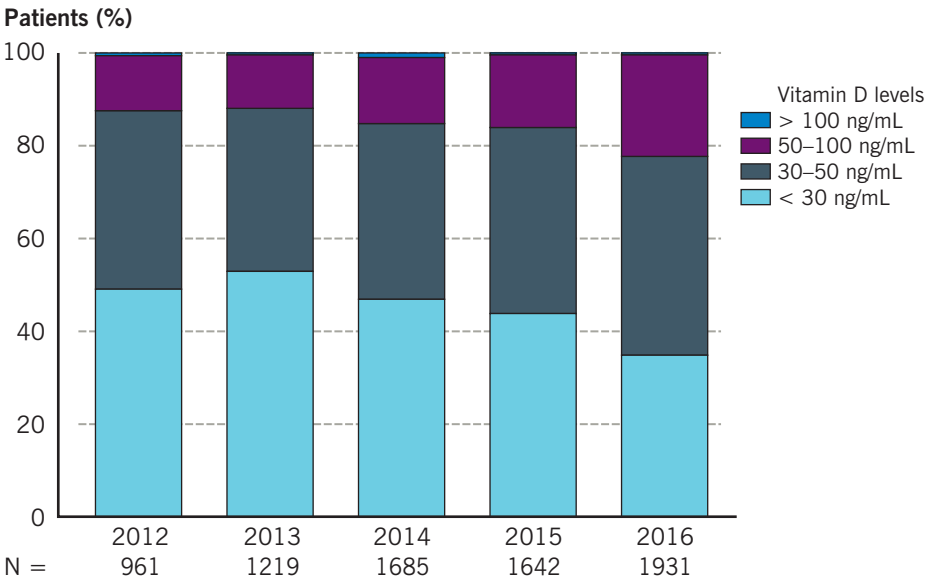
[c]Measure recommended by AAN MS work group

References

1. Rae-Grant AR, Bennett A, Sanders AE, Phipps M, Cheng E, Bever C. Quality improvement in neurology: Multiple sclerosis quality measures: Executive summary. *Neurology*. 2015 Nov 24;85(21):1904-1908.
2. Marrie RA, Hanwell H. General health issues in multiple sclerosis: comorbidities, secondary conditions, and health behaviors. *Continuum (Minneap Minn)*. 2013 Aug;19(4 Multiple Sclerosis):1046-1057.
3. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

Vitamin D Deficiency in Mellen Center MS Patients

2012 – 2016



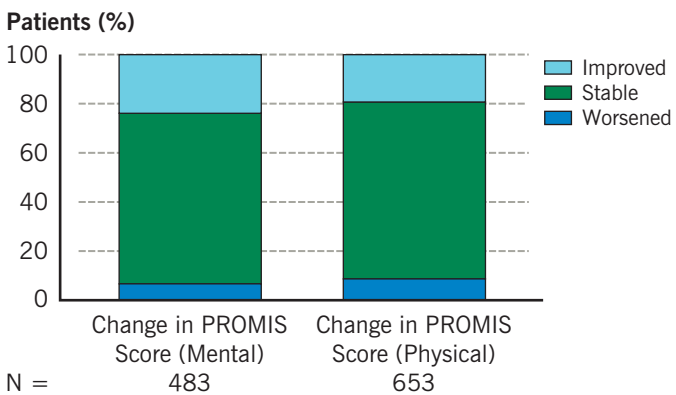
The National Health and Nutrition Examination Survey found high rates of vitamin D deficiency in the general US population. Recent studies suggest that vitamin D may play a role in MS pathogenesis, disease activity, and disease progression. The optimal approaches for supplementing vitamin D in the MS population have not been established, but the Mellen Center recommends replacing vitamin D to a minimum level of 50 ng/mL. A retrospective review of Mellen Center patients reveals that vitamin D testing (blood levels of 25-hydroxy vitamin D) is increasingly common, but most patients remain below the target level.

Quality of Life, Depression, and Fatigue for MS Patients

The Patient-Reported Outcomes Measurement Information System (PROMIS®),[1] Patient Health Questionnaire (PHQ-9), and Quality of Life in Neurologic Disorders Fatigue domain (Neuro-QoL Fatigue) are used to assess quality of life, depression, and fatigue in persons with MS. A positive screen suggesting at least mild to moderate impairment often prompts further discussion and intervention.

Change in Quality of Life for MS Patients

2016



PROMIS = Patient-Reported Outcomes Measurement Information System

In 2015 and 2016, 992 patients had at least 1 visit in each year with PROMIS Mental Health[1] data available for each visit. The mean PROMIS score of the general population is 50, with lower scores indicating lower quality of life. Among the 483 patients whose baseline PROMIS Mental Health score was ≤ 45 or one-half standard deviation below the general population, 92.7% either showed improvement or remained stable at follow-up. Median duration of follow-up was 321 days (range, 24–449). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[2]

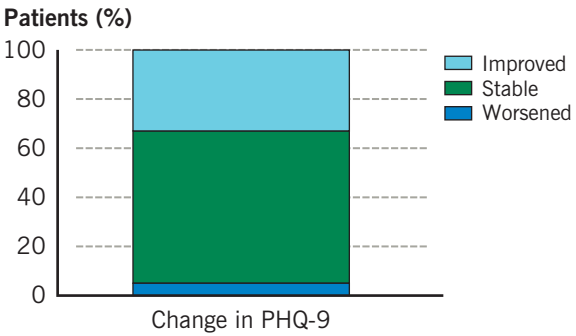
In 2015 and 2016, 950 patients had at least 1 visit in each year with PROMIS Physical Health[1] data available for each visit. Among the 653 patients whose baseline PROMIS Physical Health score was ≤ 45 or one-half standard deviation below the general population, 90.7% either showed improvement or remained stable at follow-up. Median duration of follow-up was 329 days (range, 11–462). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[2]

References

1. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.
2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Depression for MS Patients (N = 482)

2016

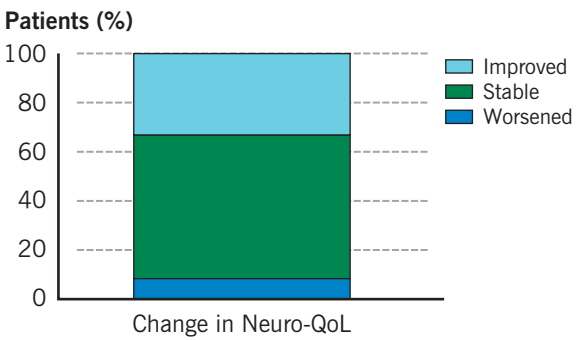


PHQ-9 = Patient Health Questionnaire

Of the 2033 patients who had at least 1 visit in both 2015 and 2016 with PHQ-9 data available for each visit, 482 had a baseline PHQ-9 score ≥ 10, indicating moderate depression. At follow-up, 94.4% either showed improvement or remained stable. Median duration of follow-up was 354 days (range, 49–676). Clinically meaningful change was defined as a total point change of 5.[1]

Change in Fatigue for MS Patients (N = 373)

2016



Neuro-QoL = Quality of Life in Neurologic Disorders

In 2015 and 2016, 1088 patients had at least 1 visit in each year with Neuro-QoL Fatigue data available for each visit. The mean Neuro-QoL score for the general population is 50 (SD = 10), with higher numbers indicating increased symptoms. Among the 373 patients whose baseline Neuro-QoL Fatigue score was ≥ 55 or one-half standard deviation from the mean (at least mild symptoms), 91.2% either showed improvement or remained stable at follow-up. Median duration of follow-up was 367 days (range, 63–673). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[2]

References

1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

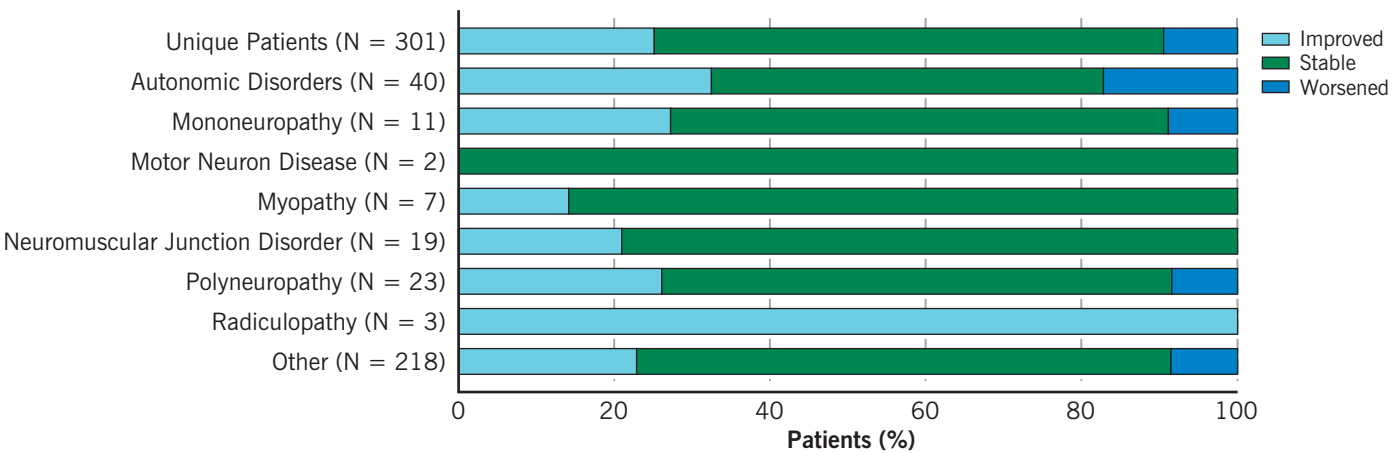
Neuromuscular Disorders

The Neuromuscular Center at Cleveland Clinic specializes in the diagnosis and treatment of a broad variety of disorders affecting the peripheral nervous system. Neuromuscular diseases can be debilitating, often progressive, and sometimes fatal. Weakness, paralysis, speech and/or swallowing difficulty, respiratory distress, sensory loss, and pain dramatically alter quality of life for both patients and their families. Cleveland Clinic's Neuromuscular Center offers advanced treatment modalities to address these issues, often coordinated with other Cleveland Clinic specialists and allied health professionals, with a goal of optimizing patients' quality of life.

Monitoring Quality of Life in Patients With Neuromuscular Disorders

Change in Mental Aspect of Quality of Life With Treatment for Neuromuscular Disorders (N = 301)

2015 – 2016



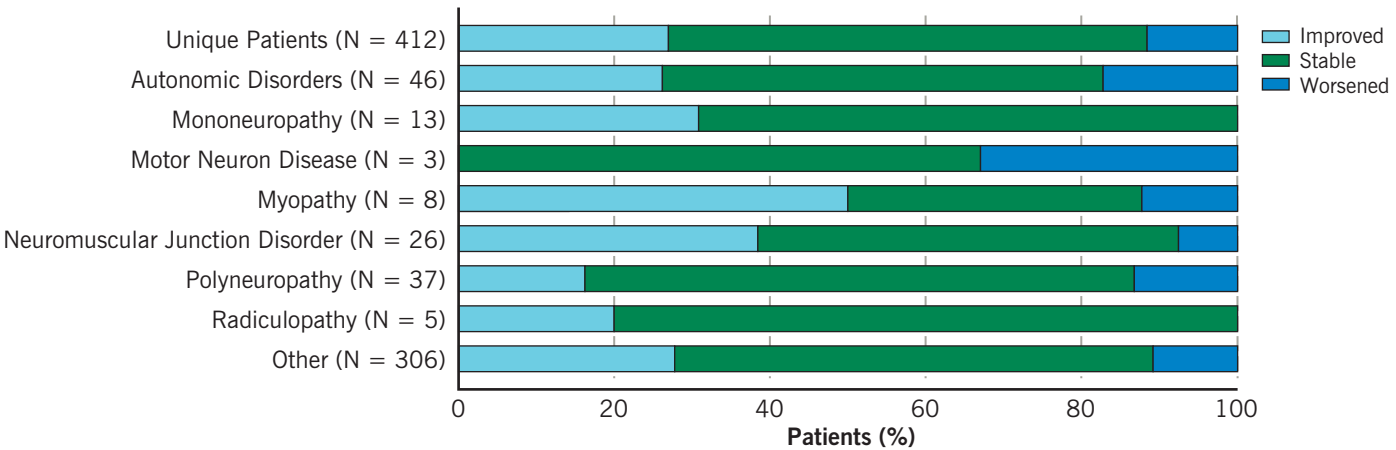
Of the 301 unique patients treated in the Neuromuscular Center, 90% either remained stable or reported an improvement in the mental aspect of quality of life as measured by the Patient-Reported Outcomes Measurement Information System (PROMIS®) Mental Health[1] T-scores from the initial visit to last follow-up in 2016. Patients with neuromuscular junction disorders, including myasthenia gravis, were most likely to improve or stabilize at follow-up (median duration between visits, 245 days; range, 96–428). Patients with autonomic disorders were most likely to report a worsened quality of life; 17.5% of these patients scored lower (median duration between visits, 200 days; range, 92–392). N = patients with PROMIS Mental Health T-score ≤ 45 who had 2 visits between 2015 and 2016 at least 90 days apart. Clinically meaningful change in PROMIS Mental Health T-score was defined as a 5-point change in score, based on one-half the standard deviation.[2] The median duration between visits for the entire group of patients was 209 days (range, 91–428).

References

1. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.
2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Physical Aspect of Quality of Life With Treatment for Neuromuscular Disorders (N = 412)

2015 – 2016



Of the 412 unique patients treated in the Neuromuscular Center, 88% either remained stable or reported an improvement in the physical aspect of quality of life as measured by the PROMIS Physical Health[1] T-scores from the initial visit to last follow-up in 2016. Patients with neuromuscular junction disorders, including myasthenia gravis, were most likely to improve or stabilize at follow-up (median duration between visits, 231 days; range, 96–428). Patients with motor neuron disease were most likely to report a worsened quality of life; 33.3% of these patients scored lower (median duration between visits, 137 days; range, 133–151). N = patients with PROMIS Physical Health T-score ≤ 45 who had 2 visits between 2015 and 2016 at least 90 days apart. Clinically meaningful change in PROMIS Physical Health T-score was defined as a 5-point change in score, based on one-half the standard deviation.[2] The median duration between visits for the entire group of patients was 207 days (range, 91–428).

References

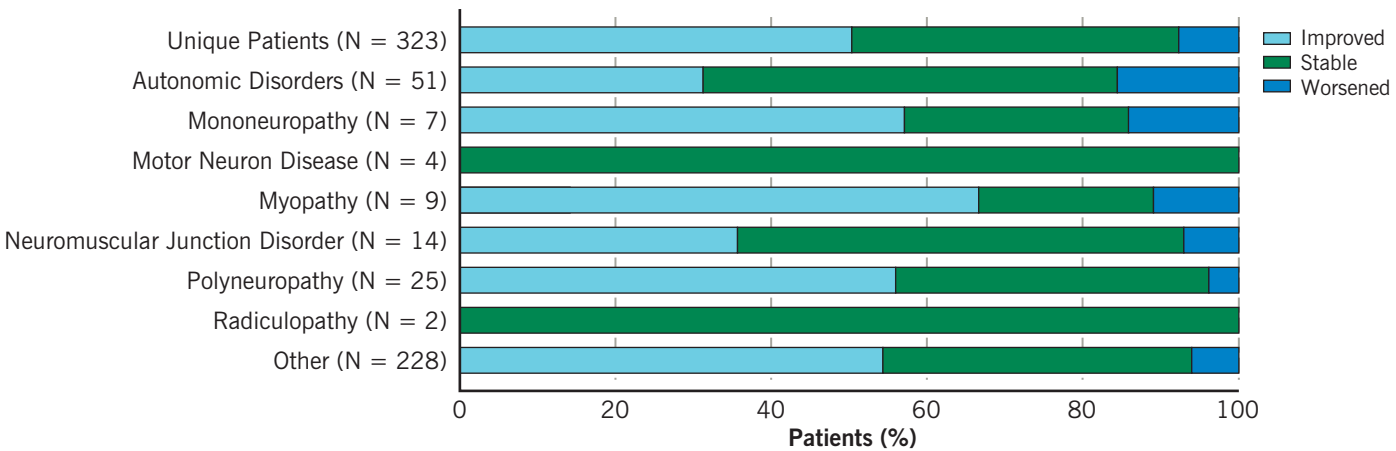
1. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Managing Depression in Patients With Neuromuscular Disorders

Long-Term Change in Comorbid Depression in Patients With Neuromuscular Disorders (N = 323)

2008 – 2016



Of the patients treated in the Neuromuscular Center, 323 were found to have depression at the time of their initial office visit. At follow-up, depressive symptoms improved in 50% of patients, remained stable in 42%, and worsened in 8% (median duration between visits, 562 days; range, 91–2987). Depression is least likely to improve in patients with autonomic disorders, with only 31% patients improved at follow-up (median duration between visits, 397 days; range, 105–2595). Depression is a treatable comorbidity in most patient groups over the long term, regardless of neuromuscular diagnosis. The graph displays change in Patient Health Questionnaire (PHQ-9) score from initial visit to follow-up for the various neuromuscular conditions. N = patients with PHQ-9 data available for 2 visits between 2008 and 2016 at least 90 days apart. Depression was defined by a baseline PHQ-9 score > 9 at the time of the patient's initial office visit. Clinically meaningful change was defined as a total point change ≥ 5.[1]

Reference

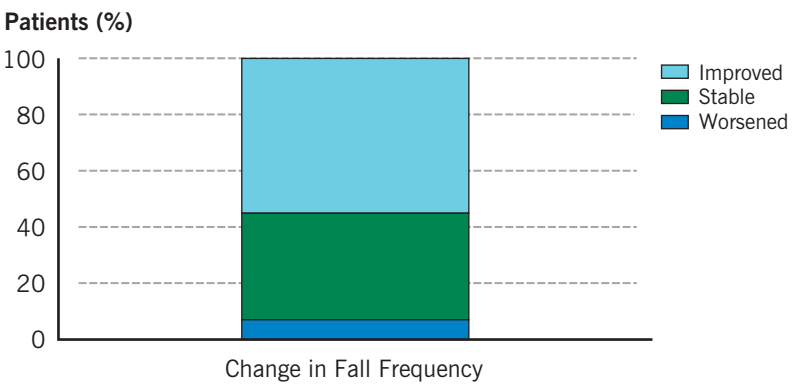
1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Reducing Falls and Days Missed From Normal Activities in Patients With Neuromuscular Disease

Frequent falls are an important cause of mortality and morbidity in patients with neuromuscular disease. The center regularly assesses fall frequency and works to develop individualized strategies to minimize fall risk. The range of potential interventions includes customized walking aids, physical therapy for gait retraining, home exercise for gait stability, changes in the home environment to reduce fall risk, and treatment of the underlying neuromuscular disorder.

Neuromuscular Patients With Frequent Falls: Change in Fall Frequency (N = 80)

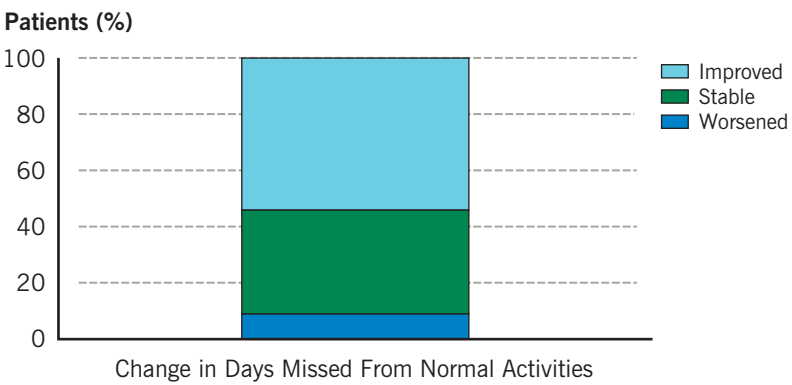
2016



In 2016, 1154 patients reported their "number of falls during the prior month" at the time of at least 2 office visits at least 90 days apart. Of the 80 patients who reported "falling frequently" at the time of their initial consultation, defined as ≥ 4 falls in the prior month, 55% (N = 44) improved, 37.5% (N = 30) remained stable, and 7.5% (N = 6) worsened. Clinically meaningful change was defined as a total change of at least 4 falls during the prior month in those with a baseline fall frequency of ≥ 4 per month. Median duration of follow-up was 709 days (range, 91–1513).

Neuromuscular Patients: Change in Days Missed From Normal Activities (N = 415)

2016



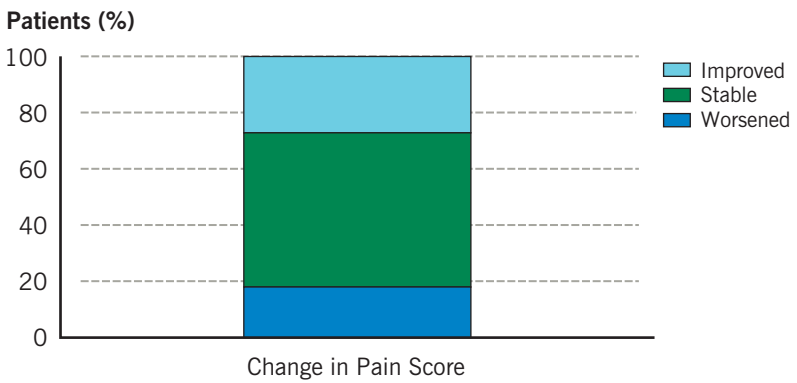
In 2016, 1154 patients reported their "days missed from usual activities in the past month" at the time of at least 2 office visits at least 90 days apart. Among patients with baseline self-reported days missed ≥ 5 (N = 415), 54% (N = 224) showed significant improvement, 36.4% (N = 151) remained stable, and 9.6% (N = 40) worsened. Clinically meaningful change was defined as a total change of at least 5 days missed in the prior month. Median duration of follow-up was 562 days (range, 91–1551).

Painful Polyneuropathy

Polyneuropathy is a disease with a range of potential causes, resulting in a combination of sensory loss, weakness, and pain. Treatments for painful polyneuropathy include oral medications, topical treatments, meditation, yoga, Tai Chi, physical exercise, and electrical stimulation. Management of nerve pain sometimes requires multidisciplinary intervention, including a referral to a pain management specialist or the Neurological Institute's Chronic Pain Rehabilitation Program.

Painful Polyneuropathy Patients: Change in Pain Score (N = 340)

2016



In 2016, 354 polyneuropathy patients reported their pain using a numeric rating scale (NRS), ranging from 0 ("no pain") to 10 ("worst possible pain") at 2 visits at least 90 days apart. Among those patients with a baseline pain score ≥ 2 (N = 340), 27.4% (N = 93) showed improvement, 54.4% (N = 185) remained stable, and 18.2% (N = 62) worsened. Clinically meaningful change was defined as one-half a standard deviation,[1] or a total point change of 2 in those whose baseline pain NRS was ≥ 2. Median duration of follow-up was 671 days (range, 91–1529).

Of the 93 patients who improved, 39 (41.9%) answered "No" to the question, "Are you being treated for your neuropathy pain?" at their initial consultation. At follow-up, 25 (64%) of these patients reported being treated with medication for neuropathic pain (e.g., pregabalin, gabapentin, etc.), and 27 (69%) reported using other treatments such as Tai Chi, exercise, meditation, and other nonpharmacological therapies.

Reference

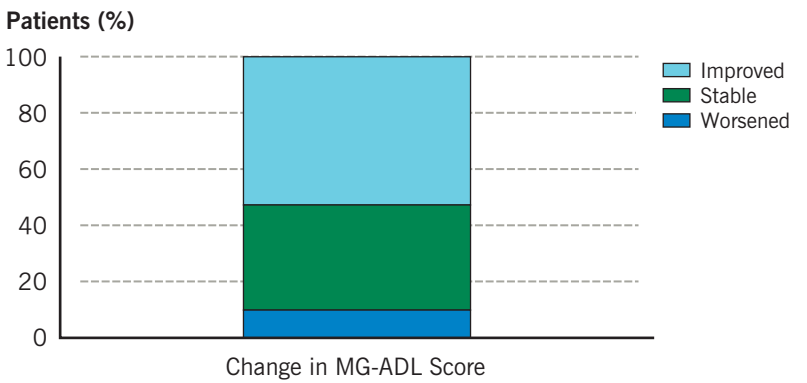
1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Myasthenia Gravis

Myasthenia gravis (MG) is a chronic disease characterized by symptoms that may include fluctuating double vision, droopy eyelids, slurred speech, difficulty swallowing, and generalized weakness. In some cases, weakness can be life-threatening, requiring multidisciplinary inpatient care. Cures are uncommon, but effective treatments are available. Cleveland Clinic's Neuromuscular Center offers an individualized approach to treating patients with MG. The effectiveness of treatment depends on many factors, including the severity of the disease, the duration of the disease, the patient's age, the patient's overall health, and treatment modality.

Myasthenia Gravis Patients: Change in Activities of Daily Living (N = 211)

2008 – 2016



MG-ADL = Myasthenia Gravis Activities of Daily Living scale

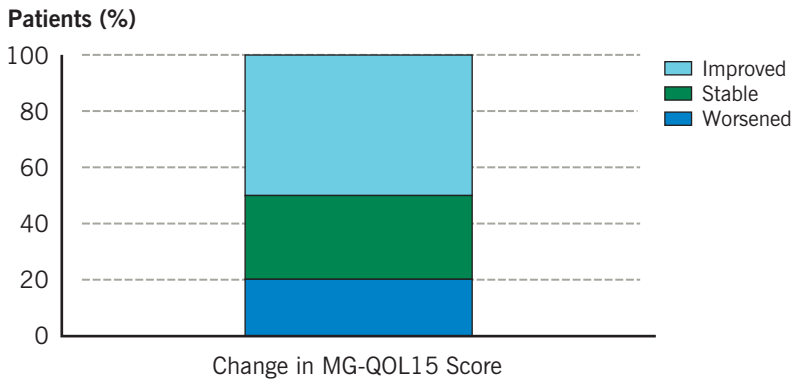
The Myasthenia Gravis Activities of Daily Living (MG-ADL) scale is an 8-item questionnaire focusing on symptoms commonly reported in MG patients. A lower score indicates less severe symptoms. The change in MG-ADL scale was analyzed at the last follow-up visit in MG patients initially assessed in the Neuromuscular Center between 2008 and 2016. Over this period, 90% of patient scores were stable or improved. Despite optimal medical management to balance symptom suppression and medication side effects, MG is characterized by exacerbations; at the time of their most recent follow-up visit, approximately 10% of MG patients worsened from their initial baseline, based on the MG-ADL scale. The average change in MG-ADL was -2.5 (SD = 3.9). Clinically meaningful change was defined as a 2 point improvement in MG-ADL score.[1] N = MG patients with MG-ADL data available over at least 2 visits between 2008 and 2016. Median duration of follow-up was 1163 days (range, 18–3052).

Reference

1. Muppidi S, Wolfe GI, Conaway M, Burns TM; MG Composite and MG-QOL15 Study Group. MG-ADL: still a relevant outcome measure. *Muscle Nerve*. 2011 Nov;44(5):727-731.

Myasthenia Gravis Patients: Change in Quality of Life (N = 201)

2010 – 2016



MG-ADL = Myasthenia Gravis Activities of Daily Living scale

The Myasthenia Gravis Quality of Life (MG-QOL15) scale assesses both physical and psychological aspects of MG, with a possible score range of 0 to 60. A lower score indicates a higher quality of life. The change in MG-QOL15 was analyzed at the last follow-up visit for MG patients initially assessed in the Neuromuscular Center between 2010 and 2016. Over this period, 80% of patient scores were stable or improved, and approximately 20% worsened from their initial baseline, based on the MG-QOL15 scale. The mean change in MG-QOL15 was -9.3 (SD = 14.7). Clinically meaningful change was defined as 7 points on the MG-QOL15.[1] N = MG patients with MG-QOL15 data available over at least 2 visits between 2010 and 2016. Median duration of follow-up was 1123 days (range, 28–2360).

Reference

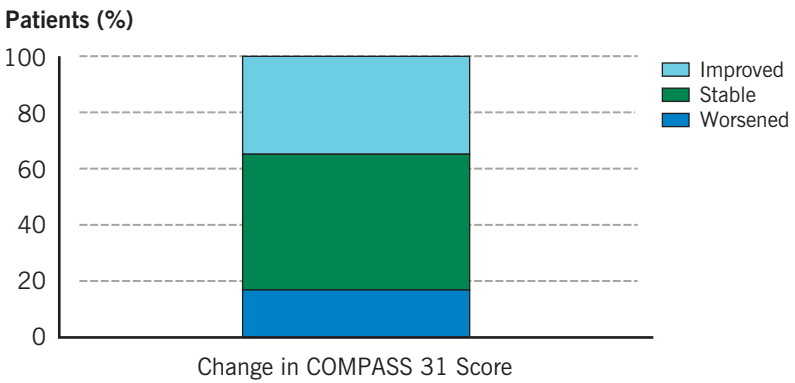
1. Burns TM, Grouse CK, Wolfe GI, Conaway MR, Sanders DB; MG Composite and MG-OL15 Study Group. The MG-QOL15 for following the health-related quality of life in patients with myasthenia gravis. *Muscle Nerve*. 2011 Jan;43(1):14-18.

Autonomic Disorders

Autonomic disorders affect the neuromuscular and cardiovascular systems of over 1 million Americans, resulting in symptomatic changes in heart rate, blood pressure, and perspiration, as well as changes in internal organ function. These disorders may significantly limit a person's ability to participate in normal daily activities. Cleveland Clinic's Autonomic Disorders Program offers care coordinated between specialists within the Neurological Institute and the Heart & Vascular Institute. Conditions treated include autonomic failure, orthostatic hypotension, orthostatic intolerance, autonomic and small fiber neuropathy, postural orthostatic tachycardia syndrome (POTS), and certain degenerative diseases (e.g., multiple system atrophy and autonomic dysfunction in Parkinson disease). Supportive interventions offered by the Neuromuscular Center include treatment of the underlying cause (when identifiable), medication, and nonmedical treatments (e.g., specialized exercise therapies, strategies to minimize blood pressure changes on standing, etc.).

Autonomic Disorder Patients: Change in COMPASS 31 Scores (N = 142)

2014 – 2016



The Composite Autonomic Symptom Score (COMPASS 31) is a self-assessment of 6 domains of autonomic function: orthostatic intolerance, vasomotor, secretomotor, gastrointestinal, bladder, and pupillomotor.[1] The 6 subscales sum to a total COMPASS 31 score between 0 and 100. A lower score indicates less severe symptoms. The change in COMPASS 31 was analyzed at the last follow-up visit for autonomic disease patients initially assessed in the Neuromuscular Center between 2014 and 2016. Over this period, 83.1% of patient scores were stable or improved, and approximately 17% worsened from their initial baseline, based on the COMPASS 31 score. Clinically meaningful change was defined as one-half a standard deviation,[2] or a total score change of 8. N = autonomic disorder patients with COMPASS 31 data available over at least 2 visits between 2014 and 2016 at least 30 days apart. Median duration of follow-up was 391 days (range, 105–913).

References

1. Sletten DM, Suarez GA, Low PA, Mandrekar J, Singer W. COMPASS 31: a refined and abbreviated Composite Autonomic Symptom Score. *Mayo Clin Proc*. 2012 Dec;87(12):1196-1201.

2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Amyotrophic Lateral Sclerosis

The Section of Amyotrophic Lateral Sclerosis (ALS) and Related Disorders provides comprehensive clinical care for patients with ALS and other motor neuron diseases (MND) in a multidisciplinary ALS/MND Team Clinic. To identify opportunities for improvement in compliance with evidence-based ALS care, the American Academy of Neurology (AAN) recently developed an ALS Quality Measurement Set.[1]

ALS Clinic: AAN ALS Quality Measurement Set Scorecard (N = 72)

2016

Measure Description	Cleveland Clinic Performance
Multidisciplinary care plan developed or updated at least once annually.	100% (72/72)
Disease-modifying pharmacotherapy for ALS discussed: patients had a documented discussion with their clinician about disease-modifying pharmacotherapy (riluzole).	91% (60/66)
Cognitive and behavioral impairment screening performed.	100% (72/72)
Symptomatic treatment offered: patients screened and found to have pseudobulbar affect, sialorrhea, or other ALS-related symptoms were offered symptomatic treatment.	97% (58/60)
Respiratory insufficiency querying and pulmonary referral: patients were queried about symptoms of respiratory insufficiency, and those with respiratory symptoms/signs were referred for pulmonary function testing.	100% (69/69)
Noninvasive ventilation discussed: patients found to have respiratory impairment had a documented discussion regarding noninvasive respiratory support options.	85% (33/39)
Dysphagia, weight loss, and impaired nutrition screening: patients were screened and the results of the screenings were documented in the medical record.	100% (72/72)
Nutritional support offered: patients with dysphagia, weight loss, or impaired nutrition were offered dietary or enteral nutrition support via percutaneous endoscopic gastrostomy or radiographically inserted gastrostomy.	86% (18/21)
Communication support referral: patients were screened for communication issues, and those found to have dysarthria were offered a referral to a speech-language pathologist.	100% (60/60)
End-of-life planning assistance: patients were documented to have been offered assistance with planning for end-of-life issues (e.g., advance directives, invasive ventilation, hospice).	100% (72/72)
ALS falls querying: patients were documented to have been queried about falls.	100% (72/72)

A systematic chart review was performed, using the last office visit note in 2016. N = ALS patients with data available for at least 2 office visits including at least 1 visit to the multidisciplinary ALS/MND Team Clinic in 2016.

Reference

1. Miller RG, Brooks BR, Swain-Eng RJ, Basner RC, Carter GT, Casey P, Cohen AB, Dubinsky R, Forshew D, Jackson CE, Kasarskis E, Procaccini NJ, Sanjak M, Tolin FP. Quality improvement in neurology: amyotrophic lateral sclerosis quality measures: report of the quality measurement and reporting subcommittee of the American Academy of Neurology. *Neurology*. 2013 Dec 10;81(24):2136-2140.

Pain/Headache

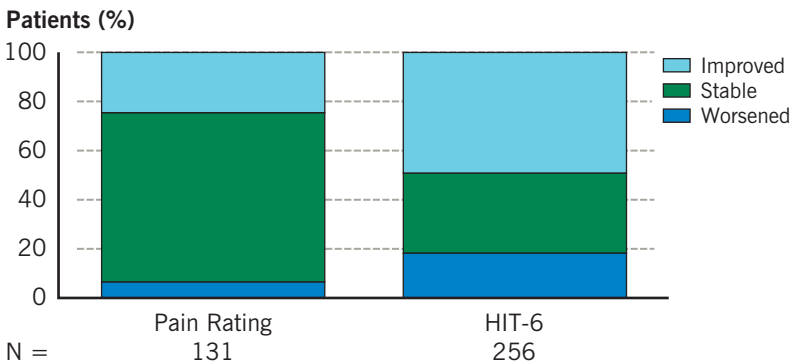
The Headache Center, within the Center for Neurological Restoration, uses the Headache Impact Test™ (HIT-6™) as a standard health status measure for all patients treated in the center. HIT-6 is a disease-specific survey that captures the effect of headache and its treatment on functional health and well-being.

Chronic Migraine

Chronic migraine refers to migraine headaches occurring at least 15 days per month, frequently associated with significant functional impairment and depression.

Outcomes of Treatment in Chronic Migraine Patients (N = 297)

2015 – 2016



HIT-6 = Headache Impact Test

In 2015 and 2016, 297 patients with chronic headaches were seen at the Headache Center and attended a follow-up appointment at least 6 months later. The average interval between the initial appointment and follow-up was ≥ 165 days. Of these 297 patients, 131 had pain ratings > 3 at admission, on a 0–10 scale (0 = no pain, 10 = worst possible pain), and also provided pain ratings at their second visit. Clinically meaningful change for pain was defined as ≥ 2.5 points.[1] Of these 297 patients, 256 reported HIT-6 scores > 50 at initial evaluation, and also provided HIT-6 scores at their second visit. Scores for HIT-6, which measures functional impairment resulting from headache, range from 36–78, with higher scores representing greater impairment. Clinically meaningful change for HIT-6 was defined as ≥ 3.7 points.[2]

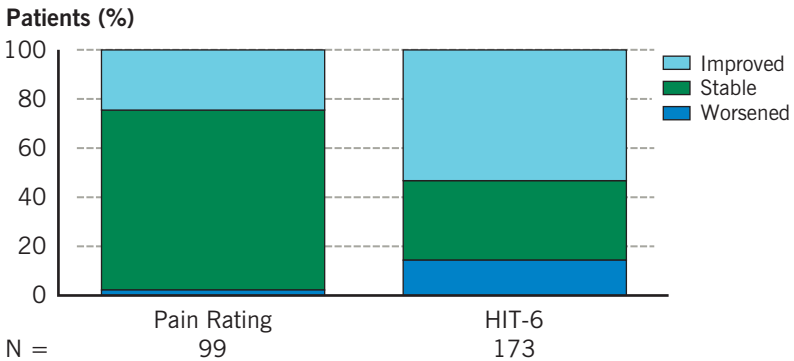
References

1. Farrar JT, Pritchett YL, Robinson M, Prakash A, Chappell A. The clinical importance of changes in the 0 to 10 numeric rating scale for worst, least, and average pain intensity: analyses of data from clinical trials of duloxetine in pain disorders. *J Pain*. 2010 Feb;11(2):109-118.
2. Coeytaux RR, Kaufman JS, Chao R, Mann JD, Devellis RF. Four methods of estimating the minimal important difference score were compared to establish a clinically significant change in Headache Impact Test. *J Clin Epidemiol*. 2006 Apr;59(4):374-380.

Episodic Migraine

Outcomes of Treatment in Episodic Migraine Patients (N = 202)

2015 – 2016



HIT-6 = Headache Impact Test

In 2015 and 2016, 202 patients were treated for episodic migraine and attended a follow-up appointment at least 6 months later. The average interval between the initial appointment and follow-up was 164 days. Of these 202 patients, 99 had pain ratings > 3 at admission, on a 0–10 scale (0 = no pain, 10 = worst possible pain), and also provided pain ratings at their second visit. Clinically meaningful change for pain was defined as ≥ 2.5 points.[1] Of these 202 patients, 173 reported HIT-6 scores > 50 at initial evaluation and provided HIT-6 scores at their second visit. Scores for HIT-6, which measures functional impairment resulting from headache, range from 36–78, with higher scores representing greater impairment. Clinically meaningful change for HIT-6 was defined as ≥ 3.7 points.[2]

References

1. Farrar JT, Pritchett YL, Robinson M, Prakash A, Chappell A. The clinical importance of changes in the 0 to 10 numeric rating scale for worst, least, and average pain intensity: analyses of data from clinical trials of duloxetine in pain disorders. *J Pain*. 2010 Feb;11(2):109-118.
2. Coeytaux RR, Kaufman JS, Chao R, Mann JD, Devellis RF. Four methods of estimating the minimal important difference score were compared to establish a clinically significant change in Headache Impact Test. *J Clin Epidemiol*. 2006 Apr;59(4):374-380.

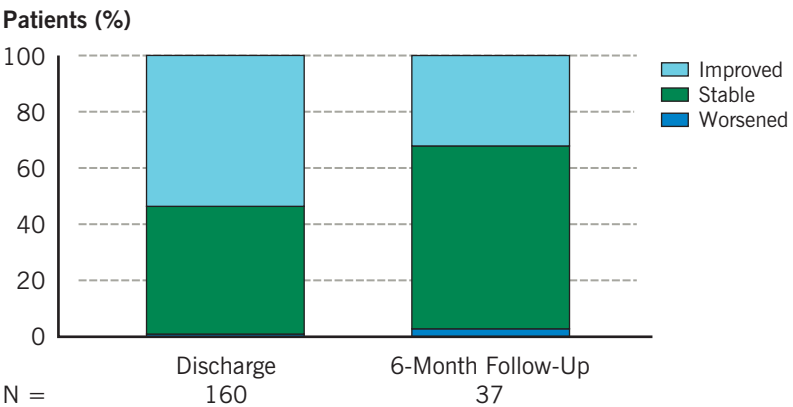
Cleveland Clinic Chronic Pain Rehabilitation Program

The Cleveland Clinic Chronic Pain Rehabilitation Program (CPRP) is a comprehensive interdisciplinary program designed to treat patients with disabling chronic pain. The CPRP treats approximately 200 patients per year and has been in existence since 1979. Duration of treatment is 3 to 4 weeks from 7:30 AM to 5:00 PM Monday through Friday, and includes medication management, individual and group psychotherapy, family therapy, physical and occupational therapy, substance use education, weaning from habituating medications, and optional monthly aftercare.

	2014	2015	2016
Number of patients enrolled	286	281	194
Number of patients completing treatment (%)	227 (79.4%)	237 (84.3%)	160 (82.5%)
Female (%)	188 (65.7%)	192 (68.3%)	142 (73.2%)
Mean age	48.7 (SD = 12.7)	47.5 (SD = 13.6)	49.5 (SD = 14.2)

Change in Pain Intensity Ratings in CPRP Patients (N = 160)

2016



Of the 160 patients who completed the CPRP in 2016, all provided both admission and discharge information about their pain intensity on a 0 to 10 scale (0 = no pain, 10 = worst possible pain), and 37 provided data at 6-month follow-up. Clinically meaningful change was defined as ≥ 2.5 points.[1,2]

CPRP = Chronic Pain Rehabilitation Program

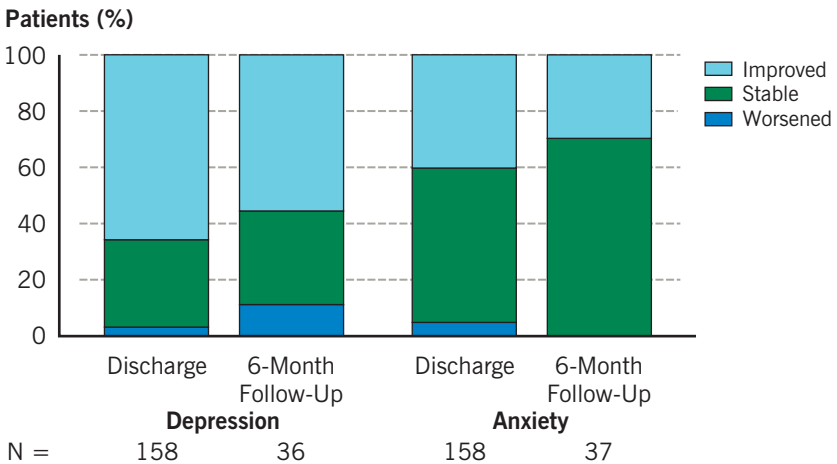
References

1. Farrar JT, Pritchett YL, Robinson M, Prakash A, Chappell A. The clinical importance of changes in the 0 to 10 numeric rating scale for worst, least, and average pain intensity: analyses of data from clinical trials of duloxetine in pain disorders. *J Pain*. 2010 Feb;11(2):109-118.

2. Salaffi F, Stancati A, Silvestri CA, Ciapetti A, Grassi W. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. *Eur J Pain*. 2004 Aug;8(4):283-291.

Change in Depression and Anxiety Symptoms in CPRP Patients (N = 160)

2016

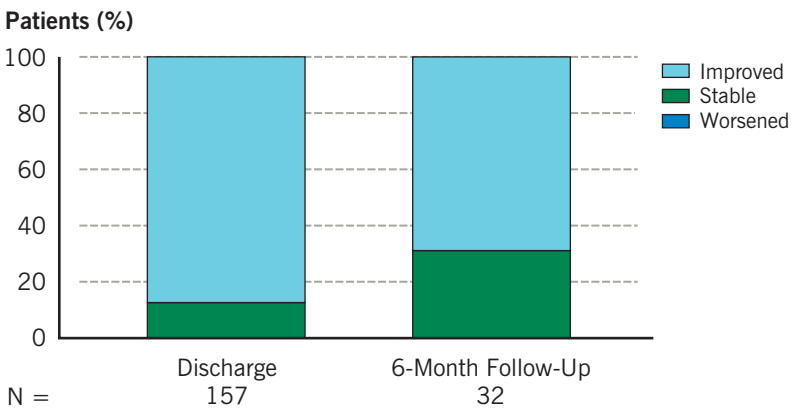


CPRP = Chronic Pain Rehabilitation Program

Of the 160 patients who successfully completed the CPRP, 158 provided admission and discharge information about their symptoms of depression and anxiety as measured by the Depression Anxiety Stress Scale (DASS-21); 36 provided 6-month follow-up information for Depression and 37 provided 6-month follow-up information for Anxiety. Higher scores indicate more severe symptoms. Clinically meaningful change cutoffs for DASS-21 have not been established, but a cutoff score of ≥ 7 points was used for each subscale in these analyses. Patients whose change was < 7 points were deemed stable.

Change in Functioning in CPRP Patients (N = 160)

2016



CPRP = Chronic Pain Rehabilitation Program

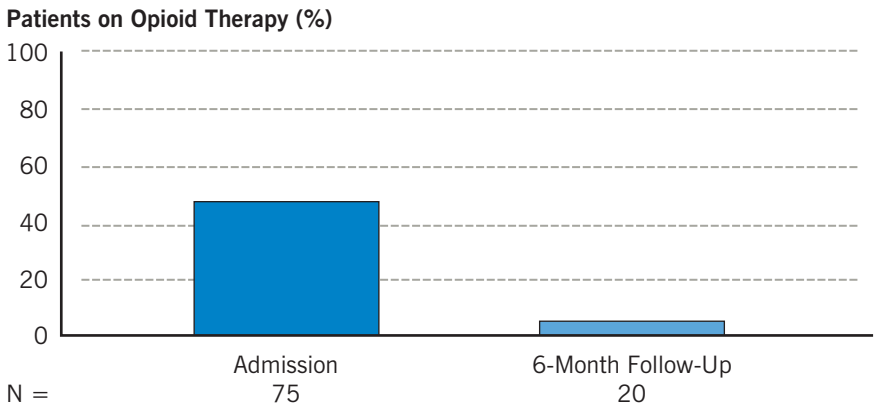
Of the 160 patients who successfully completed the CPRP, 157 provided admission and discharge information about their functioning as measured by the Pain Disability Index, and 32 provided 6-month follow-up information. Higher scores on the 0–70 scale indicate greater disability. Clinically meaningful change was defined as an improvement in function ≥ 9 points.[1] A stable score was defined as a change in score < 9. No patients demonstrated clinically meaningful deterioration.

Reference

1. Soer R, Reneman MF, Vroomen PC, Stegeman P, Coppes MH. Responsiveness and minimally clinically important change of the Pain Disability Index in patients with chronic back pain. *Spine*. 2012;37(8):711-715.

Change in Opioid Use in CPRP Patients (N = 158)

2016



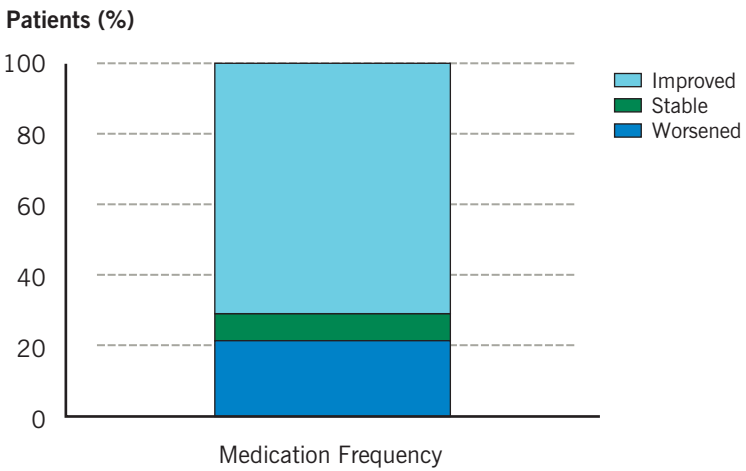
CPRP = Chronic Pain Rehabilitation Program

At the time of CPRP admission, 75 of 158 patients (47.5%) were prescribed chronic opioid therapy with a mean daily morphine milligram equivalence dosage of 88.1 (± 69.8). By discharge from the CPRP, 74 of these 75 patients were fully weaned (99%). Six-month follow-up data were available for 20 weaned patients, and 19 (95%) were still opioid-free.

Pediatric Headache

Change in Frequency of Headache Medications (N = 338)

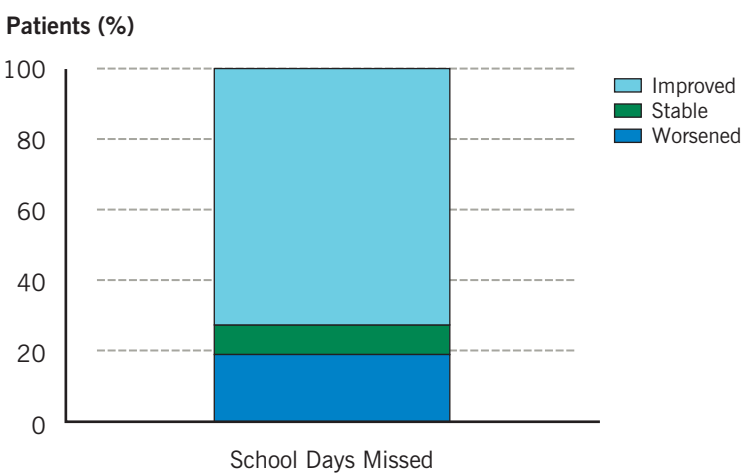
Treatment Dates: January 2014 – December 2016



Among 338 pediatric patients treated for headache, 71% showed improvement in the frequency of headache medication doses used. Improvement was defined as any decrease in headache medication frequency in patients who were on medication at initial assessment. Mean duration of follow-up was 226 days (range, 28–953).

Change in Frequency of School Days Missed (N = 220)

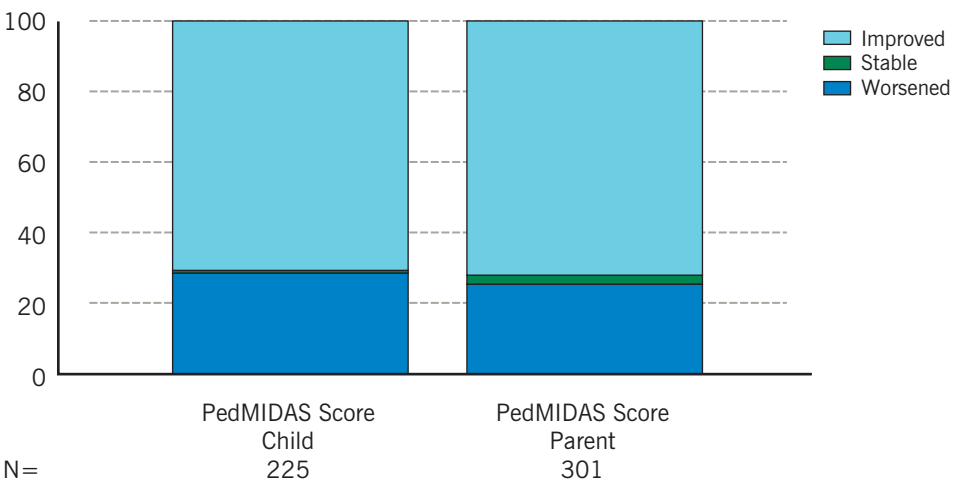
Treatment Dates: January 2014 – December 2016



Among 220 pediatric patients treated for headache, 73% showed improvement in the number of school days missed. Improvement was defined as any decrease in school days missed in patients with school absences at initial assessment. Mean duration of follow-up was 252 days (range, 91–936).

Change in Headache Disability

Treatment Dates: January 2014 – December 2016



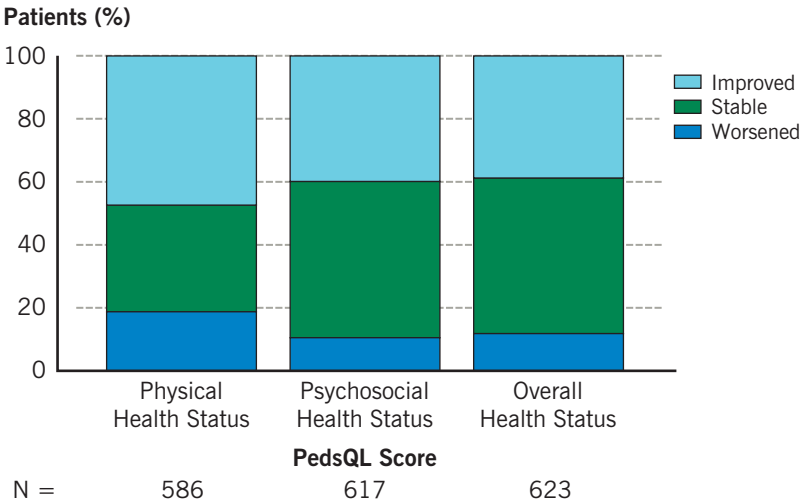
PedMIDAS = Pediatric Migraine Disability Assessment

Among 225 pediatric patients with child-reported scores, 71% showed improvement in total Pediatric Migraine Disability Assessment (PedMIDAS) score. Improvement was defined as any decrease in the PedMIDAS score in patients with a baseline score > 0. Median duration of follow-up was 261 days (range, 89–951).

Among 301 pediatric patients with parent-reported scores, 72% showed improvement in total PedMIDAS score. Improvement was defined as any decrease in the PedMIDAS score in patients with a baseline score > 0. Median duration of follow-up was 254 days (range, 91–951).

Change in Quality of Life After Treatment for Headache (Parent-Reported)

Treatment Dates: January 2014 – December 2016

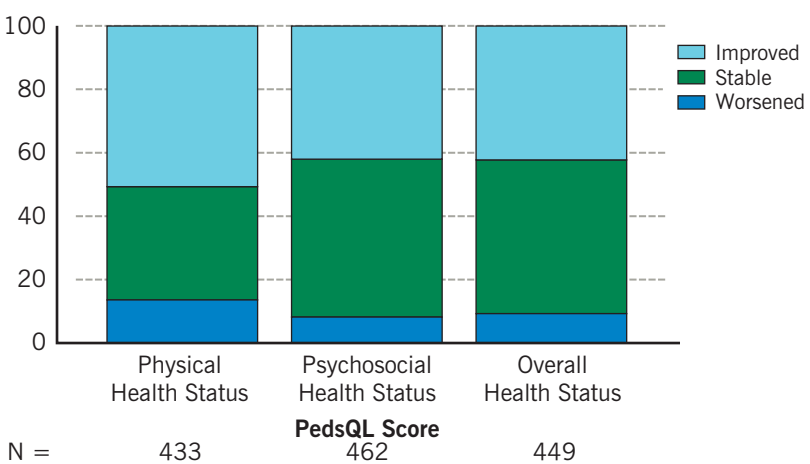


PedsQL = Pediatric Quality of Life Inventory

Among pediatric patients treated for headache, approximately 40% to 50% showed improvement in quality of life compared with their initial visit, as measured with the parent version of PedsQL™ (Pediatric Quality of Life Inventory™). The PedsQL is a 0 to 100 scale with higher scores indicating greater health-related quality of life. Clinically meaningful change was defined as one-half a standard deviation of the initial scores.[1] The median duration of follow-up was 229 to 230 days (range, 15–1077).

Change in Quality of Life After Treatment for Headache (Child-Reported)

Treatment Dates: January 2014 – December 2016



PedsQL = Pediatric Quality of Life Inventory

Among pediatric patients treated for headache, approximately 40% to 50% showed improvement in quality of life compared with their initial visit, as measured with the child version of PedsQL. Clinically meaningful change was defined as one-half a standard deviation of the initial scores.[1] The median duration of follow-up was 225 to 228 days (range, 15–1077).

Reference

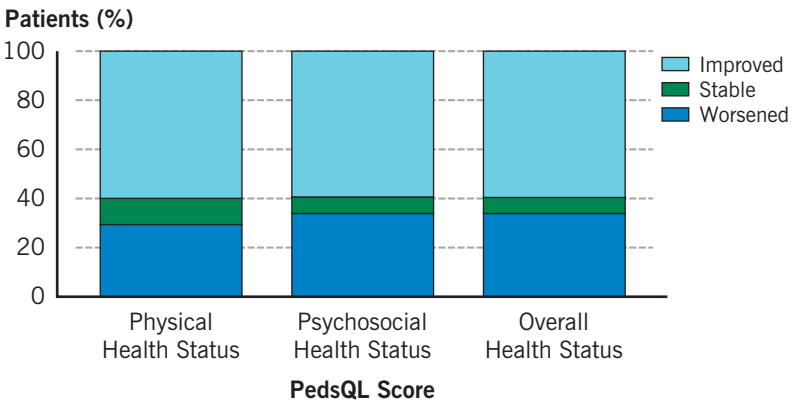
1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Pediatric Syncope

Autonomic disorders are now being recognized in increasing numbers in children and adolescents. However, disease characteristics, diagnostic criteria, and therapies are just evolving and remain largely undefined. Cleveland Clinic's Pediatric Neurology Center has established a comprehensive pediatric autonomic disorders program to address the unique needs of this group of pediatric patients.

Change in Quality of Life After Treatment for Syncope (N = 133)

Treatment Dates: September 2007 – December 2016



PedsQL = Pediatric Quality of Life Inventory

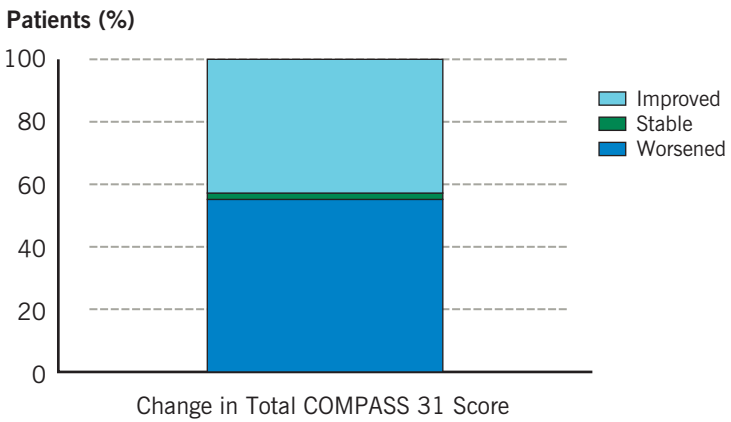
Among pediatric patients treated for syncope with multimodal treatment (medications, clinical psychology, and physical therapy), approximately 60% showed improvement in quality of life compared with their initial visit, as measured with the parent version of PedsQL, a 0 to 100 scale with higher scores indicating greater health-related quality of life. The median duration of follow-up was 561 days (range, 30–2557). Clinically meaningful change was defined as one-half a standard deviation of the initial scores,[1] or ≥ 13 points. N = syncope patients who had at least 2 visits with PedsQL data.

Reference

1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Symptom Severity After Treatment for Syncope (N = 51)

Treatment Dates: January 2015 – December 2016



COMPASS 31 = Composite Autonomic Symptom Score

Autonomic symptom severity was assessed using the Composite Autonomic Symptom Score (COMPASS 31) starting January 2015. The COMPASS 31 is a patient-reported measure of autonomic symptoms with total scores ranging from 0 to 100; lower scores indicate less severe symptoms. Over this period, 45% of patient scores were stable or improved. Median duration of follow-up was 296 days (range, 52–616). Clinically meaningful change was defined as one-half a standard deviation of the baseline scores,[1] or a total score change ≥ 7 points. N = syncope patients with COMPASS 31 data available over at least 2 visits.

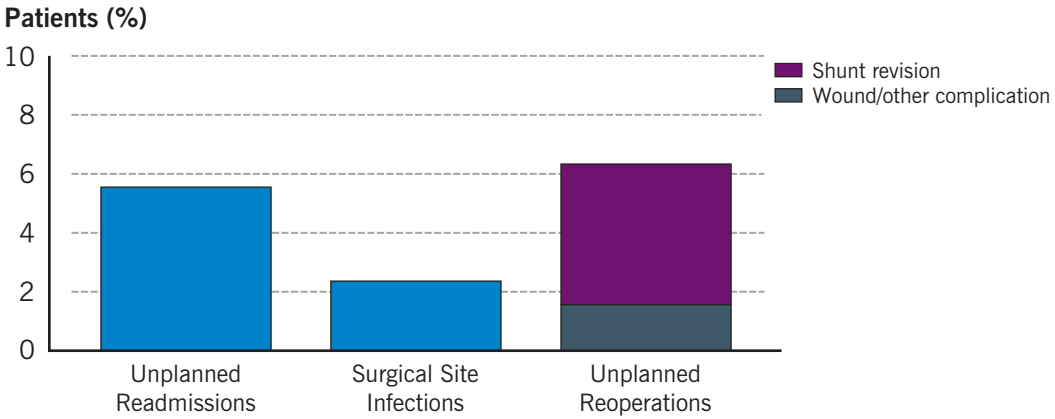
Reference

1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Pediatric Neurosurgery

Complications Following Major Pediatric Neurosurgery Procedures (N = 126)

2016

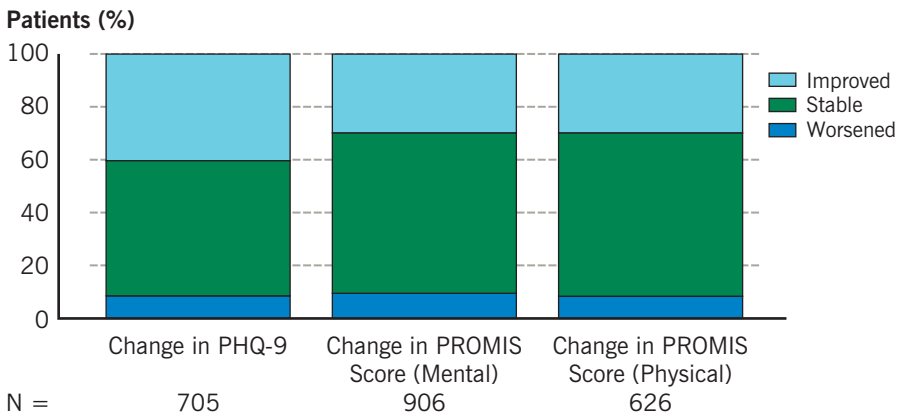


The Department of Pediatric Neurosurgery performed 126 procedures in patients < 18 years of age in 2016. There were 7 (5.6%) unplanned readmissions, and 3 patients (2.38%) had surgical site infections. Unplanned reoperations were broken into 2 categories: shunt revision (4.76%) and wound or other complication (1.59%), with a total rate of 6.35%.

Outpatient Treatment for Mood and Anxiety Disorders

Improvement in Depressive Symptoms and Global Health-Related Quality of Life Among Adult Outpatients

2016



PHQ-9 = Patient Health Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

Of the 705 adult outpatients with at least moderate depression, defined as a baseline Patient Health Questionnaire (PHQ-9) score ≥ 10, 40.1% demonstrated a clinically meaningful improvement. Clinically meaningful improvement was defined as a 5-point reduction in total PHQ-9 score from baseline to follow-up.[1] Outpatients were treated with psychotherapy and/or medication management. N = patients seen for initial assessment of a mood and/or anxiety disorder(s) in 2016 for whom initial and follow-up data were available. Median duration between initial and follow-up assessment was 131 days (range, 1–355).

The Patient-Reported Outcomes Measurement Information System (PROMIS®) Global Health[2] is a publicly available assessment tool consisting of 10 items used to assess overall physical health and mental health. Higher scores indicate better function and percentiles allow more direct comparison to the general population.

PROMIS Mental Health[2] data were available for analysis on 906 patients with at least 2 visits in 2016 and who had a baseline PROMIS Mental Health score ≤ 45; 30% showed improvement. Median duration of follow-up was 161 days (range, 1–355). PROMIS Physical Health[2] data were available for analysis on 626 patients with at least 2 visits in 2016 and who had a baseline PROMIS Physical Health score ≤ 45; 30.2% showed improvement. Median duration of follow-up was 175 days (range, 1–355). Clinically meaningful change for PROMIS was defined as a 5-point change in T-score, based on one-half the standard deviation.[3]

References

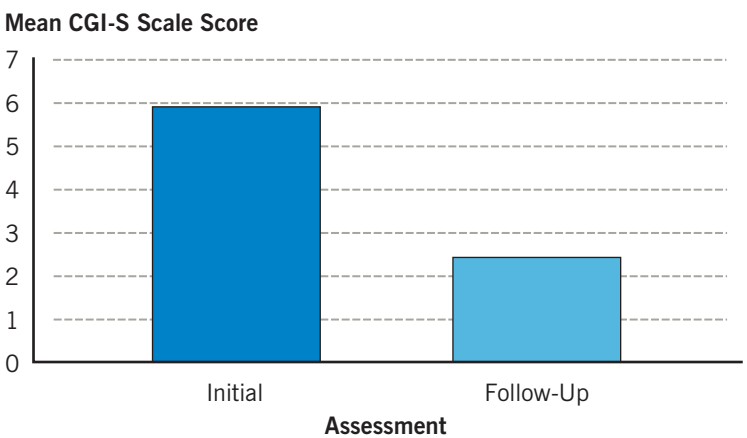
1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.
2. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.
3. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Intensive Outpatient Treatment Program

Cleveland Clinic's Center for Behavioral Health has established an Intensive Outpatient Program (IOP) to provide treatment for adults who suffer from mood disorders as well as dual diagnoses (i.e., mood disorders combined with substance abuse). This comprehensive adult behavioral program, which is located at 2 Cleveland Clinic hospitals — Lutheran and Marymount hospitals — has been created to address the unique needs of patients who can benefit from more concentrated services beyond a weekly therapy session while maintaining active lives in the community. Overall, the aim of the IOP is to help patients reduce mood disorder symptoms, regain their lost confidence, and achieve greater levels of functioning, including returning to work, resuming their daily activities, and returning to their roles as contributing members of their families. The program is available 3 to 4 days per week and is generally 4 to 6 weeks in duration, with an average group size of 8 to 12 patients.

Reduction in Illness Severity Following Intensive Outpatient Treatment Program (N = 177)

2016



CGI-S = Clinical Global Impression–Severity

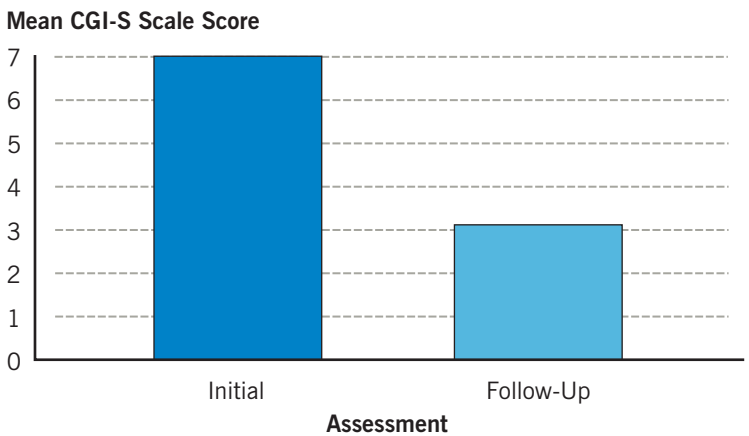
The Clinical Global Impression–Severity (CGI-S) is a standardized 7-point scale that requires the clinician to rate the severity of the patient's illness at the time of assessment. The CGI-S is widely used in behavioral health to measure severity of symptoms, with higher scores indicating greater severity of illness (1 = normal, 7 = most ill). Mean group scores at initial assessment and at the program's completion are displayed for a sample of 177 adult outpatients (67% female, 33% male; average age 41.3 years) evaluated and treated in the IOP in 2016. On average, patients experienced a significant reduction, defined as > 2 points change in CGI-S, in overall severity of illness following completion of the program, from a mean baseline score of 5.9 (severely ill) to a follow-up score of 2.4 (mildly ill) ($P < 0.0001$). Mean duration between initial and follow-up assessment was 6.6 weeks.

2016 Consultation Liaison Inpatient Psychiatry Service

The Consultation Liaison (CL) Psychiatry Service specializes in the interface between medicine and psychiatry. At Cleveland Clinic, the CL Psychiatry Service performs more than 3000 consults annually, evaluating, at the request of the treating medical or surgical team, patients currently admitted as general medical inpatients. The reasons for consultation are varied and may include assistance in the management of delirium, mood, anxiety, and adjustment disorders as well as addiction and capacity evaluations. Most consultations are for management of delirium.

Reduction in Illness Severity Following Inpatient Psychiatry Consultation for Delirium (N = 75)

2016



CGI-S = Clinical Global Impression–Severity

Mean group CGI-S scores at baseline assessment and at last follow-up visit are displayed for a sample of adult inpatients evaluated and treated for delirium by the CL Psychiatry Service in 2016. On average, patients experienced a significant reduction, defined as ≥ 2 points, in overall severity of illness following psychiatric consultation within an average of approximately 4 days, with scores dropping from a mean baseline score of 7.0 (extremely ill) to a follow-up score of 3.1 (mildly ill) ($P < 0.0001$).

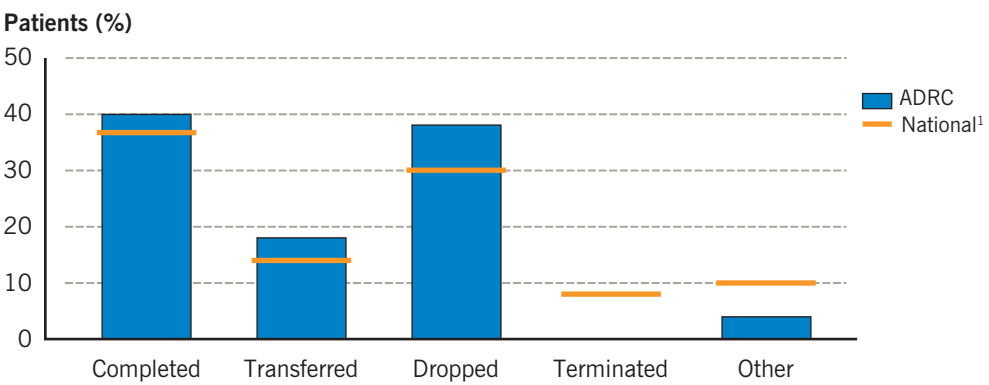
Alcohol and Drug Rehabilitation

The Alcohol and Drug Rehabilitation Center (ADRC) provides a multidisciplinary team approach to the evaluation and treatment of chemical dependency. The ADRC is designed to help patients confront and overcome their chemical and/or alcohol dependency, and to assist in developing strategies for maintaining a chemical-free lifestyle.

The ADRC's Intensive Outpatient Program (IOP) and Partial Hospital Program (PHP) have been designed to provide treatment for adults who are suffering from chemical dependency. These comprehensive adult behavioral programs, which are located at Cleveland Clinic Lutheran Hospital, have been created to address the unique needs of patients who can benefit from more concentrated services while maintaining active lives in the community. Overall, the aim of the IOP/PHP is to help patients reduce symptoms and achieve greater levels of functioning. The program is available 4 to 5 days per week and is generally 12 to 14 weeks in duration with an average group size of 8 to 12 patients. The last 2 months of the treatment period consist of once weekly group aftercare sessions, so the contact hours are concentrated in the first 4 to 6 weeks of the program.

Completion Rates for Outpatient Programs for Chemical Dependency (N = 125)

Jan. 1 – June 30, 2016



ADRC = Alcohol and Drug Rehabilitation Center

Outcomes from the ADRC's intensive outpatient programs from Jan. 1 through June 30, 2016, are compared with national figures.[1] Overall, 40% of IOP/PHP discharges completed all recommended treatment compared with 37% nationally, 18% were transferred to another treatment program compared with 14% nationally, and 38% dropped out of treatment compared with 30% nationally. No patient had treatment terminated by the facility and 4% failed to complete treatment for other reasons, compared with national rates of 8% and 10%, respectively.

Reference

1. Treatment Episode Data Set (TEDS) 2011 Discharges from Substance Abuse Treatment Services. DEPARTMENT OF HEALTH AND HUMAN SERVICES. Substance Abuse and Mental Health Services Administration. Office of Applied Studies (wwwdasis.samhsa.gov/dasis2/teds.htm).

Sleep Disorders

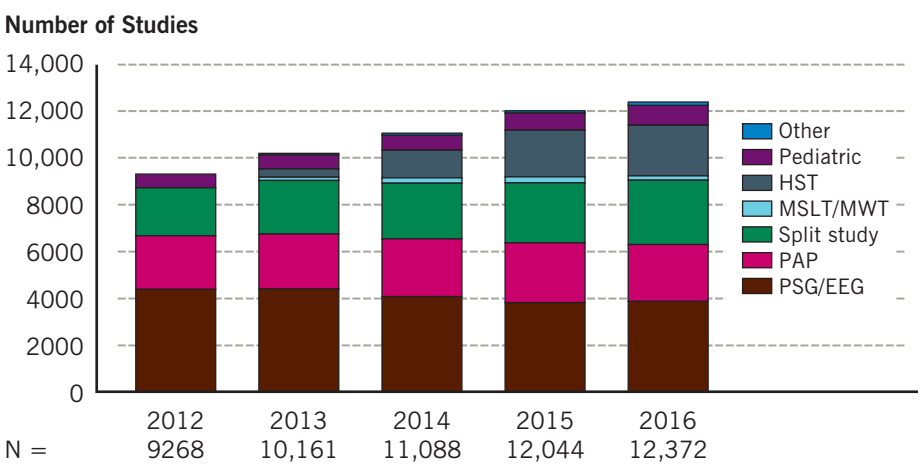
Cleveland Clinic's Sleep Disorders Center, established in 1978, was among the first in the nation dedicated to the diagnosis and treatment of sleep and wake disorders across the entire age spectrum. Accredited by the American Academy of Sleep Medicine, the Sleep Disorders Center provides a comprehensive, multidisciplinary approach to patient care with a broad array of specialists in Neurology, Pulmonary and Critical Care Medicine, Psychiatry and Psychology, Internal Medicine, Family Medicine, Pediatrics, and Otolaryngology.

The program has 41 beds in 9 sleep laboratory locations within Cleveland Clinic health system. The center was among the first to pilot the hotel-based sleep laboratory model. Six of the 9 laboratory locations are based in hotels to maximize patient access and comfort. The procedures performed include routine and advanced polysomnography with therapeutic interventions, maintenance of wakefulness tests, multiple sleep latency tests, and positive airway pressure (PAP) nap studies (daytime sleep studies aimed to optimize PAP adherence), as well as procedures tailored to special populations including neonates and children. The overall number of adult sleep studies performed in locations across northeast Ohio continues to increase each year.

Among the 2016 Sleep Disorders Center outcomes are implementation of quality improvement monitoring of the home sleep apnea testing program, innovative resources to optimize PAP adherence, illustration of the impact of PAP treatment in sleep apnea on patient-reported outcomes (including depression and drowsy driving) and cardiometabolic outcomes, inter-relationships of sleep disorders and epilepsy and other neurologic disorders, pediatric sleep outcomes, and insomnia.

Overall Sleep Studies

2012 – 2016



For patients under 18 years of age, total sleep studies increased from 755 in 2015 to 833 in 2016 (reflecting a 10% increase), including 736 polysomnogram (PSG), 26 PAP, 28 multiple sleep latency/ maintenance of wakefulness tests, 9 split night, 30 PSGs in combination with 18-channel electroencephalography, and 4 home sleep testing studies.

HST = home sleep testing, MSLT/MWT = multiple sleep latency test/maintenance of wakefulness test, Other = PAP Nap studies for acclimation, and titration studies with oral pressure therapy, oral appliance, or nasal end expiratory positive pressure, PAP = positive airway pressure titration study, PSG/EEG = polysomnogram alone or in combination with 18-channel electroencephalography, Split study = combination PSG and PAP titration study

Home Sleep Apnea Testing

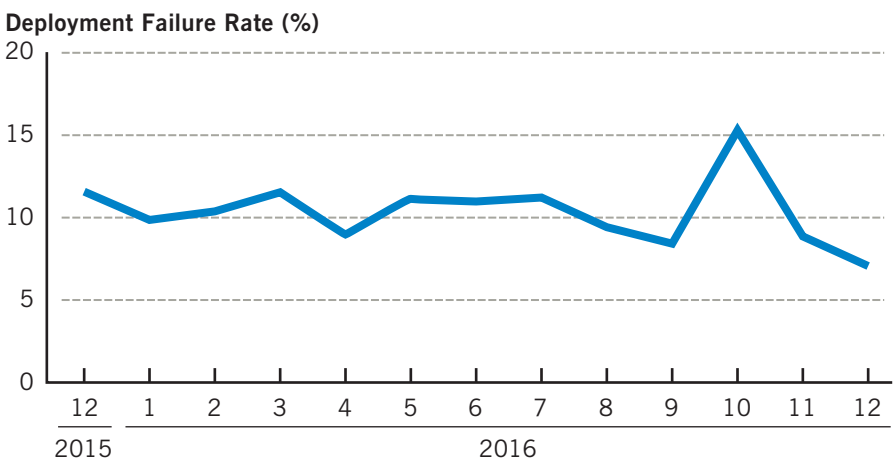
An enterprise-wide home sleep testing (HST) program was launched in 2013. HST is an integral component of the Obstructive Sleep Apnea (OSA) Care Path that provides the framework for implementing a standardized, cost-effective approach for identifying and setting the stage to treat OSA. HST, a confirmatory test for patients with high pretest probability of moderate-to-severe OSA, has experienced consistent volume growth: from 2013 to 2016, there was an approximate 7-fold increase in HST volume, while in-laboratory testing (i.e., PSG, PAP, and Split studies) has remained stable.

All sleep test orders are reviewed by a board-certified sleep specialist to help determine the most clinically appropriate and cost-effective sleep test for the patient. Approximately 15,744 sleep study orders were reviewed in 2016; 83% were for in-laboratory sleep tests and approximately 17% were for HST. Review by a board-certified sleep specialist resulted in a 7% increase in HST studies (i.e., 7% of attended PSG orders were changed to HSTs after conferring with the ordering provider).

The percentage of HST studies that did not meet minimum recording requirements ranged from 7.1% to 15.3% over the past 13 months, mostly due to inappropriate use of the device resulting in a technically inadequate study (74.7% of cases). Continuous quality improvement measures are in place with weekly meetings focused on improving the HST failure rate. The failure rate was reduced after use of enhanced patient educational materials with an improved, colorful, step-by-step patient guide on how to apply sensors required for accurate home testing.

Percentage of Home Sleep Testing Failures for Devices Deployed in Ohio

December 2015 – December 2016



Obstructive Sleep Apnea

OSA is characterized by repetitive upper airway collapse and represents a common disorder afflicting millions of people, with an estimated prevalence of moderate-to-severe OSA in the middle-aged population of 13% in men and 6% in women. This represents a 10% to 50% increase in prevalence, depending upon the age subgroup, over the past 15 to 20 years.[1] Untreated OSA is associated with a host of medical, neurologic, and psychiatric problems, including hypertension, heart disease, cardiac arrhythmias, stroke, epilepsy, depression, and obesity. Untreated OSA can cause psychosocial complications such as daytime sleepiness, neurocognitive deficits, occupational difficulties, and motor vehicle accidents. PAP therapy is the first-line treatment for moderate-to-severe OSA and has been shown to improve many of these adverse outcomes.

PAP Adherence in Patients With Sleep Apnea (N = 1880)

2015 – 2016

	Cleveland Clinic	National Average
Adherence rate (percent of patients using PAP ≥ 4 hours/night)	80%	46%–68%

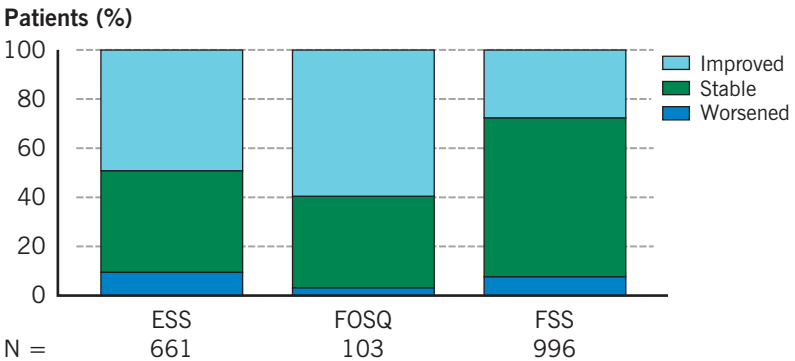
PAP therapy adherence is commonly defined as ≥ 4 hours of use per night. The average PAP adherence in most published studies is approximately 50%.[2,3] Of the 1880 patients with OSA treated in the Sleep Disorders Center in 2015 and 2016, 80% used a PAP device ≥ 4 hours a day for ≥ 5 days per week. These higher rates were due in part to the implementation of various components of the OSA Care Path, which ensures optimally timed follow-up visits that include health status assessments along with aggressive trouble-shooting strategies for patients having challenges acclimating to treatment. An interdisciplinary team of providers, including nurses, midlevel providers, physicians, registered technologists, and durable medical equipment (DME) representatives, work together in a coordinated manner to optimize outcomes. Patients having difficulty with PAP therapy adherence can be seen in group clinics (Sleep Apnea Management) where sleep experts and DME representatives can help to solve problems. PAP Nap daytime sleep studies can also enhance PAP adherence through PAP desensitization and acclimation.

References

1. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. *Am J Epidemiol*. 2013 May 1;177(9):1006-1014.
2. Kribbs NB, Pack AI, Kline LR, Smith PL, Schwartz AR, Schubert NM, Redline S, Henry JN, Getsy JE, Dinges DF. Objective measurement of patterns of nasal CPAP use by patients with obstructive sleep apnea. *Am Rev Respir Dis*. 1993 Apr;147(4):887-895.
3. Reeves-Hoche MK, Meck R, Zwillich CW. Nasal CPAP: an objective evaluation of patient compliance. *Am J Respir Crit Care Med*. 1994 Jan;149(1):149-154.

Change in Sleepiness and Fatigue in Patients With OSA Before and After PAP Treatment

2015 – 2016



ESS = Epworth Sleepiness Scale, FOSQ = Functional Outcomes of Sleep Questionnaire, FSS = Fatigue Severity Scale, OSA = obstructive sleep apnea, PAP = positive airway pressure

Daytime sleepiness, as measured by the Epworth Sleepiness Scale (ESS), was assessed in 1473 patients who had at least 2 visits in 2015–2016 with ESS data available for analysis. Among patients with a baseline ESS score ≥ 10 (N = 661), 49.2% showed improvement, 40.7% remained stable, and 10.1% worsened. Median duration of follow-up was 224 days (range, 15–715). Clinically meaningful change was defined as a 3-point change in score, based on one-half the standard deviation.[1]

Sleep-related quality of life, as measured by the Functional Outcomes of Sleep Questionnaire (FOSQ), was assessed in 1296 patients who had at least 2 visits in 2015–2016 with FOSQ data available for analysis. Among patients with a baseline FOSQ score ≤ 10 (N = 103), 59.2% showed improvement, 36.9% remained stable, and 3.9% worsened. Median duration of follow-up was 265 days (range, 15–681). Clinically meaningful change was defined as a 2-point change in score, based on one-half the standard deviation.[1]

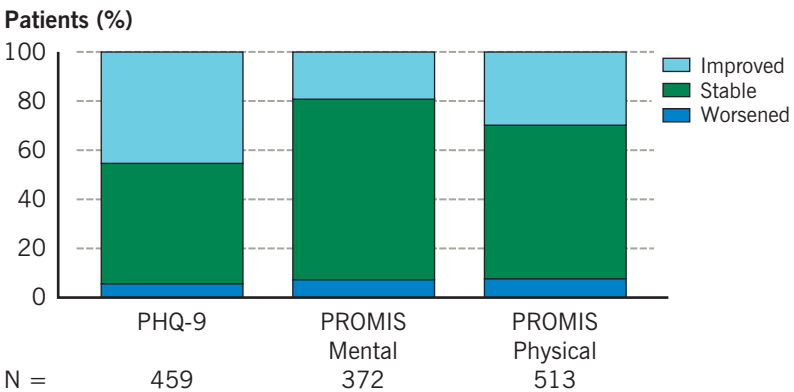
Daytime fatigue, as measured by the Fatigue Severity Scale (FSS), was assessed in 1447 patients who had at least 2 visits in 2015–2016 with FSS data available for analysis. Among those patients with a baseline FSS score ≥ 36 (N = 996), 27.5% showed improvement, 64.5% remained stable, and 8% worsened. Median duration of follow-up was 124 days (range, 1–690). Clinically meaningful change was defined as an 8-point change in score, based on one-half the standard deviation.[1]

Reference

1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Depressive Symptoms and Quality of Life in Patients With OSA After PAP Treatment

2015 – 2016



OSA = obstructive sleep apnea, PAP = positive airway pressure, PHQ-9 = Patient Health Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

Of the 1297 patients who had at least 2 visits in 2015–2016 with Patient Health Questionnaire (PHQ-9) data available for analysis, 459 had a baseline PHQ-9 score ≥ 10. Of those patients, 45.5% showed improvement, 48.6% remained stable, and 5.9% worsened. Median duration of follow-up was 212 days (range, 14–715). Clinically meaningful change was defined as a total point change of 5.[1]

Of the 866 patients who had at least 2 visits in 2015–2016 with Patient-Reported Outcomes Measurement Information System (PROMIS®) Mental Health[2] data available for analysis, 372 had a baseline PROMIS Mental Health score ≤ 45. Of those patients, 19.6% showed improvement, 72.6% remained stable, and 7.8% worsened. Median duration of follow-up was 169 days (range, 15–440). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[3]

Of the 855 patients who had at least 2 visits in 2015–2016 with PROMIS Physical Health[2] data available for analysis, 513 had a baseline PROMIS Physical Health score ≤ 45. Of those, 30.4% showed improvement, 61.8% remained stable, and 7.8% worsened. Median duration of follow-up was 168 days (range, 3–426). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[3]

References

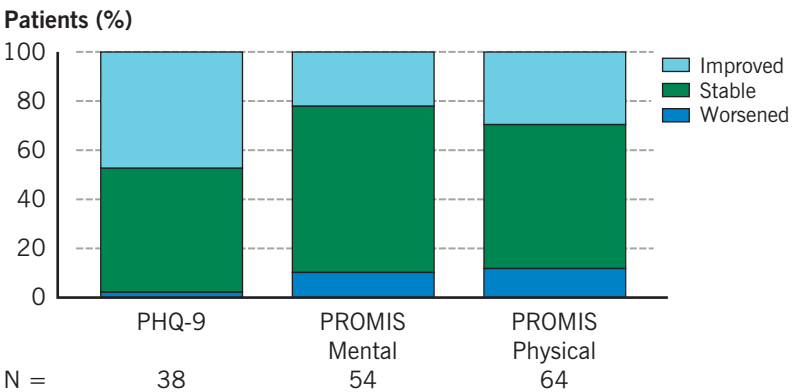
1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.
2. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.
3. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Sleep Apnea Management Clinic

The Sleep Apnea Management (SAM) Clinic is an innovative resource that addresses PAP management issues to promote long-term adherence. The SAM Clinic offers a multidisciplinary approach bringing a group of patients with common problems together with a board-certified sleep medicine practitioner or advanced practice provider and a DME representative. Of the 234 patients who participated in the SAM Clinic in 2015–2016, 82% (N = 193) were compliant, defined as using a PAP device ≥ 4 hours a day for ≥ 5 days per week.

Change in Depressive Symptoms and Quality of Life Following Sleep Apnea Management Clinic

2015 – 2016



Of the 99 patients who had at least 2 visits in 2015–2016 with PHQ-9 data available for analysis, 38 had a baseline PHQ-9 score ≥ 10. Of those patients, 47.4% showed improvement, 50% remained stable, and 2.6% worsened. Median duration of follow-up was 168 days (range, 35–654). Clinically meaningful change was defined as a total point change of 5.[1]

PHQ-9 = Patient Health Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

Of the 117 patients who had at least 2 visits in 2015–2016 with available PROMIS data, 54 had a baseline PROMIS Mental Health[2] score ≤ 45. Of those patients, 22.2% showed improvement, 66.7% remained stable, and 11.1% worsened. Median duration of follow-up was 123 days (range, 15–350). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[3]

Of the 114 patients who had at least 2 visits in 2015–2016 with PROMIS Physical Health[2] data available for analysis, 64 had a baseline PROMIS Physical Health score ≤ 45. Of those patients, 29.7% showed improvement, 57.8% remained stable, and 12.5% worsened. Median duration of follow-up was 138 days (range, 15–423). Clinically meaningful change was defined as a 5-point change in T-score, based on one-half the standard deviation.[3]

References

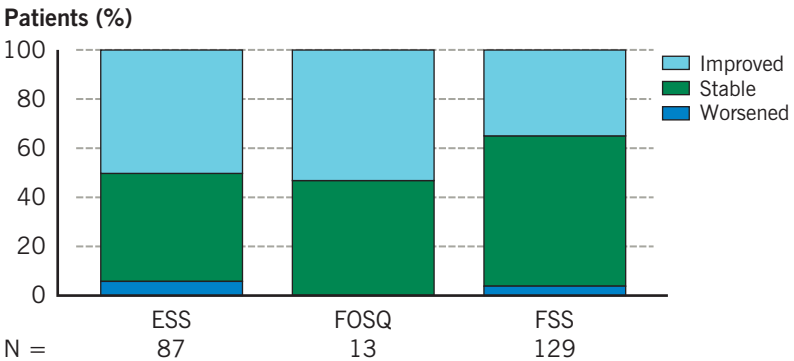
1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

2. Hays RD, Bjorner JB, Revicki DA, Spritzer KL, Cella D. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Qual Life Res*. 2009 Sep;18(7):873-880.

3. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Sleepiness and Fatigue Following Sleep Apnea Management Clinic

2015 – 2016



ESS = Epworth Sleepiness Scale, FOSQ = Functional Outcomes of Sleep Questionnaire, FSS = Fatigue Severity Scale

Of the 191 patients who had at least 2 visits in 2015–2016 with ESS data available for analysis, 87 had a baseline ESS score ≥ 10. Of these patients, 50.6% showed improvement, 43.7% remained stable, and 5.7% worsened. Median duration of follow-up was 151 days (range, 10–654). Clinically meaningful change was defined as a 3-point change in score, based on one-half the standard deviation.[1]

Of the 100 patients who had at least 2 visits in 2015–2016 with FOSQ data available for analysis, 13 had a baseline FOSQ score ≤ 10. Of these patients, 53.8% showed improvement, 46.2% remained stable, and none worsened. Median duration of follow-up was 154 days (range, 39–630). Clinically meaningful change was defined as a 2-point change in score, based on one-half the standard deviation.[1]

Of the 186 patients who had at least 2 visits in 2015–2016 with FSS data available for analysis, 129 had a baseline FSS score ≥ 36. Of these patients, 35.7% showed improvement, 60.5% remained stable, and 3.9% worsened. Median duration of follow-up was 162 days (range, 10–654). Clinically meaningful change was defined as an 8-point change in score, based on one-half the standard deviation.[1]

Reference

1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

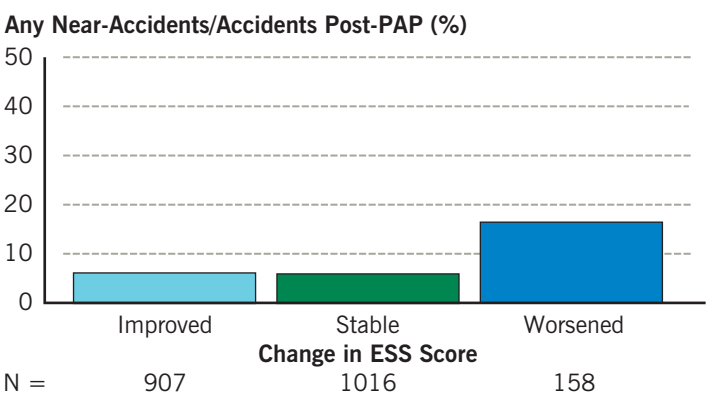
Effect of Treatment on Patient-Reported Outcomes

Drowsy driving related accidents in sleep disordered breathing (SDB) represent an important public health issue with a few large clinic-based cohort studies demonstrating impact of SDB treatment. Questionnaire-based self-reported near-motor vehicle accidents/accidents scores of 1995 patients with SDB who initiated PAP therapy between Jan. 1, 2010, and Dec. 31, 2014, were examined, and changes in the proportion of near-accidents/accidents before and after PAP therapy were stratified by adherence (usage ≥ 4 hours nightly ≥ 70% of the time).

After taking into account age, gender, race, socioeconomic status, smoking, body mass index (BMI), sleep duration, antidepressants, and comorbidities, PAP therapy reduced near-accidents/accidents from 13.9% to 6.6% ($P < 0.0001$). In subgroups, self-reported near-accidents/accidents reduced from 14% to 5.3% in adherent patients ($P < 0.001$) vs 16.0% to 13.1% in nonadherent patients ($P < 0.001$). For each 1-point improvement in ESS score, the odds of self-reported near-accidents/accidents decreased by 8.0% (odds ratio [OR] = 0.92, 95% confidence interval [CI] = 0.88-0.96, $P < 0.001$). For each 1-point increase in the baseline PHQ-9 score, the odds of reporting near-accidents/accidents increased by 6.0% (OR = 1.06, 95% CI = 1.03-1.10, $P < 0.001$). Overall, PAP therapy improved self-reported drowsy driving in patients with SDB.

Change in ESS in Relation to Near-Accidents/Accidents Following PAP Therapy (N = 2081)

2010 – 2014

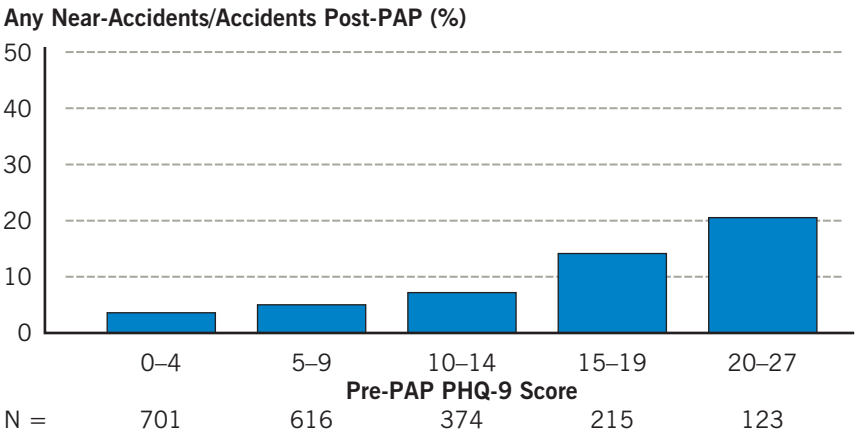


ESS = Epworth Sleepiness Scale, PAP = positive airway pressure

The graph shows the relationship between change in ESS score and post-PAP self-reported near-accidents/accidents for patients treated with PAP between 2010 and 2014. Median time between visits was 105 days (range, 30–364).

Change in PHQ-9 in Relation to Near-Accidents/Accidents Following PAP Therapy (N = 2029)

2010 – 2014

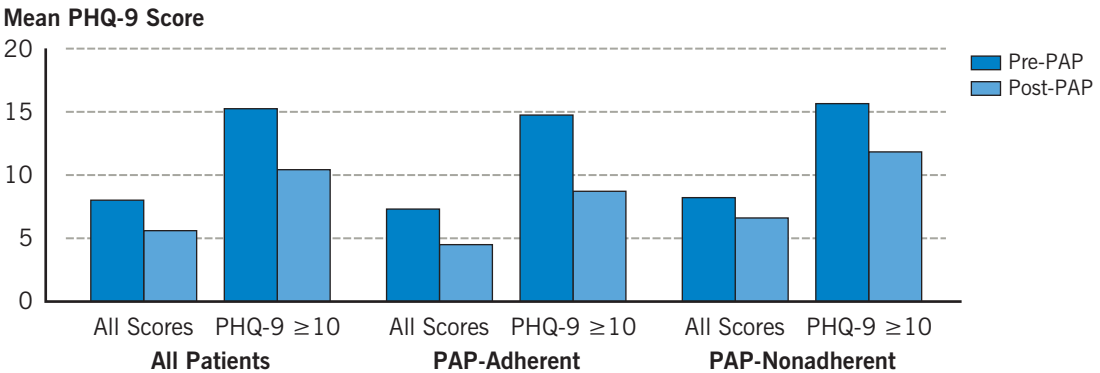


PAP = positive airway pressure, PHQ-9 = Patient Health Questionnaire

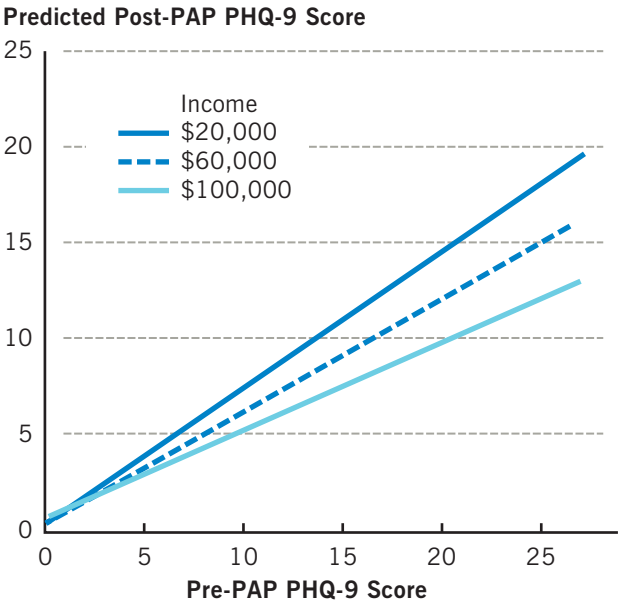
The graph shows the relationship between pre-PAP PHQ-9 score category and post-PAP self-reported near-accidents/accidents for patients treated with PAP between 2010 and 2014. Median time between visits was 105 days (range, 30–365).

Impact of Socioeconomic Status on Therapeutic Benefit of Sleep Apnea Treatment on Depression Measures (N = 1981)

2010 – 2014



PAP = positive airway pressure, PHQ-9 = Patient Health Questionnaire



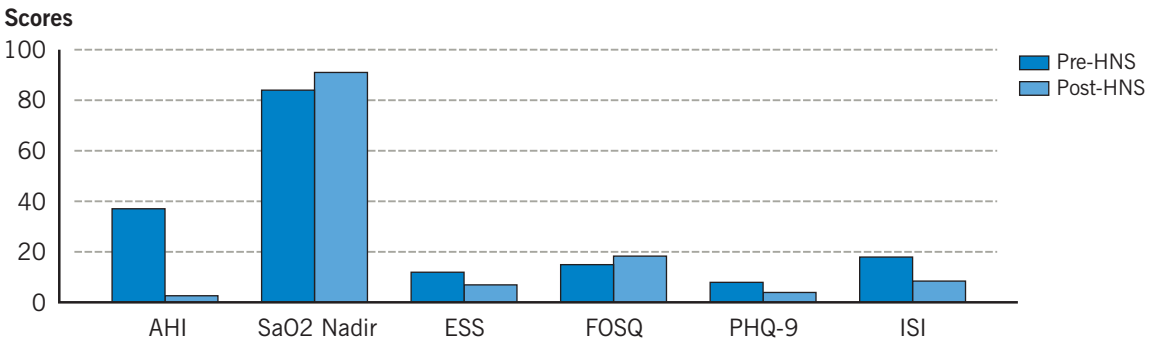
Data collected from adult patients with SDB attending the ambulatory sleep center clinic between Jan. 1, 2010, and Dec. 31, 2014, were analyzed with PHQ-9 as the primary outcome measure. Paired and 2-sample *t* tests were used to assess changes based on PAP adherence, and linear regression models additionally assessed potential covariates and interactions, including socioeconomic status, generating a final cohort of 1981 SDB patients (age 56.4 ± 13.3 years; 45.7% female; 76.2% white). Regardless of adherence, PAP therapy improved PHQ-9 scores (-2.4 ± 4.6 points, $P < 0.0001$), with more robust responses in patients with baseline PHQ-9 scores ≥ 10 (-4.8 ± 5.7 points, $P < 0.0001$). Adherent patients had significantly greater comparative improvement (-2.8 ± 4.4 points vs 1.6 ± 4.2 points, $P < 0.05$), and an even greater benefit was observed for those with baseline PHQ-9 ≥ 10 (-6.0 ± 5.3 points vs -3.8 ± 4.9 points, $P < 0.05$). Patients from lower socioeconomic status and greater depressive symptom burden had worse post-PAP PHQ-9 scores.

Hypoglossal Nerve Stimulation

Hypoglossal nerve stimulation (HNS) represents a novel neurotherapeutic modality for OSA treatment. OSA patients undergoing HNS were examined between November 2015 and November 2016. Baseline to 1-month changes in polysomnographic indices (apnea-hypopnea index [AHI] and oxygen saturation [SaO2] nadir) and patient-reported outcomes (ESS, FOSQ, Insomnia Severity Index [ISI], and PHQ-9) were analyzed.

Polysomnographic Indices Before and After Hypoglossal Nerve Stimulation

November 2015 – November 2016



AHI – apnea-hypopnea index, ESS = Epworth Sleepiness Scale, FOSQ = Functional Outcomes of Sleep Questionnaire, HNS = hypoglossal nerve stimulation, ISI = Insomnia Severity Index, PHQ-9 = Patient Health Questionnaire, SaO2 = oxygen saturation

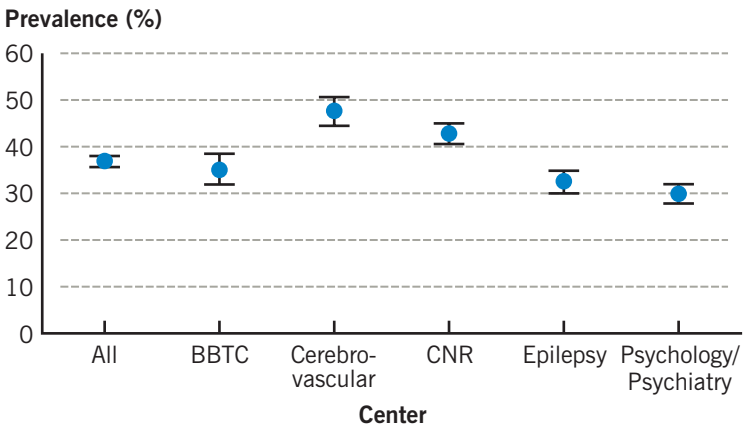
The AHI, ESS, and PHQ-9 scores were significantly improved after HNS implantation compared with baseline (median -28.1 [quartiles -37.8, -25.4], -4.0 [-5.0, -4.0], and -4.0 [-6.0, -0.50], respectively, all $P < 0.008$), while SaO2 nadir and FOSQ increased (6.0 [4.0, 10.5], $P < 0.001$, and 2.0 [1.00, 3.5], $P = 0.005$), respectively. Although not statistically significant, changes in ESS (correlation 0.42, 95% CI = -0.15 to 0.99), ISI (0.47, 95% CI = -0.19 to 1.00), and PHQ-9 (0.15, 95% CI = -0.60 to 0.89) had positive correlation with change of AHI while correlation with FOSQ (-0.31, 95% CI = -0.98 to 0.36) was negative.

These results following HNS demonstrate improvement of self-reported dozing propensity and sleepiness impact on quality of life, early clinically significant improvement in depression scores, and trend for improvement in insomnia symptoms.

Sleep Disorders Relative to Neurological Outcomes

Obstructive Sleep Apnea Prevalence (N = 7509)

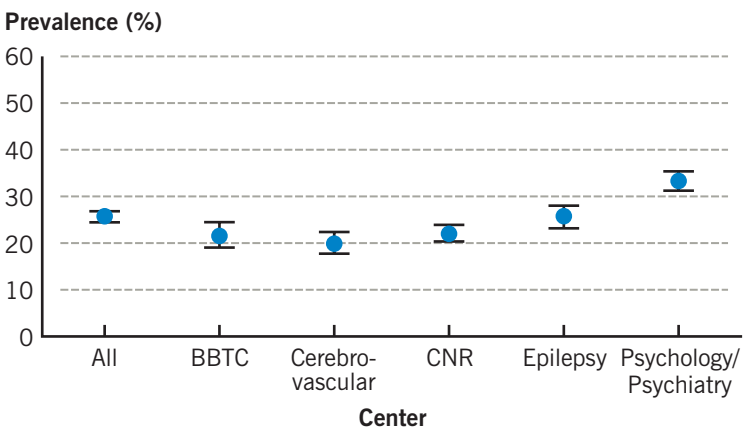
March 2015 – October 2016



BBTC = Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center,
CNR = Center for Neurological Restoration

Insomnia Severity Index Prevalence (N = 8246)

March 2015 – October 2016



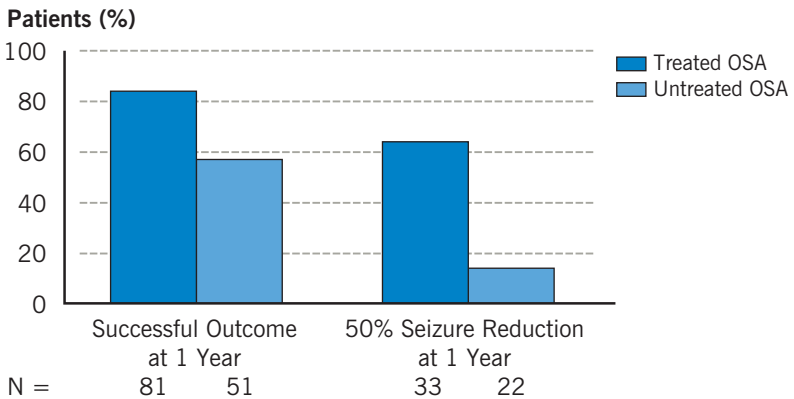
BBTC = Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center,
CNR = Center for Neurological Restoration

Neurological patients were evaluated for sleep disorders using STOP (snoring, tiredness, observed apnea, high blood pressure) and ISI to assess the prevalence of high-risk OSA (h-OSA) and insomnia. STOP and ISI data were collected between March 2015 and October 2016 at the first patient visit in the Adult Psychiatry, Neurorestoration, Cerebrovascular, Brain Tumor, and Epilepsy centers. A STOP score ≥ 2 was defined as h-OSA and ISI score ≥15 as insomnia. STOP and ISI were completed by 39.3% and 43.2% of 19,086 new patients, respectively. Crude prevalence estimates for h-OSA and insomnia were 36.6% and 25%, respectively. However, after adjusting for a number of demographic and clinical factors, including age, gender, race, income, smoking status, PHQ-9 score, and comorbidities, Brain Tumor patients had 1.58 times higher odds of insomnia (95% CI, 1.25-2.00) compared with Adult Psychiatry. For h-OSA, all other centers had significantly higher odds than Adult Psychiatry; Cerebrovascular was associated with 1.91 times higher odds (95% CI, 1.59-2.30), Epilepsy 1.48 times higher odds (95% CI, 1.16-1.90), Brain Tumor 1.43 times higher odds (95% CI, 1.16-1.75), and Neurorestoration 1.23 times higher odds (95% CI, 1.05-1.45). Because of the prevalence of h-OSA and insomnia in neurological patients, routine screening is recommended.

Epilepsy and Obstructive Sleep Apnea

PAP Therapy and Seizure Control in Epilepsy Patients With Sleep Apnea (N = 132)

1997 – 2016



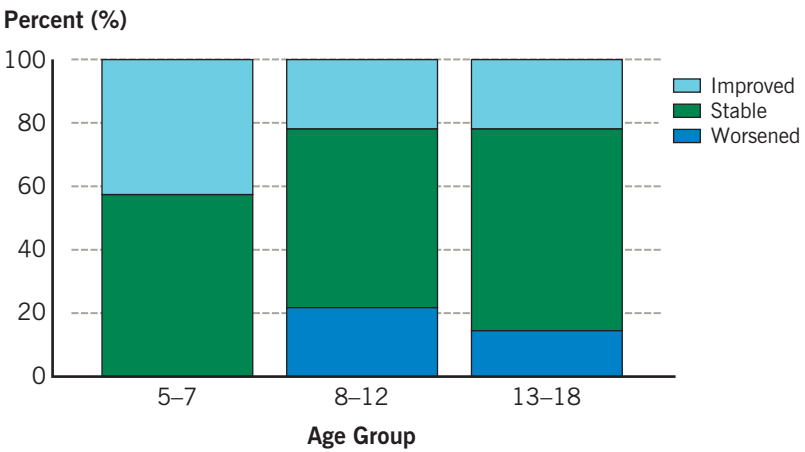
OSA = obstructive sleep apnea, PAP = positive airway pressure

OSA is a prevalent, often overlooked, comorbidity in people with epilepsy, and PAP therapy can lead to improved seizure control. The effect of PAP therapy on long-term seizure outcomes in adults with epilepsy who underwent polysomnography at Cleveland Clinic over a 20-year period was examined. In a sample of 132 patients, 81 (61%) were receiving PAP therapy (83% adherent) and 51 (39%) were untreated. PAP adherence (≥ 4 hours use ≥ 70% nights) was ascertained by device download. Seizure data were obtained from an electronic data entry system for patients and providers. Mean follow-up was 5.3 ± 3.9 years and 40% were followed for 5 years. Response rate at 1 year was greater in PAP-treated patients (64%; $P < 0.001$) than in untreated patients (14%). Successful outcome was achieved more often in PAP-treated patients (84%) than in untreated patients (57%; $P = 0.002$).

Sleep Disorders in Children

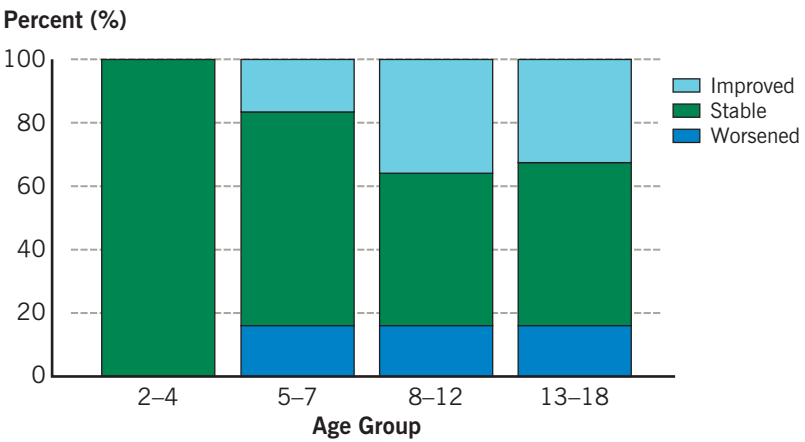
Change in Quality of Life for Pediatric Patients (Child-Reported) (N = 88)

2011 – 2016



Change in Quality of Life for Pediatric Patients (Parent-Reported) (N = 129)

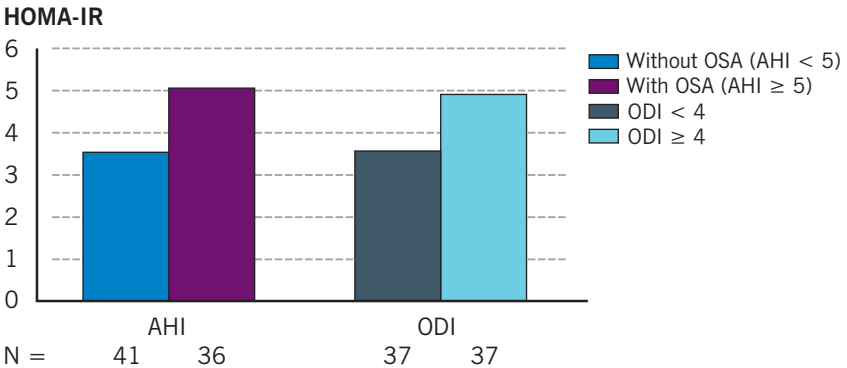
2011 – 2016



Pediatric patients seen in the Sleep Disorders Center between 2011 and 2016 who had at least 2 visits with PedsQL™ (Pediatric Quality of Life Inventory™) data available were included for analysis. To analyze clinical improvement, only those with a baseline score ≤ 91 were included. The graphs show results separately for child- and parent-reported versions of the PedsQL. Clinically meaningful change was defined as a change ≥ 9 points.

Obstructive Sleep Apnea With Insulin Resistance in Obese Children (N = 77)

2013 – 2016



AHI = apnea-hypopnea index, HOMA-IR = homeostatic model assessment of insulin resistance, ODI = oxygen desaturation index, OSA = obstructive sleep apnea

OSA and insulin resistance are prevalent in obese children. Patients aged 2–18 years with normal development who underwent overnight polysomnography, anthropometric measurements, and fasting laboratory tests from 2013 to 2016 were reviewed. The primary outcome measure was homeostatic model assessment of insulin resistance (HOMA-IR). Patients treated for IR ≥ 5 with metformin prior to lab studies were excluded. The final cohort of 77 patients (mean age 11.9 ± 4.2 years, 55.8% female, all obese [BMI median 99%], 45% white) was divided into 2 groups: 41 without OSA (AHI < 5) and 36 with OSA (AHI ≥ 5). Prevalence of comorbidities (e.g., hypertension, dyslipidemia) was similar. The OSA group had 1.44 greater HOMA-IR units than the non-OSA group ($P = 0.022$). Patients with higher oxygen desaturation index had greater HOMA-IR (by 1.38 units; $P = 0.048$). However, after adjusting for BMI, age, and gender, AHI ≥ 5 was no longer significant ($P = 0.76$). BMI was the strongest predictor for increased HOMA-IR ($P < 0.001$). These findings support the association of OSA and IR in obese children, although this relationship appears to be influenced by BMI.

Sleep Disorders

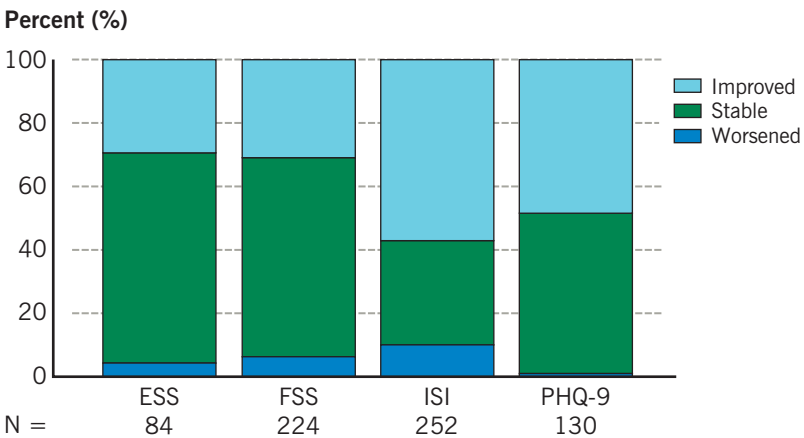
Insomnia

Insomnia is a common sleep disorder, characterized by the inability to initiate or maintain sleep or early morning awakenings. At least one-third of the adult population report having symptoms consistent with insomnia, and 10% to 15% meet the diagnostic criteria for chronic insomnia. Untreated insomnia is associated with many psychiatric and medical comorbidities, in addition to a significant economic burden related to increased healthcare utilization, decreased productivity, and increased absenteeism from work or school. Cognitive behavioral therapy for insomnia (CBT-I), which does not involve sedative-hypnotic medications, is one of the most effective treatments for insomnia. Traditionally, CBT-I has been provided by a behavioral sleep medicine specialist in individual or group therapy sessions.

Patients are evaluated and treated for insomnia with CBT-I by a behavioral sleep medicine expert at the Sleep Disorders Center, individually or in a group setting. CBT-I strategies include stimulus control, sleep restriction, and cognitive restructuring of negative thoughts about sleep. Meta-analyses have shown better and more durable outcomes in insomnia patients using CBT-I compared with using sedative-hypnotic medications alone.

Improvement in Insomnia-Related Symptoms Following Individual CBT-I

November 2015 – November 2016



CBT-I = cognitive behavioral therapy for insomnia, ESS = Epworth Sleepiness Scale, FSS = Fatigue Severity Scale, ISI = Insomnia Severity Index, PHQ-9 = Patient Health Questionnaire

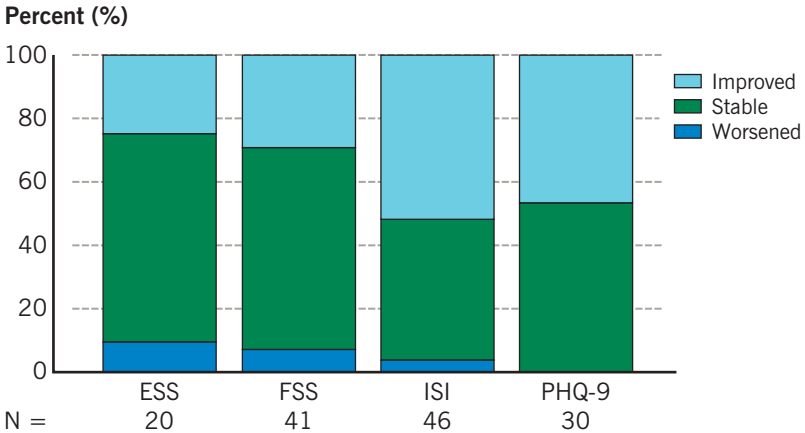
Of the 288 patients who had at least 2 visits in 2015–2016 with ESS data available for analysis, 84 had a baseline ESS score ≥ 10. Of these patients, 29.8% showed improvement, 65.5% remained stable, and 4.8% worsened. Median duration of follow-up was 192 days (range, 8–616). Clinically meaningful change was defined as a 5-point change in score, based on one-half the standard deviation.[1] Among those patients with a baseline FSS score ≥ 36 (N = 224), 31.2% showed improvement, 61.6% remained stable, and 7.1% worsened. Median duration of follow-up for these patients was 174 days (range, 1–709). Clinically meaningful change was defined as a 7-point change in score, based on one-half the standard deviation.[1] Among those patients with a baseline ISI score ≥ 10 (N = 252), 57.1% showed improvement, 32.1% remained stable, and 10.7% worsened. Median duration of follow-up for these patients was 168 days (range, 1–709). Clinically meaningful change was defined as a 3-point change in score, based on one-half the standard deviation.[1] Among those patients with a baseline PHQ-9 score ≥ 10 (N = 130), 48.5% showed improvement, 50% remained stable, and 1.5% worsened. Median duration of follow-up for these patients was 172 days (range, 1–672). Clinically meaningful change was defined as a total point change of 5.[2]

References

1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.
2. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Improvement in Insomnia-Related Symptoms Following Group CBT-I

2015 – 2016



CBT-I = cognitive behavioral therapy for insomnia, ESS = Epworth Sleepiness Scale, FSS = Fatigue Severity Scale, ISI = Insomnia Severity Index, PHQ-9 = Patient Health Questionnaire

Of the 49 patients who had at least 2 visits in 2015–2016 with ESS data available for analysis, 20 had a baseline ESS score ≥ 10. Of these patients, 25% showed improvement, 65% remained stable, and 10% worsened. Median duration of follow-up was 99 days (range, 16–562). Clinically meaningful change was defined as a 4-point change in score, based on one-half the standard deviation.[1] Among those patients with a baseline FSS score ≥ 36 (N = 41), 29.3% showed improvement, 63.4% remained stable, and 7.3% worsened. Median duration of follow-up for these patients was 64 days (range 3–562). Clinically meaningful change was defined as a 7-point change in score, based on one-half the standard deviation.[1] Among those patients with a baseline ISI score ≥ 10 (N = 46), 52.2% showed improvement, 43.5% remained stable, and 4.3% worsened. Median duration of follow-up for these patients was 63 days (range, 7–494). Clinically meaningful change was defined as a 3-point change in score, based on one-half the standard deviation.[1] Among those patients with a baseline PHQ-9 score ≥ 10 (N = 30), 46.7% showed improvement, 53.3% remained stable, and none worsened. Median duration of follow-up for these patients was 118 days (range, 8–494). Clinically meaningful change was defined as a total point change of 5.[2]

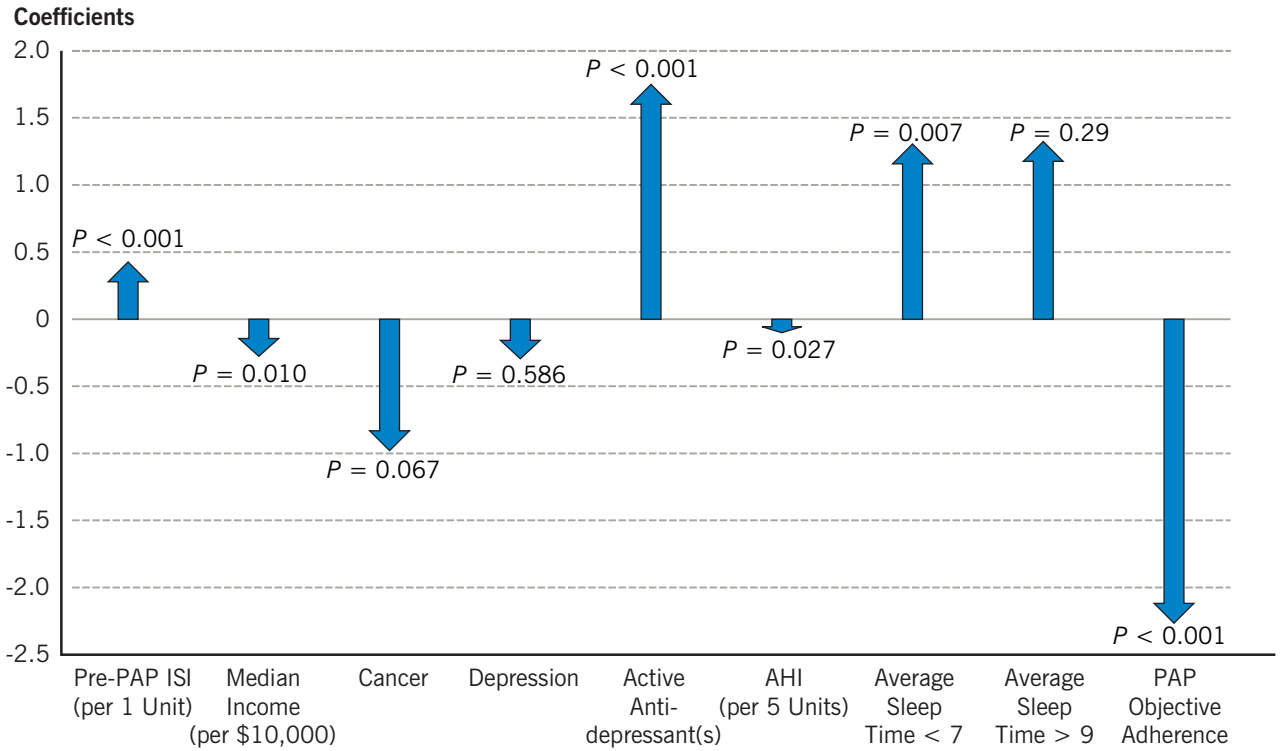
References

1. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

2. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Insomnia Severity Index Score Changes in Response to Positive Airway Pressure in Sleep Disordered Breathing (N = 1183)

2010 – 2014



AHI = apnea-hypopnea index, ISI = Insomnia Severity Index, PAP = positive airway pressure

Clinical effectiveness data for the impact of PAP therapy on insomnia symptoms in SDB are limited. Patients with SDB who initiated PAP therapy between Jan. 1, 2010, and Dec. 31, 2014, and who had ISI data were analyzed. Paired and 2-sample *t* tests were used to evaluate ISI changes with PAP and stratified based on PAP adherence (usage > 4 hours nightly > 70% of the time). The analytic sample consisted of 1183 patients (mean age 55.7 ± 13.1 years, 49.8% male, 77.4% white, and BMI 33.1 ± 9.0 kg/m^2). PAP therapy resulted in significantly improved ISI scores (-3.26 ± 6.57, $P < 0.001$) for all ISI items, even after adjustment for age, gender, race, socioeconomic status, smoking, and comorbidities. Objectively PAP-adherent patients demonstrated a significant improvement (-4.03 ± 6.26) vs nonadherent patients (-2.28 ± 6.42, $P < 0.001$) in total ISI score as well as all ISI items except falling asleep and early waking. Median income, active antidepressant use, AHI, and PAP adherence were strong predictors of post-PAP ISI changes after adjusting for covariates. Patient characteristics of lower socioeconomic status, using antidepressants, lower AHI, and PAP nonadherence demonstrated resistance to PAP-related improvement in ISI scores.

Spinal Disease

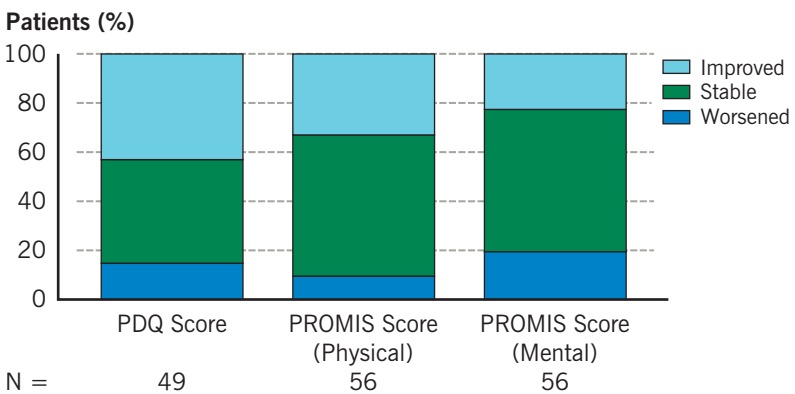
The Center for Spine Health is an interdisciplinary, multispecialty group comprehensively treating spine-related disorders. The center's goals include accurate diagnosis of all spine disorders, speedy return to full function, and measurement of patient-centered outcomes. These outcomes represent ongoing efforts to standardize care around best practices to provide maximum patient benefit at minimal cost to patients and the health system.

The center offers a full continuum of care including medical management, physical therapy, pharmacological interventions, minimally invasive injection procedures, surgical interventions, acupuncture, osteopathic manipulation, specialized exercise programs, and a functional restoration program. The center consists of board-certified neurosurgeons, orthopedic surgeons, spine-medicine specialists, physiatrists, rheumatologists, internists, sports medicine specialists, pain medicine specialists, neurologists, and psychiatrists.

Cervical Disc Herniation

Change in Functional Status Following Cervical Decompression With Fusion for Cervical Disc Herniation

Surgical Dates: Jan. 4 – July 11, 2016



PDQ = Pain Disability Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

In patients who underwent cervical fusion for symptoms of severe arm pain due to a cervical disc herniation, 49 had a baseline impairment of physical function, defined as a Pain Disability Questionnaire (PDQ) score > 16; 43% noted improvement after surgery and 14% worsened. Median duration of follow-up was 112 days (range, 41–306). Among 56 patients assessed using the Patient-Reported Outcomes Measurement Information System (PROMIS®)[1], 34% noted clinically meaningful improvement of their PROMIS Physical Health scores and 9% worsened.

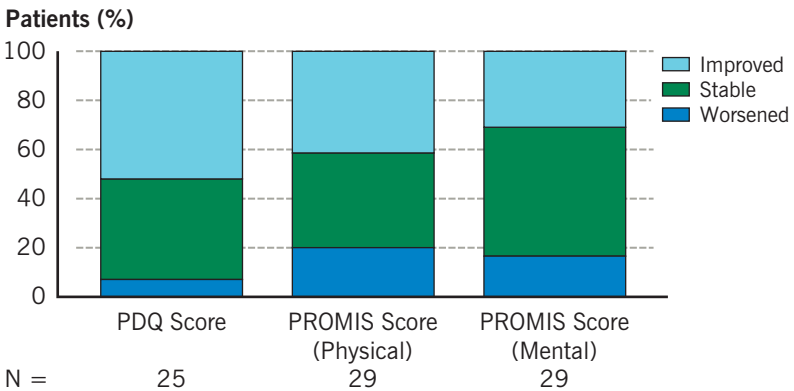
In this and subsequent graphs, clinically meaningful change in PROMIS scores was defined as a change of one-half a standard deviation[2] and a total point change of > 16 for the PDQ.

References

1. Cella D, Yount S, Rothrock N, Gershon R, Cook K, Reeve B, Ader D, Fries JF, Bruce B, Rose M, on behalf of the PROMIS Cooperative Group. The Patient-Reported Outcomes Measurement Information System (PROMIS). *Med Care*. 2007 May;45(5 Suppl 1):S3-S11.
2. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. *Med Care*. 2003 May;41(5):582-592.

Change in Functional Status Following Cervical Decompression Without Fusion for Cervical Disc Herniation

Surgical Dates: Jan. 12 – July 6, 2016



PDQ = Pain Disability Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

In 25 patients who underwent cervical decompression surgery without fusion for symptoms of severe arm pain due to cervical disc herniation, 52% of those with baseline impairment of physical function (PDQ > 16) noted clinically meaningful functional improvement after surgery and 8% worsened. Median duration of follow-up after surgery was 106 days (range, 40–217). In 29 patients, 41% noted improved PROMIS Physical Health scores, and 21% worsened; 31% noted improvement in their PROMIS Mental Health scores.

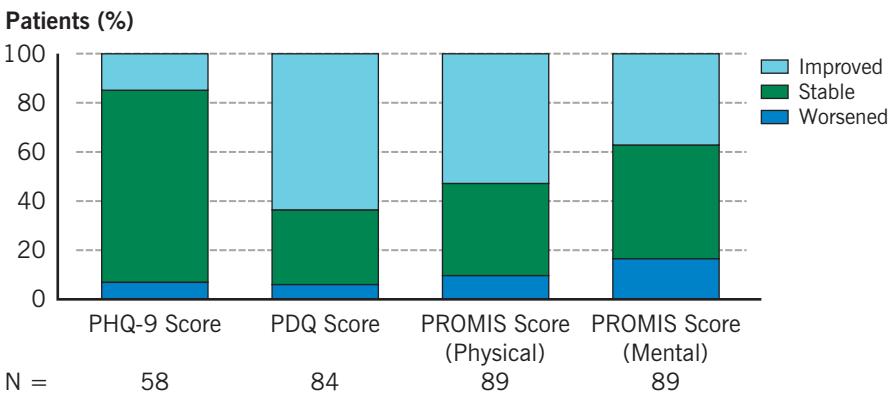
Lumbar Spinal Disease

Surgical Treatment

Spinal stenosis results in narrowing of the spinal canal, which can lead to leg pain and impaired walking and standing. For symptomatic patients, the goal of surgery is to decompress the spinal canal to eliminate neural compression and relieve leg pain; this may or may not require instrumented fusion of the operated levels.

Change in Functional Status Following Lumbar Decompression With Fusion for Spinal Stenosis

Surgical Dates: Jan. 4 – July 15, 2016



PDQ = Pain Disability Questionnaire, PHQ-9 = Patient Health Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

Among patients undergoing lumbar decompression with fusion for symptomatic spinal stenosis, 58 reported at least moderate depressive symptoms, defined as Patient Health Questionnaire (PHQ-9) score ≥ 10 prior to surgery; 16% noted improvement and 7% worsened in depressive symptoms. Of the 84 patients who had baseline impairment of physical function (PDQ > 16), 64% noted clinically meaningful functional improvement after surgery, while 6% worsened. In 89 patients, 54% noted improvement in PROMIS Physical Health scores while 9% worsened, and 38% noted improvement in PROMIS Mental Health scores. Median duration of follow-up was 152 days (range, 42–398).

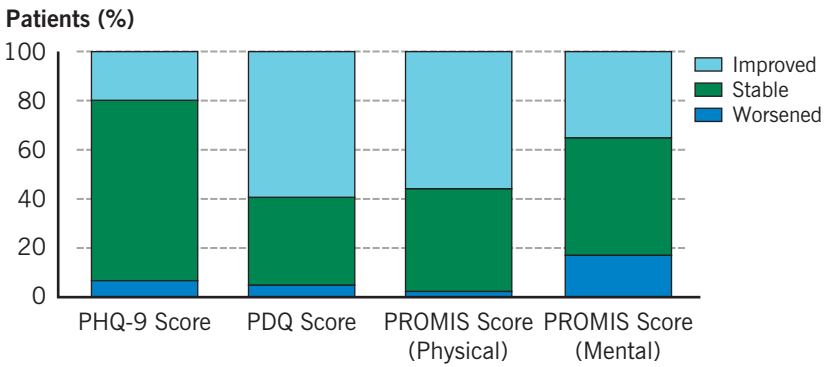
In this and subsequent graphs, clinically meaningful change in PHQ-9 scores was defined as a change of ≥ 5 points.[1]

Reference

1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Change in Functional Status Following Lumbar Decompression Without Fusion for Disc Herniation

Surgical Dates: Jan. 5 – July 19, 2016



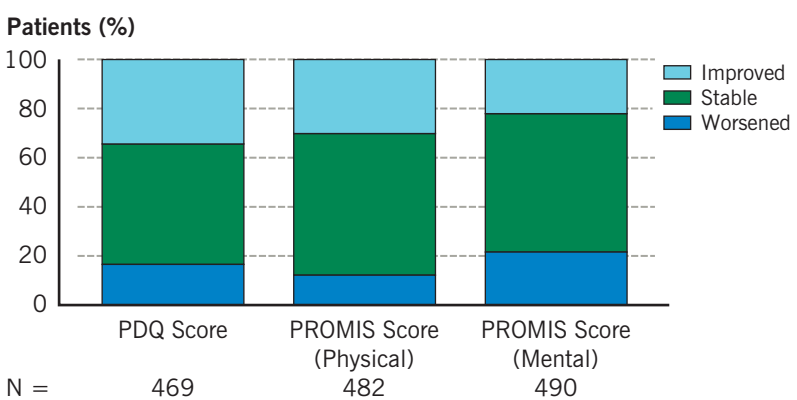
PDQ = Pain Disability Questionnaire, PHQ-9 = Patient Health Questionnaire, PROMIS = Patient-Reported Outcomes Measurement Information System

Among patients undergoing lumbar decompression surgery without fusion to treat severe leg pain from a lumbar disc herniation, 30 patients reported at least moderate depressive symptoms (PHQ-9 ≥ 10) prior to surgery; 73% of patients had no change in their depressive symptoms, while 20% noted improvement and 7% worsened. Among 45 patients who had baseline impairment of physical function (PDQ > 16), 60% noted clinically meaningful improvement after surgery, while 4% worsened. Of 43 patients, 56% improved their PROMIS Physical Health scores after surgery. Median duration of follow-up was 123 days after surgery (range, 38–343).

Spinal Injections (Nonsurgical Treatment)

Change in Functional Status Following Lumbar Spinal Injections for Disc Herniation

Treatment Dates: Jan. 4 – July 28, 2016



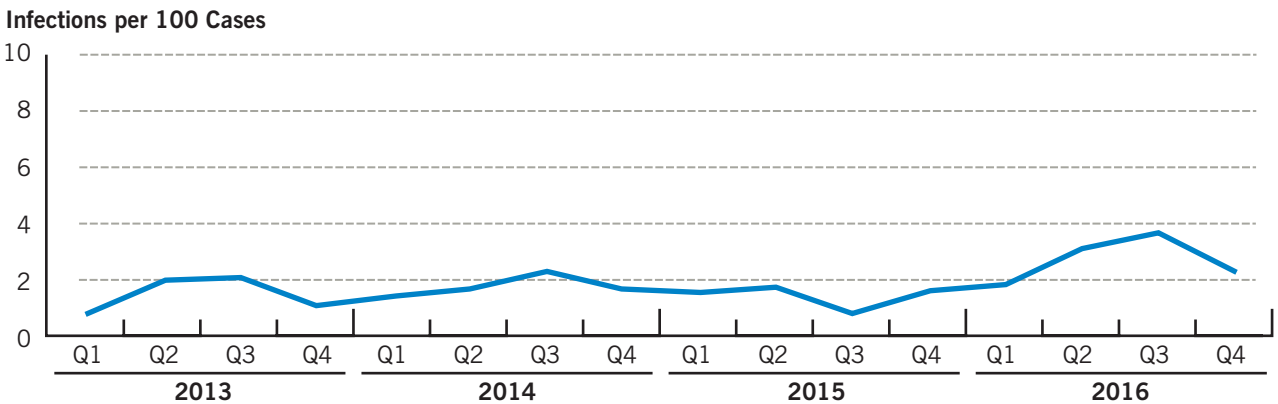
PDQ = Pain Disability Questionnaire,
PROMIS = Patient-Reported Outcomes Measurement Information System

Among patients undergoing lumbar spinal injections for severe leg pain due to a lumbar disc herniation, 469 had baseline impairment of physical function (PDQ > 16); 35% noted clinically meaningful improvement in function after injection while 17% worsened. Among 482 patients, 30% noted sustained improvement in PROMIS Physical Health scores while 13% worsened, and among 490 patients, 22% noted improvement in PROMIS Mental Health scores. Median duration of follow-up was 137 days after injection (range, 35–393).

Surgical Complications

Surgical Site Infection Rates for Spinal Surgery (N = 5957)

2013 – 2016



A multiyear effort in the Spine Center to reduce complications continues to center around reducing surgical site infections. Efforts have included nasal swab surveillance, nasal decolonization protocol (when indicated), changing rules for operating theater traffic, updating rules about operating table preparation, changing the perioperative scrub protocol, and new wound closure advisories. A recent increase in infection rates has resulted in significant changes in surgical equipment, planning, and operations to return to formerly low levels.[1,2]

Additionally, the center is working to reduce unplanned readmissions. The trend remains variable and work continues to ensure that patients return home without inpatient readmission within 30 days after surgery.

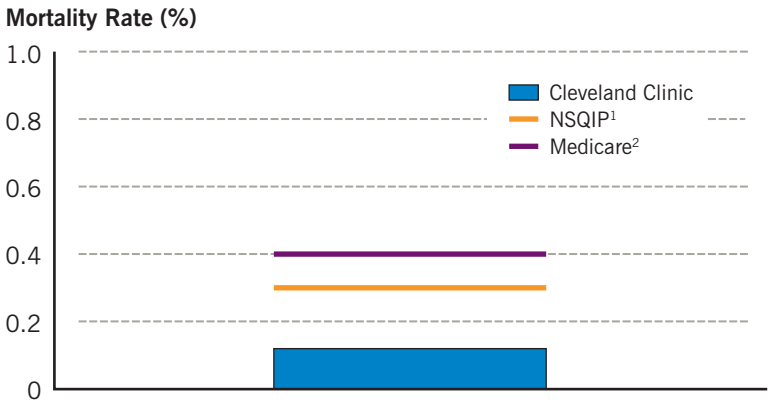
References

1. Smith JS, Shaffrey CI, Sansur CA, Berven SH, Fu KM, Broadstone PA, Choma TJ, Goytan MJ, Noordeen HH, Knapp DR Jr, Hart RA, Donaldson WF 3rd, Polly DW Jr, Perra JH, Boachie-Adjei O; Scoliosis Research Society Morbidity and Mortality Committee. Rates of infection after spine surgery based on 108,419 procedures: a report from the Scoliosis Research Society Morbidity and Mortality Committee. *Spine*. 2011 Apr 1;36(7):556-563.

2. Schimmel JJ, Horsting PP, de Kleuver M, Wonders G, van Limbeek J. Risk factors for deep surgical site infections after spinal fusion. *Eur Spine J*. 2010 Oct;19(10):1711-1719.

Thirty-Day Postoperative Mortality Rate Following Spinal Surgery (N = 3372)

2016



The 30-day postoperative mortality rate following spinal surgery in 2016 was 0.12%, compared with a rate of 0.30% for the National Surgical Quality Improvement Program® (NSQIP®)[1] Database and a rate of 0.40% for the Medicare database.[2]

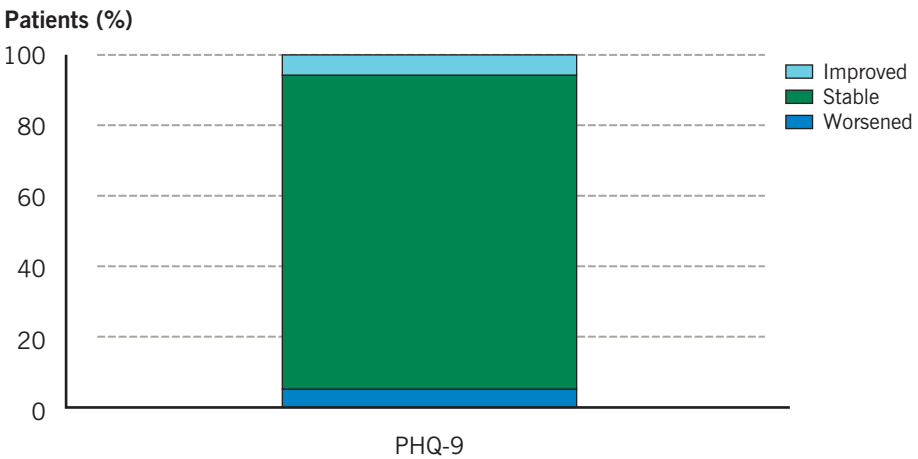
References

1. Schoenfeld AJ, Ochoa LM, Bader JO, Belmont PJ Jr. Risk factors for immediate postoperative complications and mortality following spine surgery: a study of 3475 patients from the National Surgical Quality Improvement Program. *J Bone Joint Surg Am*. 2011 Sep 7;93(17):1577-1582.
2. Deyo RA, Mirza SK, Martin BI, Kreuter W, Goodman DC, Jarvik JG. Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. *JAMA*. 2010 Apr 7;303(13):1259-1265.

Outpatient Physical Medicine and Rehabilitation

Change in Depressive Symptoms Following Physical Medicine and Rehabilitation Physician Clinic Visits (N = 116)

2016



PHQ-9 = Patient Health Questionnaire

To assess depression, patients seen in the physical medicine and rehabilitation clinic are administered the Patient Health Questionnaire (PHQ-9). In 2016, 116 patients had a least 2 visits with PHQ-9 data available for analysis. Median duration of follow-up was 63 days (range, 28–90). Clinically meaningful change was defined as a total point change of 5.[1]

Reference

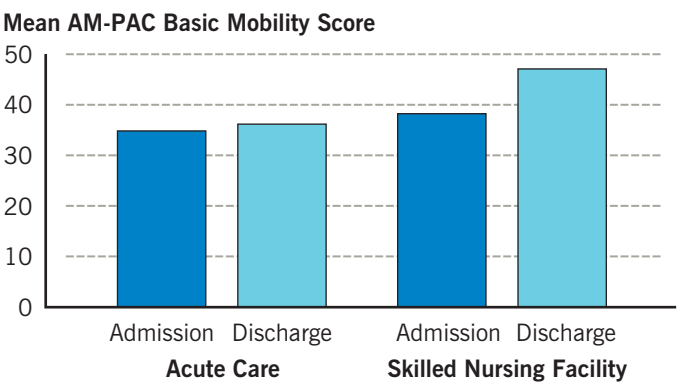
1. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. *Med Care*. 2004 Dec;42(12):1194-1201.

Physical and Occupational Therapy

Physical and occupational therapists in the acute care hospital fulfill multiple functions, including assessing skilled needs for postacute care, providing patient and family education about safe postdischarge activity, and delivering treatments that begin the rehabilitation process during progressively shorter hospital stays. Patients with rehabilitative needs often continue their therapy in a skilled nursing facility (SNF).

Mobility Improvement in Acute Care and Skilled Nursing After Physical Therapy (N = 1126)

2016

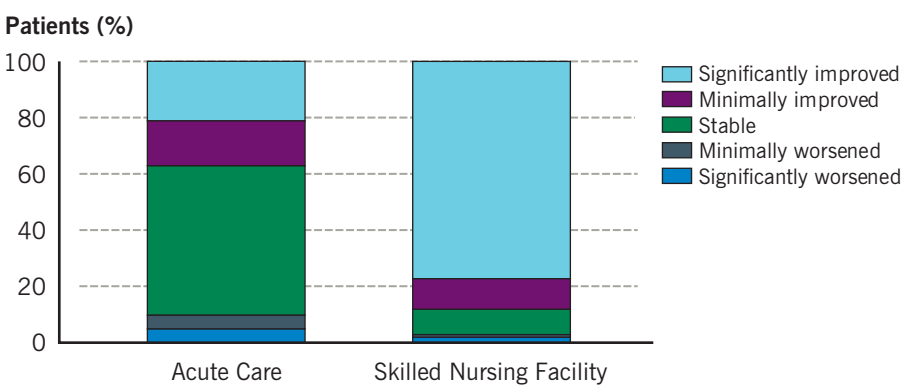


AM-PAC = Boston University Activity Measure for Post Acute Care

Patient mobility was assessed as they moved from the acute care hospital to a Cleveland Clinic Connected Care SNF using a short form of the Boston University Activity Measure for Post Acute Care (AM-PAC™). Mobility was assessed using the AM-PAC inpatient short form (6-Clicks) Basic Mobility tool. For some patients, inpatient physical therapy only begins the rehabilitation process, and patients are more likely to see functional gains when they receive a more intense level of therapy in the SNF. Median interval between assessments is 3 days for acute care and 16 days for Connected Care SNF.

Level of Change in Mobility After Physical Therapy (N = 1126)

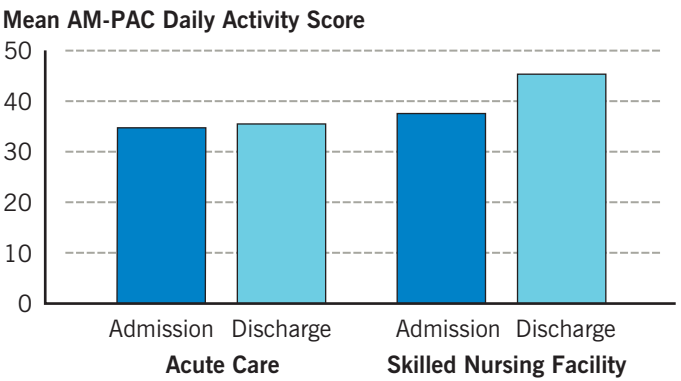
2016



Mobility function was assessed in the acute care hospital using the 6-Clicks Basic Mobility domain score. Mobility function for the same group in Connected Care SNF was assessed using the same tool. Clinically meaningful improvement/decline was defined as a change of ≥ 4 points; minimal improvement/decline was defined as a change between 0 and 4 points.

Change in Daily Activity in Acute Care and Skilled Nursing After Occupational Therapy (N = 1031)

2016

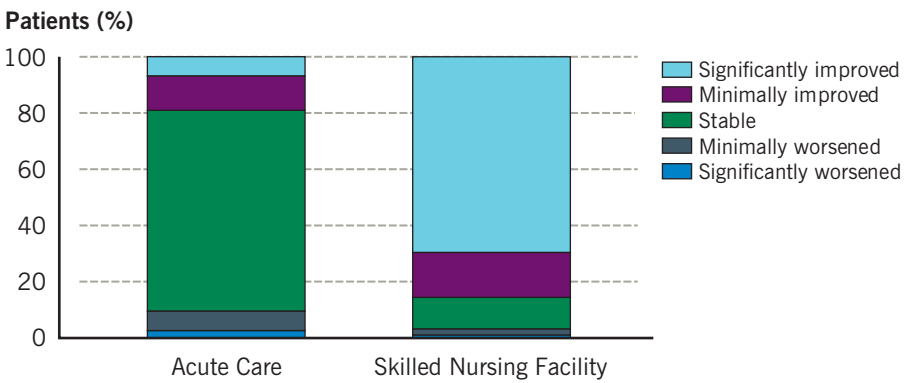


AM-PAC = Boston University Activity Measure for Post Acute Care

Daily activity was assessed as patients moved from the acute care hospital to a Cleveland Clinic Connected Care SNF using the AM-PAC short form. Activity was assessed using the AM-PAC inpatient short form (6-Clicks) Daily Activity tool. For some patients, inpatient occupational therapy only begins the rehabilitation process, and patients are more likely to see functional gains when they receive a more intense level of therapy in the SNF. Mean interval between assessments was 2.6 days for acute care and 17.5 days for Connected Care SNF.

Level of Change in Daily Activity After Occupational Therapy (N = 1031)

2016

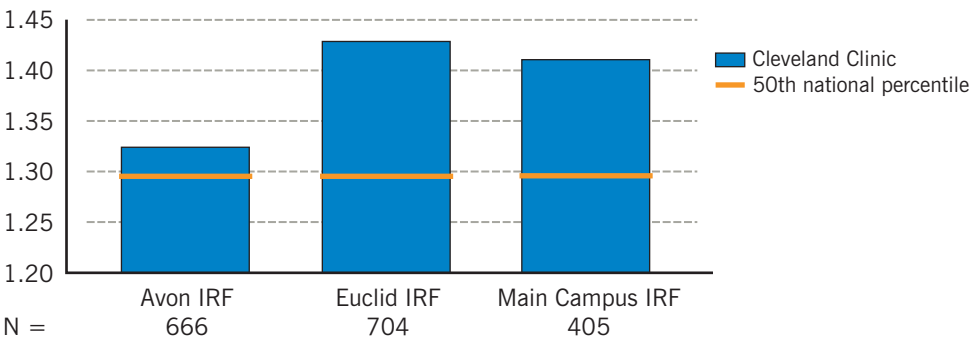


Function was assessed using the 6-Clicks Daily Activity domain score. Clinically meaningful improvement/decline was defined as a change of ≥ 4 points; minimal improvement/decline was defined as a change between 0 and 4 points.

Inpatient Rehabilitation Facility

Inpatient Admissions: Case Mix Index

2016

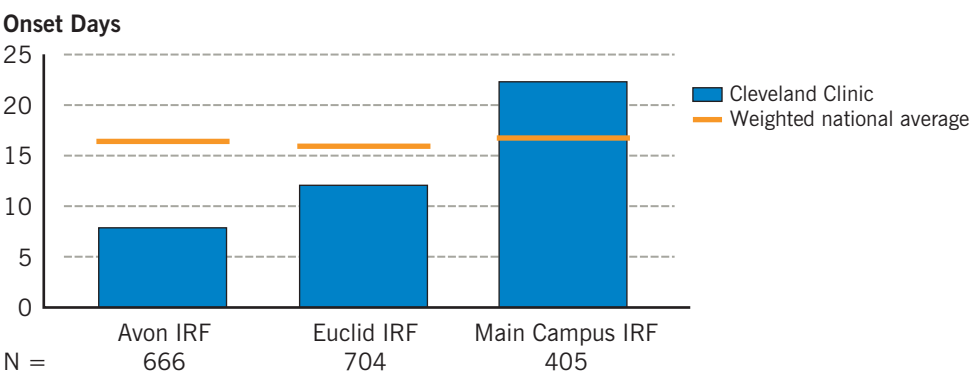


IRF = inpatient rehabilitation facility

Since 2015, Cleveland Clinic inpatient rehabilitation facilities have been operated under a joint venture management agreement with Select Medical Corporation. The case mix index, derived from eRehabData®, reflects the diversity, clinical complexity, and need for resources in the inpatient rehabilitation facilities. Across all 3 Cleveland Clinic inpatient rehabilitation facilities, case mix index exceeded the 50th national percentile.

Inpatient Admissions: Onset Days

2016

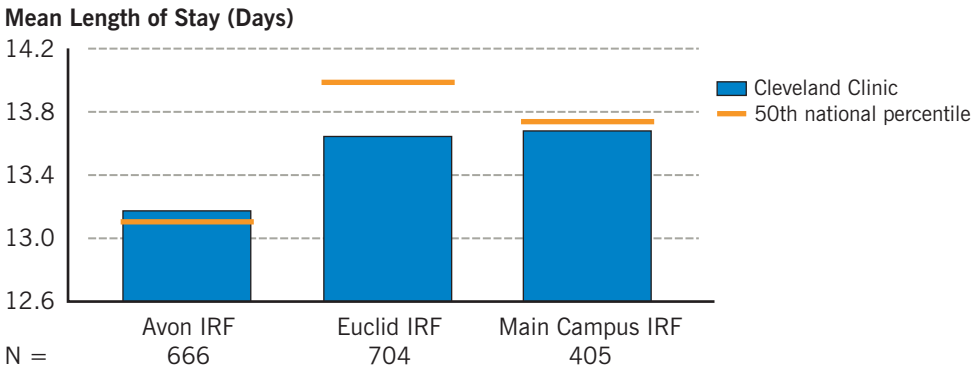


IRF = inpatient rehabilitation facility

Onset days reflect the time elapsed between acute care hospital admission and admission to a Cleveland Clinic inpatient rehabilitation facility. The onset days for Avon and Euclid inpatient rehabilitation facilities were better than the weighted national average, measured and compared via eRehabData. Main campus inpatient rehabilitation facility onset days may reflect the preponderance of patients with extended acute hospital stays associated with organ transplantation, cancer, and complex cardiac conditions.

Inpatient Admissions: Mean Length of Stay

2016

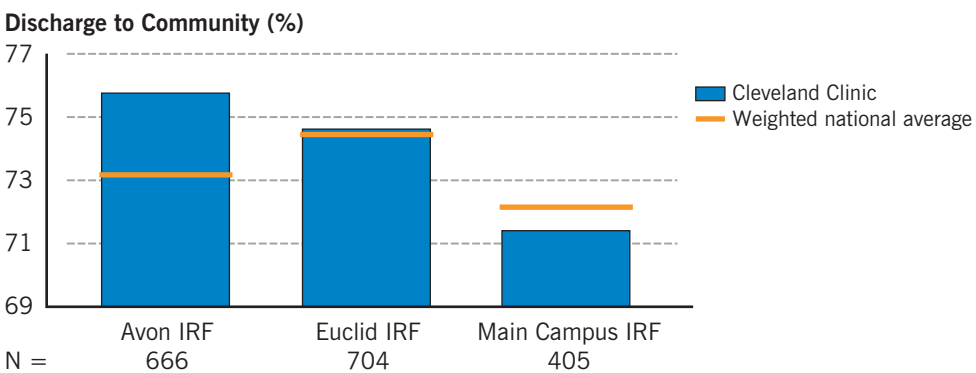


IRF = inpatient rehabilitation facility

Mean length of stay for Cleveland Clinic inpatient rehabilitation facilities is obtained from eRehabData. Across facilities, target lengths of stay differ according to the mix of patients and their rehabilitation impairment category, but the average is 13–14 days.

Inpatient Admissions: Community Discharges

2016

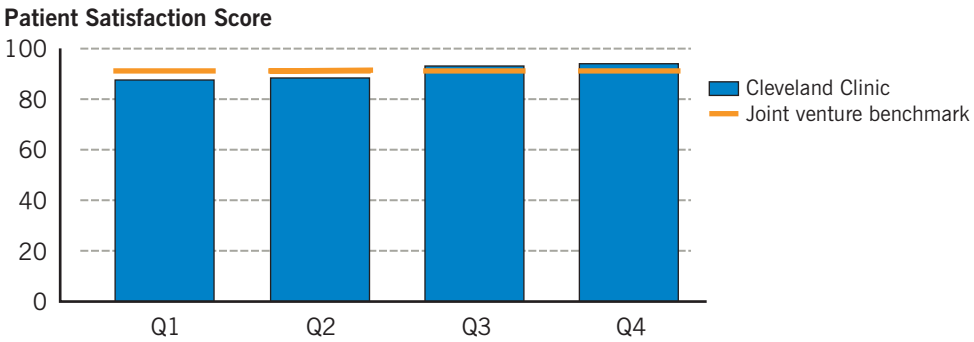


IRF = inpatient rehabilitation facility

The percentage of patients discharged home, as measured by eRehabData, is a reflection of proper patient selection and quality rehabilitation care. Cleveland Clinic inpatient rehabilitation facilities are operated under a joint venture management agreement with Select Medical Corporation. Avon and Euclid inpatient rehabilitation facilities exceeded the national average under this metric.

Inpatient Admissions: Patient Satisfaction (N = 666)

2016

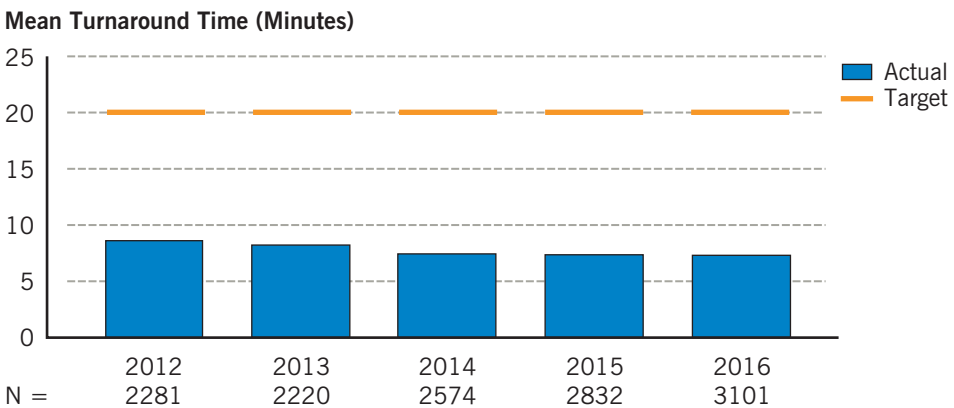


In 2016, the first full year of patient satisfaction outcomes reports became available through Cleveland Clinic's joint venture with Select Medical Corporation. Cleveland Clinic Rehabilitation Hospital Avon opened in December 2015. Patient satisfaction data are derived through eRehabData, including 3 survey instruments delivered to patients and their families.

Neuroimaging

Since 2011, the Center for Neuroimaging has been responsible for interpreting brain attack head CTs (for acute stroke) and CT angiography (CTA) for the entire Cleveland Clinic health system, requiring the coordination of multiple hospitals' radiology departments, emergency departments, and physician groups within a single system. Guidelines for Primary Stroke Centers dictate that a noncontrast head CT be performed within 25 minutes of presentation and an interpretation be provided to the responsible licensed independent practitioner within 45 minutes of presentation or 20 minutes of acquisition. Rapid completion and interpretation of brain attack head CTs expedites the management of acute stroke patients.

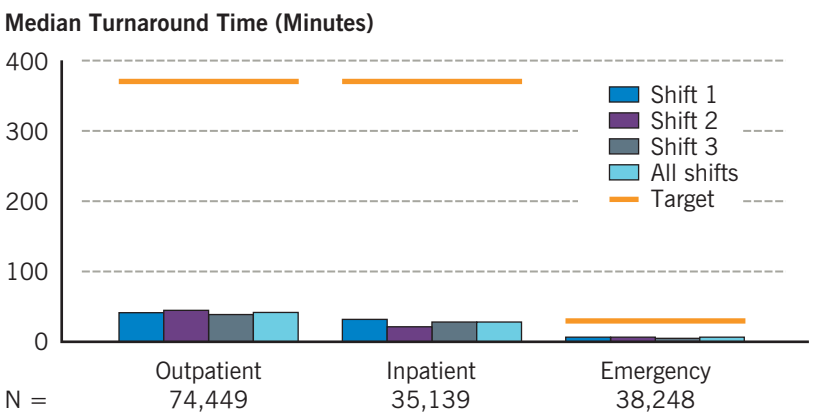
Brain Attack Head CT Reporting Turnaround Times



Mean turnaround time has continued to decrease. For the > 3000 brain attack head CTs acquired across the health system in 2016, mean turnaround time was 7.31 minutes, well under the target of 20 minutes and slightly reduced from the 2015 mean turnaround time of 7.34 minutes. N = the overall number of brain attack head CTs performed for acute stroke.

Neuroradiology Median Reporting Turnaround Times

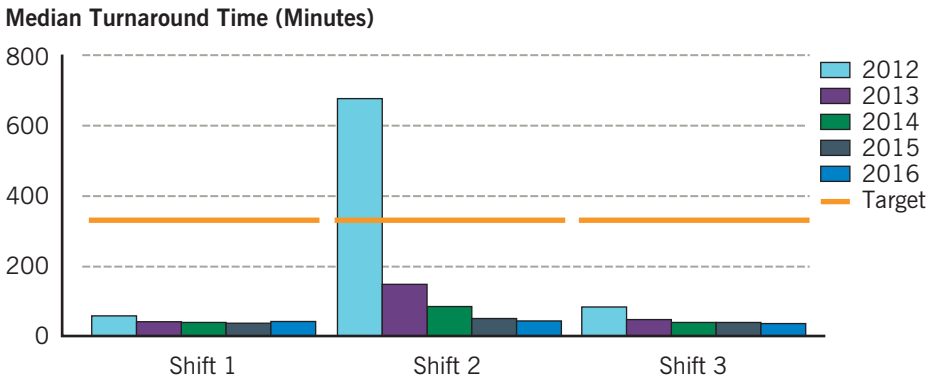
2016



The Center for Neuroimaging maintains true 24-hour 7-day coverage for the entire Cleveland Clinic health system, including afterhours coverage for affiliates in Akron, Ohio, and Weston, Florida. The current targets for turnaround times from acquisition to final report are 6 hours for outpatients, 6 hours for inpatients, and 30 minutes for emergency department patients. The median turnaround times for each category of studies during 2016 are well within the proposed times regardless of the time of day or day of the week.

Neuroradiology Median Reporting Turnaround Times — Outpatients

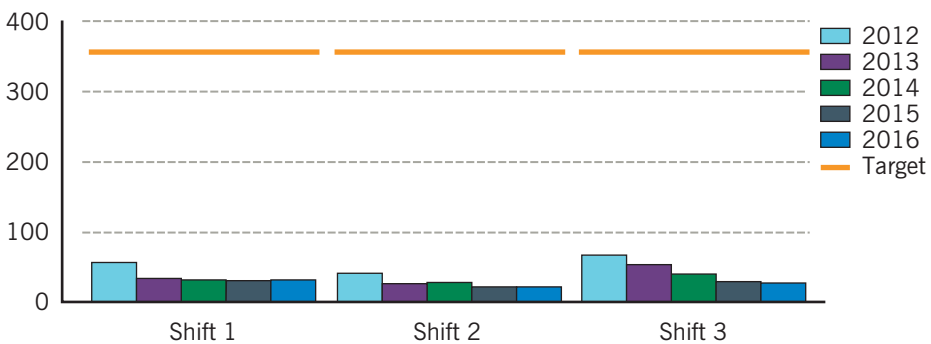
2012 – 2016



Turnaround times for outpatient studies have decreased over the past 5 years. The median turnaround times during 2012 for shift 2 appear to be greater than the targeted time, but the goal for turnaround time was cut in half at the end of 2012 and the graph displays the current target of 6 hours for outpatients. The time reductions in 2013 also reflect a change in staffing during shift 2 for improved efficiency.

Neuroradiology Median Reporting Turnaround Times — Inpatients

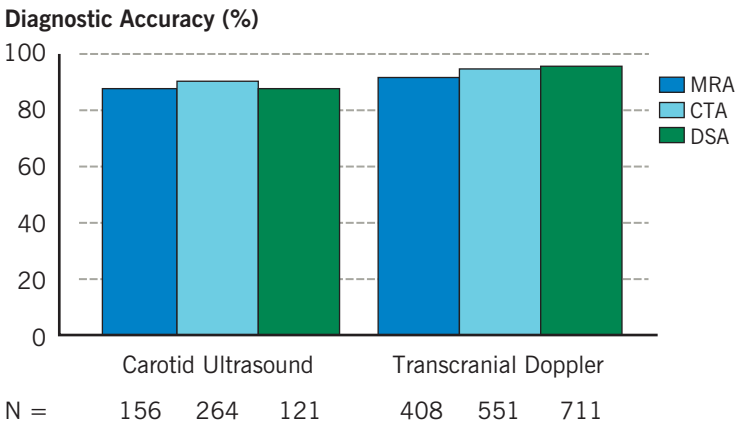
2012 – 2016



Turnaround times for inpatient studies have decreased over the past 5 years for all 3 shifts and are well below the targeted time of 6 hours.

Diagnostic Accuracy of Methods for Assessing Carotid and Intracranial Stenosis

2016

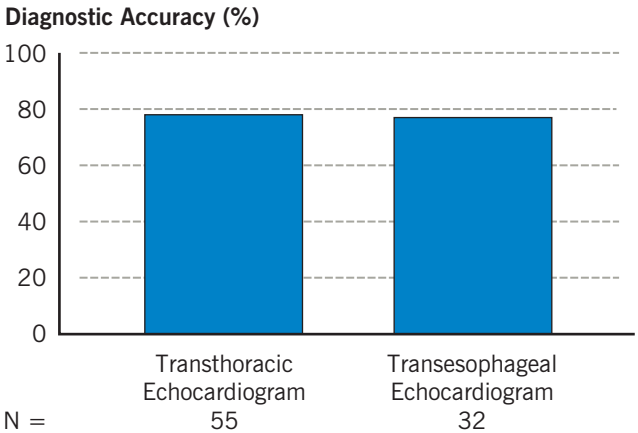


CTA = CT angiography, DSA = digital subtraction angiography, MRA = MR angiography

Cleveland Clinic's Neurovascular Lab routinely performs duplex carotid ultrasound and transcranial Doppler (TCD) studies to evaluate the extracranial and intracranial vasculature for stenosis. Carotid ultrasound stenosis measurements were correlated with stenosis measurements on MR angiography (MRA), CTA, and digital subtraction angiography (DSA) studies, using North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria. TCD studies were correlated to a classification of mild, moderate, or severe stenosis on these same studies. For carotid ultrasound, N = number of patients who had both carotid ultrasound and MRA, CTA, or DSA. For TCD, N = number of patients who had both TCD and MRA, CTA, or DSA. Diagnostic accuracy is defined as the proportion of all tests that are correct. The diagnostic accuracy compared to other noninvasive studies was at least 87% while the accuracy relative to the gold standard DSA was 87% to 95%.

Transcranial Doppler Ultrasound With Bubble Study to Evaluate Stroke Patients for Right-to-Left Shunt

2016



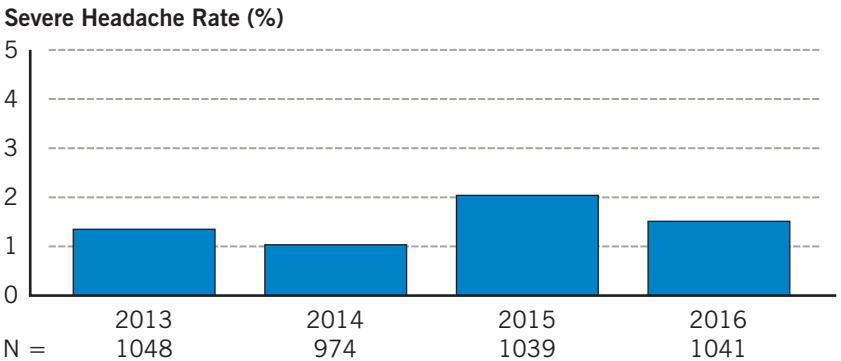
TCD monitoring of the middle cerebral arteries (MCAs) during the intravenous injection of agitated saline, also referred to as transcranial Doppler with bubble study (TCD-b), is used to evaluate for right-to-left shunts (RLS), such as patent foramen ovale (PFO), in patients with stroke of unclear etiology. Transthoracic (TTE) and transesophageal (TEE) echocardiograms are used to evaluate for cardiac RLS. TCD-b can be useful for identifying extracardiac RLS,[1] is less expensive than TTE or TEE, and is less invasive than TEE, but TCD-b does require 30 minutes of continuous monitoring of both MCAs. N = number of patients who had both TCD-b and either TTE or TEE. Diagnostic accuracy is defined as the proportion of all tests that are correct.

Reference

1. Goutman SA, Katzan IL, Gupta R. Transcranial Doppler with bubble study as a method to detect extracardiac right-to-left shunts in patients with ischemic stroke. *J Neuroimaging*. 2013 Oct;23(4):523-525.

Rates of Severe Headache Following Lumbar Puncture

2013 – 2016



Headaches due to cerebrospinal fluid (CSF) leak are a well-described complication of dural puncture. The Center for Neuroimaging routinely performs inpatient and outpatient lumbar punctures and myelograms under fluoroscopic guidance for the referring services. Lumbar punctures may be requested for diagnostic purposes, for therapeutic CSF drainage, or for the injection of chemotherapeutic or radiopharmaceutical agents to ensure subarachnoid injections. Myelograms are performed for better delineation of anatomy and disease, especially in patients for whom MRI is contraindicated. The complication rate has been measured by reviewing secondary diagnoses and conducting a supplementary manual review of the electronic medical record to identify complications that were a direct result of these procedures and required blood patches to resolve symptoms of severe headache related to CSF hypotension. In a recently published case series of complications following fluoroscopically guided lumbar punctures and myelograms, the rate of headache requiring blood patch was 0.9%.[1]

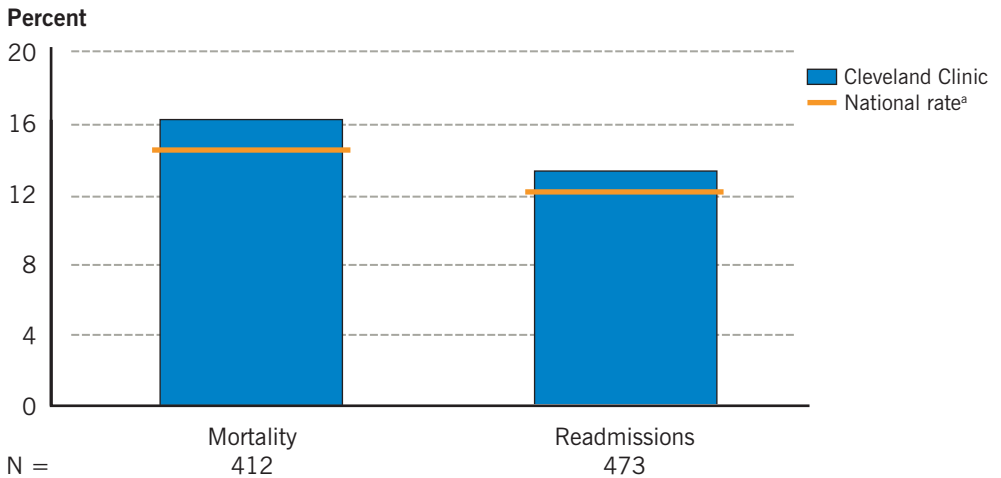
Reference

1. Rodriguez D, Branstetter BF 4th, Agarwal V, Palfey S, Ching KC, Bump GM, Hughes MA. JOURNAL CLUB: Incidence of complications following fluoroscopically guided lumbar punctures and myelograms. *AJR Am J Roentgenol*. 2016 Jan;206(1):20-25.

Acute Ischemic Stroke

Acute Ischemic Stroke All-Cause 30-Day Mortality and All-Cause 30-Day Readmissions

July 2013 – June 2016



[a] Source: medicare.gov/hospitalcompare

CMS calculates 2 acute ischemic stroke outcomes measures based on Medicare claims and enrollment information. The most recent risk-adjusted data available from CMS are shown. Although Cleveland Clinic's stroke patient mortality and readmissions rates are slightly higher than the US national rate, CMS ranks Cleveland Clinic's performance on each as "no different than" the US national rate. To further reduce avoidable readmissions, Cleveland Clinic is focused on optimizing transitions from hospital to home or postacute facility. Specific initiatives have been implemented to ensure effective communication, education, and follow-up.

Surgical Quality Improvement

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP®) objectively measures and reports risk-adjusted surgical outcomes based on a defined sampling and abstraction methodology. These outcomes data reflect Cleveland Clinic's overall neurosurgery ACS NSQIP performance benchmarked against 357 participating sites.

Neurosurgery Outcomes

July 2015 – June 2016

Outcome	N	Observed Rate (%)	Expected Rate (%)
30-day morbidity	490	8.57	6.21
Pneumonia	489	1.84	1.26
Ventilator > 48 hours	489	1.23	0.90
Deep vein thrombosis/pulmonary embolism	490	2.24	1.52
Surgical site infection	489	2.66	1.71
Urinary tract infection	490	1.43	1.42
Return to operating room	490	3.67	3.27
Readmission	490	8.16	6.88

In addition to overall neurosurgical ACS NSQIP outcomes data, data specific to brain tumor surgery and spine surgery are provided. Brain tumor surgery performance is benchmarked against 238 participating sites; spine surgery performance is benchmarked against 364 sites.

Brain Tumor Surgery Outcomes

July 2015 – June 2016

Outcome	N	Observed Rate (%)	Expected Rate (%)
30-day mortality	87	1.15	2.20
30-day morbidity	87	12.64	8.69
Unplanned intubation	87	1.15	2.07
Ventilator > 48 hours	86	1.16	1.70
Urinary tract infection	87	2.30	1.33
Surgical site infection	86	4.65	1.54
Sepsis	87	4.60	1.06
Return to operating room	87	5.75	4.38
Readmission	87	10.34	10.34

Spine Surgery Outcomes

July 2015 – June 2016

Outcome	N	Observed Rate (%)	Expected Rate (%)
30-day mortality	416	0.24	0.47
30-day morbidity	416	7.69	5.62
Cardiac event	416	0.72	0.40
Pneumonia	415	1.69	1.00
Unplanned intubation	416	1.69	0.68
Ventilator > 48 hours	416	1.20	0.79
Deep vein thrombosis/pulmonary embolism	416	2.16	1.24
Renal failure	416	0.48	0.30
Urinary tract infection	416	1.20	1.31
Surgical site infection	416	2.16	1.61
Sepsis	414	2.17	0.92
C. difficile colitis	416	0.00	0.25
Return to operating room	416	3.37	2.94
Readmission	416	7.69	5.96

Source: facs.org/quality-programs/acs-nsqip

Patient Experience — Neurological Institute

Keeping patients at the center of all that Cleveland Clinic does is critical. Patients First is the guiding principle at Cleveland Clinic. Patients First is safe care, high-quality care, in the context of patient satisfaction, and high value. Ultimately, caregivers have the power to impact every touch point of a patient's journey, including their clinical, physical, and emotional experience.

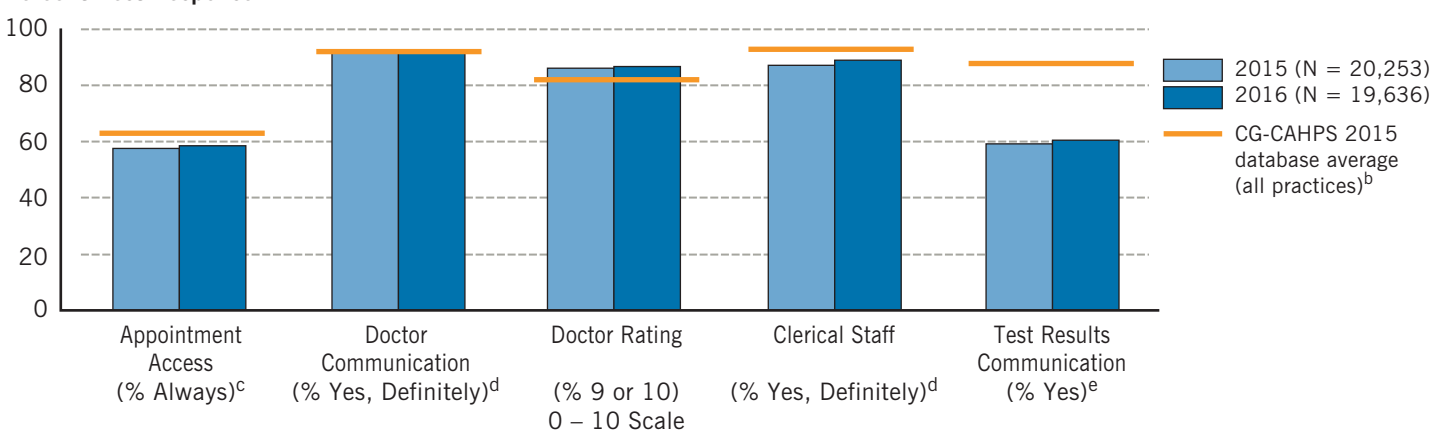
Cleveland Clinic recognizes that patient experience goes well beyond patient satisfaction surveys. Nonetheless, sharing the survey results with caregivers and the public affords opportunities to improve how Cleveland Clinic delivers exceptional care.

Outpatient Office Visit Survey — Neurological Institute

CG-CAHPS Assessment[a]

2015 – 2016

Percent Best Response



[a]In 2013, Cleveland Clinic began administering the Clinician and Group Practice Consumer Assessment of Healthcare Providers and Systems surveys (CG-CAHPS), standardized instruments developed by the Agency for Healthcare Research and Quality (AHRQ) and supported by the Centers for Medicare & Medicaid Services for use in the physician office setting to measure patients' perspectives of outpatient care.
[b]Based on results submitted to the AHRQ CG-CAHPS database from 2829 practices in 2015
[c]Response options: Always, Usually, Sometimes, Never
[d]Response options: Yes, definitely; Yes, somewhat; No
[e]Response options: Yes, No

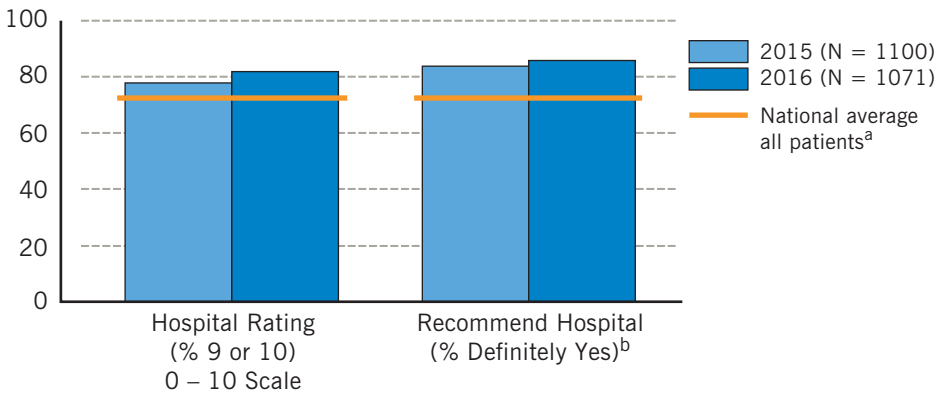
Source: Press Ganey, a national hospital survey vendor

Inpatient Survey — Neurological Institute

HCAHPS Overall Assessment

2015 – 2016

Best Response (%)



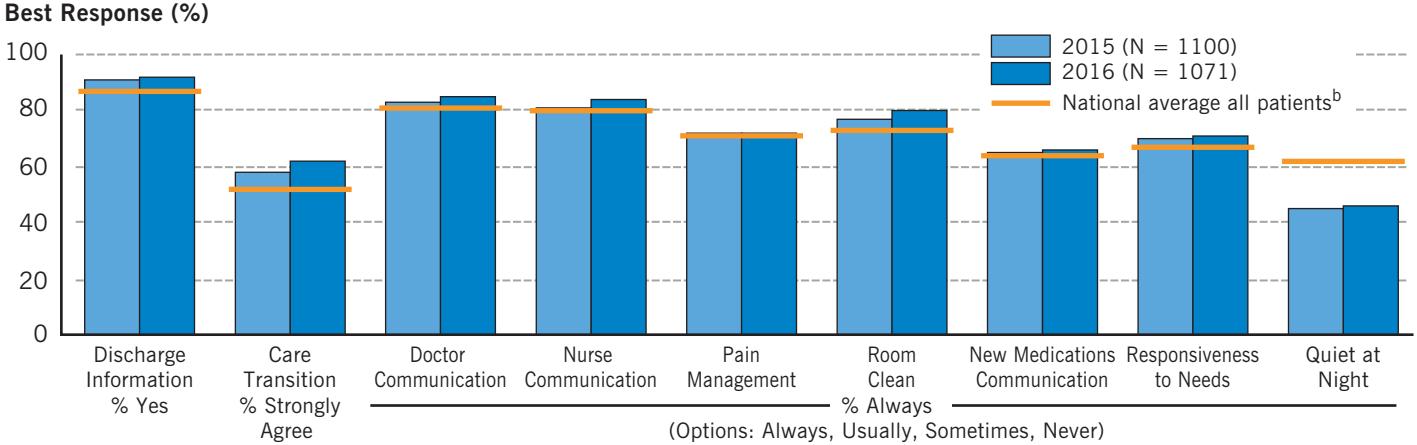
[a]Based on national survey results of discharged patients, January 2015 – December 2015, from 4172 US hospitals. medicare.gov/hospitalcompare
[b]Response options: Definitely yes, Probably yes, Probably no, Definitely no

The Centers for Medicare & Medicaid Services requires United States hospitals that treat Medicare patients to participate in the national Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, a standardized tool that measures patients' perspectives of hospital care. Results collected for public reporting are available at medicare.gov/hospitalcompare.

HCAHPS Domains of Care[a]

2015 – 2016

Best Response (%)



[a]Except for "Room Clean" and "Quiet at Night," each bar represents a composite score based on responses to multiple survey questions.
[b]Based on national survey results of discharged patients, January 2015 – December 2015, from 4172 US hospitals. medicare.gov/hospitalcompare

Source: Press Ganey, a national hospital survey vendor, 2016

Cleveland Clinic — Implementing Value-Based Care

Overview

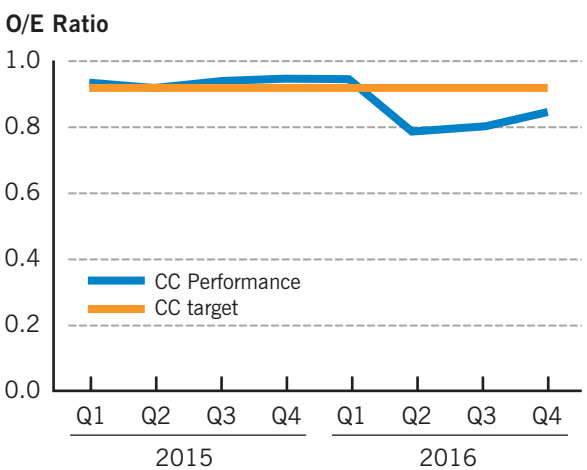
Cleveland Clinic health system uses a systematic approach to performance improvement while simultaneously pursuing 3 goals: improving the patient experience of care (including quality and satisfaction), improving population health, and reducing the cost of healthcare. The following measures are examples of 2016 focus areas in pursuit of this 3-part aim. Throughout this section, "Cleveland Clinic" refers to the academic medical center or "main campus," and those results are shown.

Real-time data are leveraged in each Cleveland Clinic location to drive performance improvement. Although not an exact match to publicly reported data, more timely internal data create transparency at all organizational levels and support improved care in all clinical locations.

Improve the Patient Experience of Care

Cleveland Clinic Overall Mortality Ratio

2015 – 2016

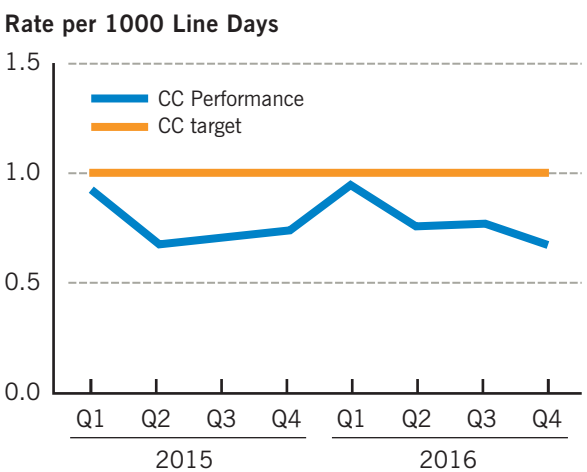


Source: Data from the Vizient Clinical Data Base/Resource Manager™ used by permission of Vizient. All rights reserved.

Cleveland Clinic's observed/expected (O/E) mortality ratio outperformed its internal target derived from the Vizient 2016 risk model. Ratios less than 1.0 indicate mortality performance "better than expected" in Vizient's risk adjustment model.

Cleveland Clinic Central Line-Associated Bloodstream Infection, reported as Standardized Infection Ratio (SIR)

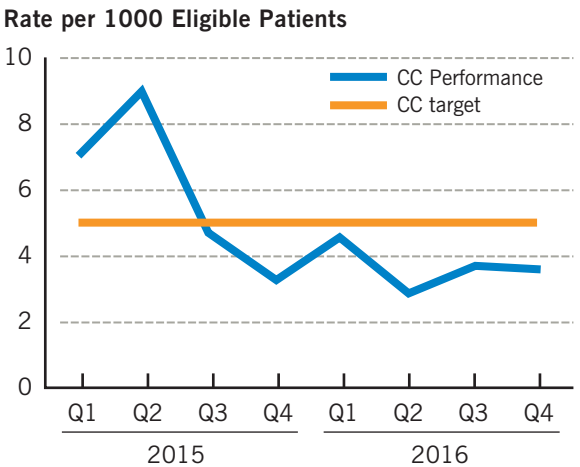
2015 – 2016



Cleveland Clinic has implemented several strategies to reduce central line-associated bloodstream infections (CLABSIs), including a central-line bundle of insertion, maintenance, and removal best practices. Focused reviews of every CLABSI occurrence support reductions in CLABSI rates in the high-risk critical care population.

Cleveland Clinic Postoperative Respiratory Failure Risk-Adjusted Rate

2015 – 2016

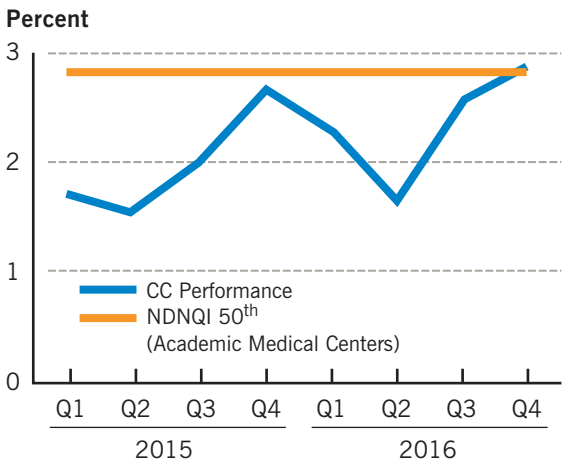


Source: Data from the Vizient Clinical Data Base/Resource Manager™ used by permission of Vizient. All rights reserved.

Efforts continue toward reducing intubation time, assessing readiness for extubation, and preventing the need for reintubation. Cleveland Clinic has leveraged the technology within the electronic medical record to support ongoing improvement efforts in reducing postoperative respiratory failure (AHRQ Patient Safety Indicator 11). Prevention of respiratory failure remains a safety priority for Cleveland Clinic.

Cleveland Clinic Hospital-Acquired Pressure Ulcer Prevalence (Adult)

2015 – 2016



Source: Data reported from the National Database for Nursing Quality Indicators® (NDNQI®) with permission from Press Ganey.

A pressure ulcer is an injury to the skin that can be caused by pressure, moisture, or friction. These sometimes occur when patients have difficulty changing position on their own. Cleveland Clinic caregivers have been trained to provide appropriate skin care and regular repositioning while taking advantage of special devices and mattresses to reduce pressure for high-risk patients. In addition, they actively look for hospital-acquired pressure ulcers and treat them quickly if they occur.

Cleveland Clinic strategies to mitigate the risk of these pressure injuries include routine rounding to accurately stage pressure injuries, monthly multidisciplinary wound care meetings, and ongoing nursing education, both in the classroom and at the bedside.

Cleveland Clinic — Implementing Value-Based Care

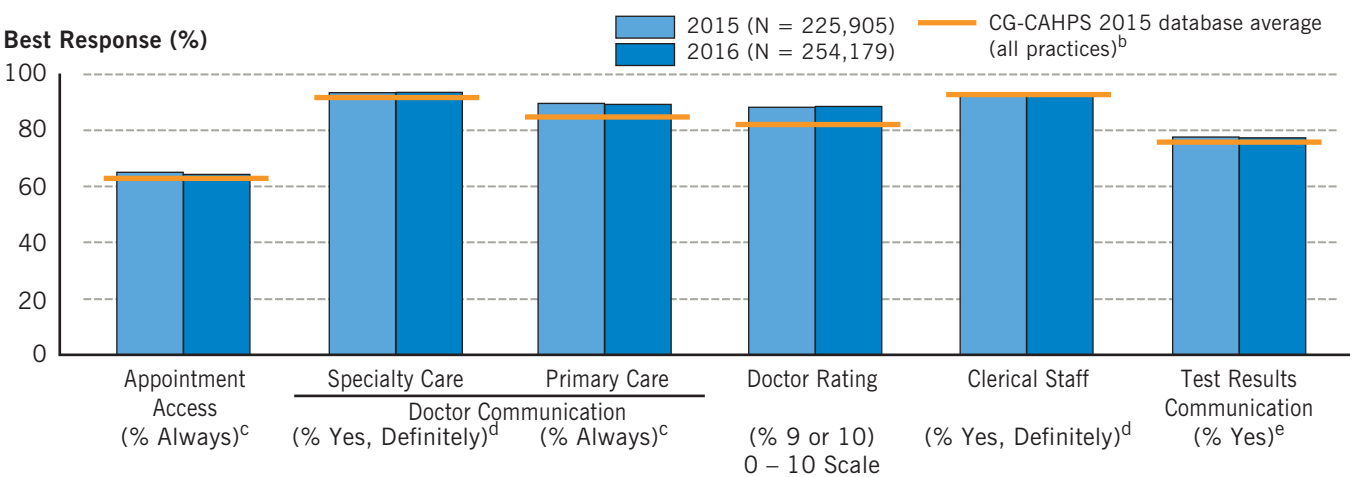
Keeping patients at the center of all that we do is critical. Patients First is the guiding principle at Cleveland Clinic. Patients First is safe care, high-quality care, in the context of patient satisfaction, and high value. Ultimately, our caregivers have the power to impact every touch point of a patient's journey, including their clinical, physical, and emotional experience.

We know that patient experience goes well beyond patient satisfaction surveys. Nonetheless, by sharing the survey results with our caregivers and the public, we constantly identify opportunities to improve how we deliver exceptional care.

Outpatient Office Visit Survey — Cleveland Clinic

CG-CAHPS Assessment[a]

2015 – 2016



[a]In 2013, Cleveland Clinic began administering the Clinician and Group Practice Consumer Assessment of Healthcare Providers and Systems surveys (CG-CAHPS), standardized instruments developed by the Agency for Healthcare Research and Quality (AHRQ) and supported by the Centers for Medicare & Medicaid Services for use in the physician office setting to measure patients' perspectives of outpatient care.
[b]Based on results submitted to the AHRQ CG-CAHPS database from 2829 practices in 2015
[c]Response options: Always, Usually, Sometimes, Never
[d]Response options: Yes, definitely; Yes, somewhat; No
[e]Response options: Yes, No

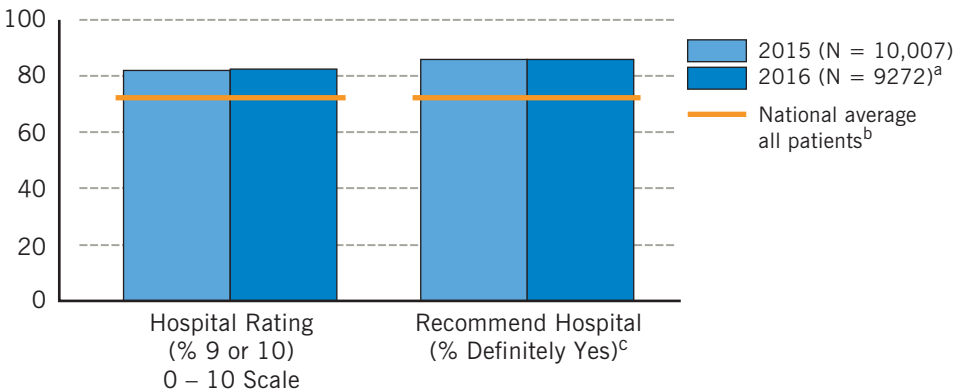
Source: Press Ganey, a national hospital survey vendor

Inpatient Survey — Cleveland Clinic

HCAHPS Overall Assessment

2015 – 2016

Best Response (%)



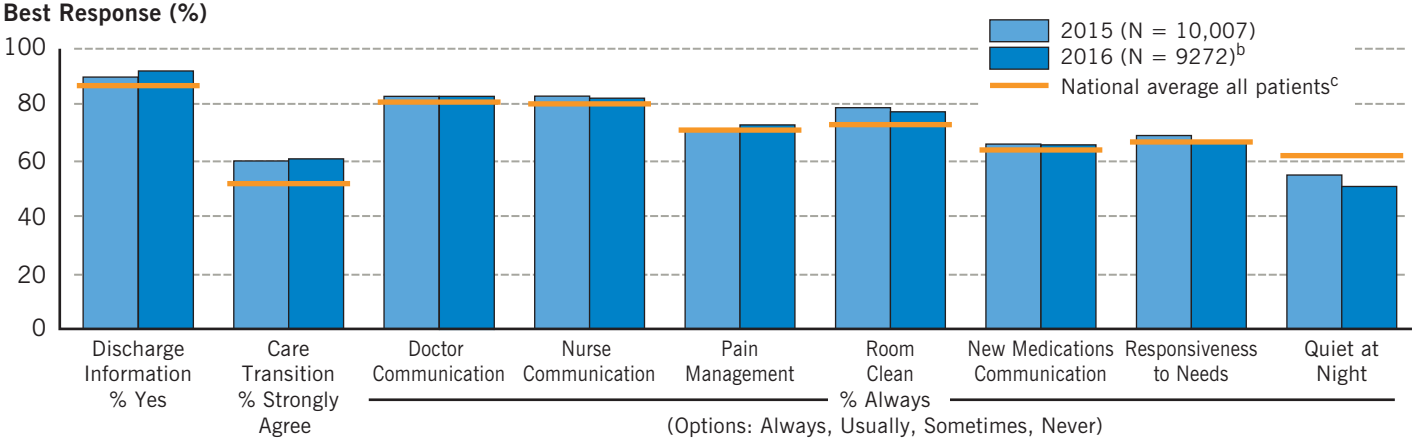
[a]At the time of publication, 2016 ratings have not been reported by the Centers for Medicare & Medicaid Services and ratings are not adjusted for patient mix.
[b]Based on national survey results of discharged patients, January 2015 – December 2015, from 4172 US hospitals. medicare.gov/hospitalcompare
[c]Response options: Definitely yes, Probably yes, Probably no, Definitely no

The Centers for Medicare & Medicaid Services requires United States hospitals that treat Medicare patients to participate in the national Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, a standardized tool that measures patients' perspectives of hospital care. Results collected for public reporting are available at medicare.gov/hospitalcompare.

HCAHPS Domains of Care[a]

2015 – 2016

Best Response (%)



[a]Except for "Room Clean" and "Quiet at Night," each bar represents a composite score based on responses to multiple survey questions.
[b]At the time of publication, 2016 ratings have not been reported by the Centers for Medicare & Medicaid Services and ratings are not adjusted for patient mix.
[c]Based on national survey results of discharged patients, January 2015 – December 2015, from 4172 US hospitals. medicare.gov/hospitalcompare

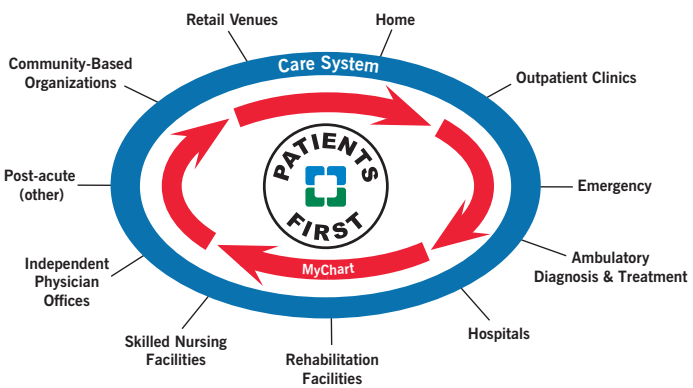
Source: Centers for Medicare & Medicaid Services, 2015; Press Ganey, a national hospital survey vendor, 2016

Focus on Value

Cleveland Clinic has developed and implemented new models of care that focus on "Patients First" and aim to deliver on the Institute of Medicine goal of **S**afe, **T**imely, **E**ffective, **E**fficient, **E**quitable, **P**atient-centered care. Creating new models of Value-Based Care is a strategic priority for Cleveland Clinic. As care delivery shifts from fee-for-service to a population health and bundled payment delivery system, Cleveland Clinic is focused on concurrently improving patient safety, outcomes, and experience.

What does this new model of care look like?

Integrated Care Model



The Cleveland Clinic Integrated Care Model (CCICM) is a value-based model of care, designed to improve outcomes while reducing cost. It is designed to deliver value in both population health and specialty care.

- The patient remains at the heart of the CCICM.
- The blue band represents the care system, which is a seamless pathway that patients move along as they receive care in different settings. The care system represents integration of care across the continuum.
- Critical competencies are required to build this new care system. Cleveland Clinic is creating disease- and condition-specific care paths for a variety of procedures and chronic diseases. Another facet is implementing comprehensive care coordination for high-risk patients to prevent unnecessary hospitalizations and emergency department visits. Efforts include managing transitions in care, optimizing access and flow for patients through the CCICM, and developing novel tactics to engage patients and caregivers in this work.
- Measuring performance around quality, safety, utilization, cost, appropriateness of care, and patient and caregiver experience is an essential component of this work.

Improve Population Health

Cleveland Clinic Accountable Care Organization Measure Performance

2016

National Percentile Ranking

90th	• Falls Screening • Heart Failure • Ischemic Vascular Disease • BMI Screening • Tobacco Screening
80th	• Coronary Artery Disease • Diabetes • Breast Cancer Screening • Pneumonia Vaccination
70th	• Colorectal Cancer Screening • Influenza Vaccination • Blood Pressure Screening • Hypertension
50th	• Depression Screening

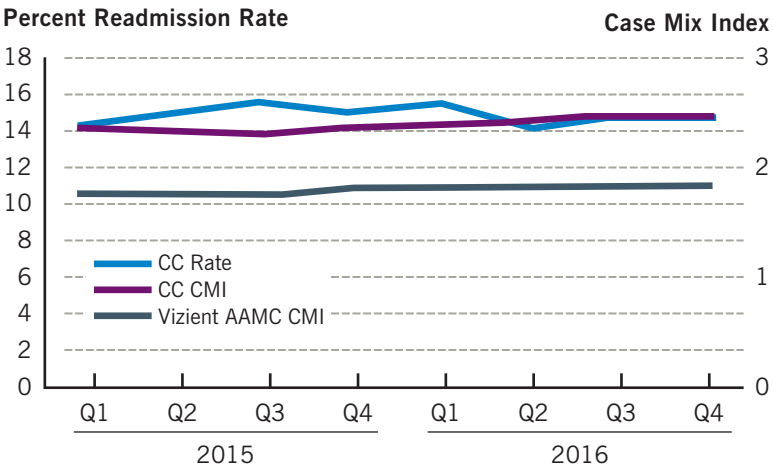
Higher percentiles are better

As part of Cleveland Clinic's commitment to population health and in support of its Accountable Care Organization (ACO), these ACO measures have been prioritized for monitoring and improvement. Cleveland Clinic is improving performance in these measures by enhancing care coordination, optimizing technology and information systems, and engaging primary care specialty teams directly in the improvement work. These pursuits are part of Cleveland Clinic's overall strategy to transform care in order to improve health and make care more affordable.

Reduce the Cost of Care

Cleveland Clinic All-Cause 30-Day Readmission Rate to Any Cleveland Clinic Hospital

2015 – 2016

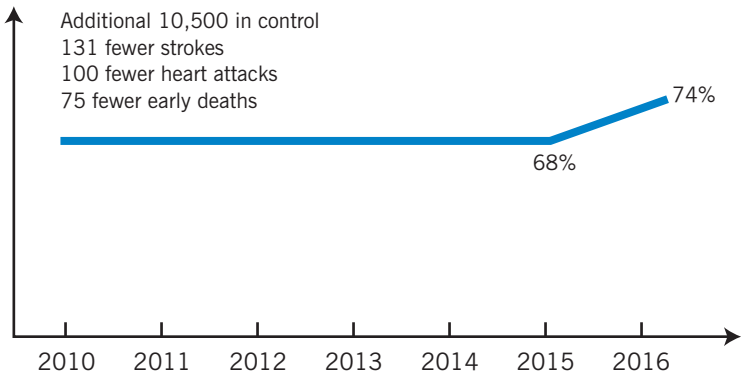


CMI = case mix index

Source: Data from the Vizient Clinical Data Base/Resource Manager™ used by permission of Vizient. All rights reserved.

Cleveland Clinic monitors 30-day readmission rates for any reason to any of its system hospitals. Unplanned readmissions are actively reviewed for improvement opportunities. Comprehensive care coordination and care management for high-risk patients has been initiated in an effort to prevent unnecessary hospitalizations and emergency department visits. Sicker, more complex patients are more susceptible to readmission. Case mix index (CMI) reflects patient severity of illness and resource utilization. Cleveland Clinic's CMI remains one of the highest among American academic medical centers.

Accountable Care Organization (ACO) Improving Outcomes and Reducing Costs

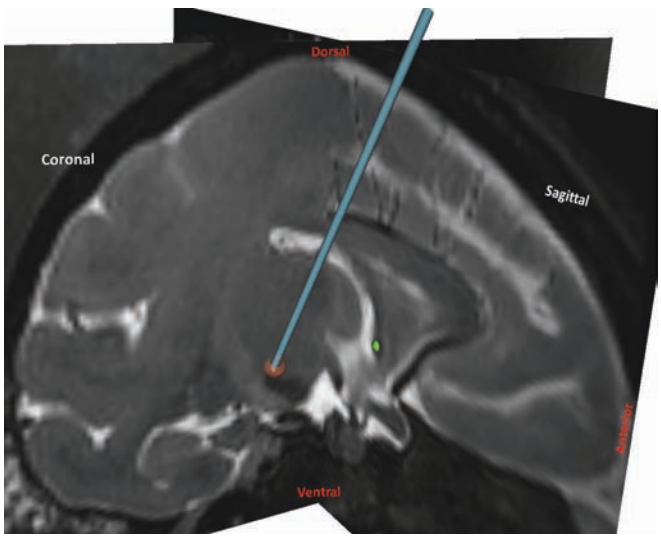


Cleveland Clinic was one of the top performing new ACOs in the United States (for 2015 performance as determined in 2016) due to efficiency, cost reduction, and improvements in effectiveness of chronic disease management such as treating hypertension, reducing preventable hospitalizations through care coordination, and optimizing the care at skilled nursing facilities through its Connected Care program.

For example, a system-wide effort to improve the control of blood pressure for patients with hypertension was begun in 2016 and resulted in an additional 10,500 patients with blood pressure controlled. This will translate to many fewer strokes, heart attacks, and preventable deaths.

A Promising New Approach to Deep Brain Stimulation for Parkinson Disease

Deep brain stimulation (DBS) is standard-of-care treatment for patients with advanced, medically refractory Parkinson disease (PD). It involves the surgical implantation of a pacemaker-like device to deliver a stream of high-frequency electrical pulses to modulate neural activity across the brain's sensorimotor circuitry. Side effects can arise from current spread to nonmotor areas within the target area or to brain regions outside the target area. Researchers in Cleveland Clinic's Neurological Institute and Lerner Research Institute are investigating a DBS paradigm called "coordinated reset DBS"[1] that promises to reduce the risk of side effects by eliminating the need for continuous stimulation and reducing the amplitude of each stimulus pulse. Ongoing preclinical work supports this promise and indicates that it is time to plan using this promising science in humans.[2] This close collaboration between scientists and neuroscientists at Cleveland Clinic and their commitment to discovery and innovation will help bring this approach to the bedside, thus offering new hope to patients with advanced PD.



Representation of the coordinated reset DBS paradigm in 2 planes, with a view of how the DBS lead is targeted relative to coronal and sagittal MRIs.

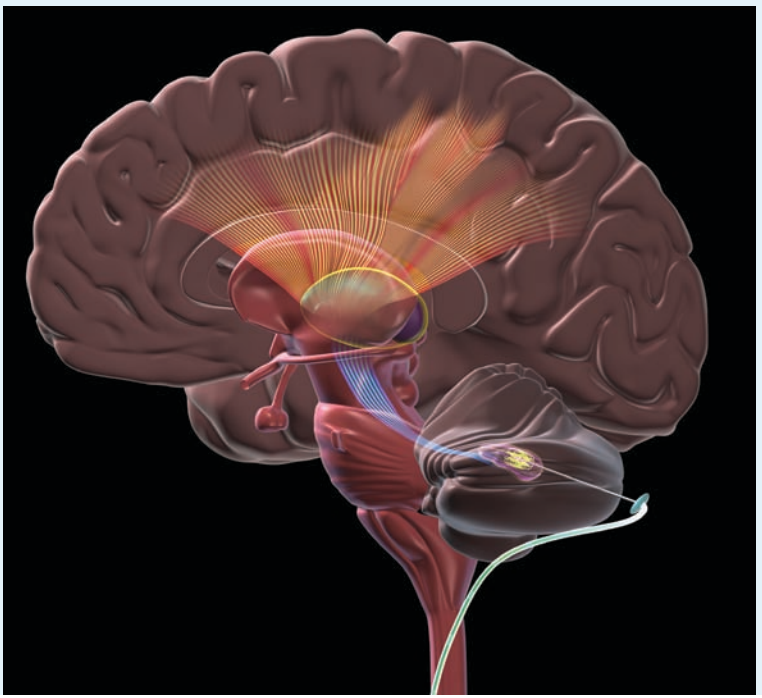
References

1. Tass PA. A model of desynchronizing deep brain stimulation with a demand-controlled coordinated reset of neural subpopulations. *Biol Cybern*. 2003 Aug;89(2):81-88.

2. Wang J, Nebeck S, Muralidharan A, Johnson MD, Vitek JL, Baker KB. Coordinated reset deep brain stimulation of subthalamic nucleus produces long-lasting, dose-dependent motor improvements in the 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine non-human primate model of Parkinsonism. *Brain Stimul*. 2016 Jul-Aug;9(4):609-617.

Deep Brain Stimulation Trial to Promote Motor Recovery After Stroke

Despite significant progress in acute intervention strategies, 50% of stroke survivors continue to exhibit disabling hemiparesis 6 months after stroke and 30% require assistance with activities of daily living.[1] A team of researchers in the Center for Neurological Restoration has completed the first deep brain stimulation implantation in the human cerebellum to promote motor recovery after stroke. This FDA-approved trial will assess the safety and feasibility of deep brain stimulation of the dentate nucleus for treatment of persistent (> 12 months), moderate-to-severe upper extremity hemiparesis secondary to middle cerebral artery ischemic stroke. This study builds on prior preclinical work from the center demonstrating that this treatment strategy enhances excitability and plasticity in spared cerebral cortical regions and promotes further recovery of motor function.[2,3]



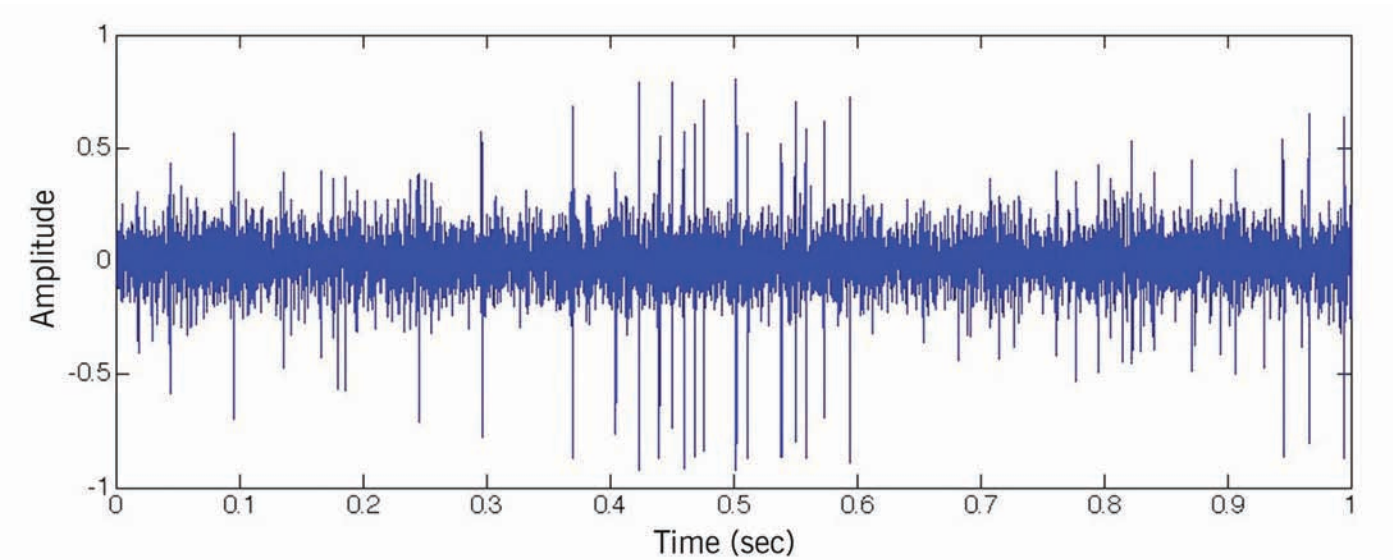
Artist's rendering of deep brain stimulation of the dentate nucleus.

References

1. Kelly-Hayes M, Beiser A, Kase CS, Scaramucci A, D'Agostino RB, Wolf PA. The influence of gender and age on disability following ischemic stroke: the Framingham study. *J Stroke Cerebrovasc Dis*. 2003 May-Jun;12(3):119-126.
2. Cooperrider J, Furmaga H, Plow E, Park HJ, Chen Z, Kidd G, Baker KB, Gale JT, Machado AG. Chronic deep cerebellar stimulation promotes long-term potentiation, microstructural plasticity, and reorganization of perilesional cortical representation in a rodent model. *J Neurosci*. 2014 Jul 2;34(27):9040-9050.
3. Machado AG, Cooperrider J, Furmaga HT, Baker KB, Park HJ, Chen Z, Gale JT. Chronic 30-Hz deep cerebellar stimulation coupled with training enhances post-ischemia motor recovery and peri-infarct synaptophysin expression in rodents. *Neurosurgery*. 2013 Aug;73(2):344-353.

Understanding Cognitive Impairment at the Neuronal Level

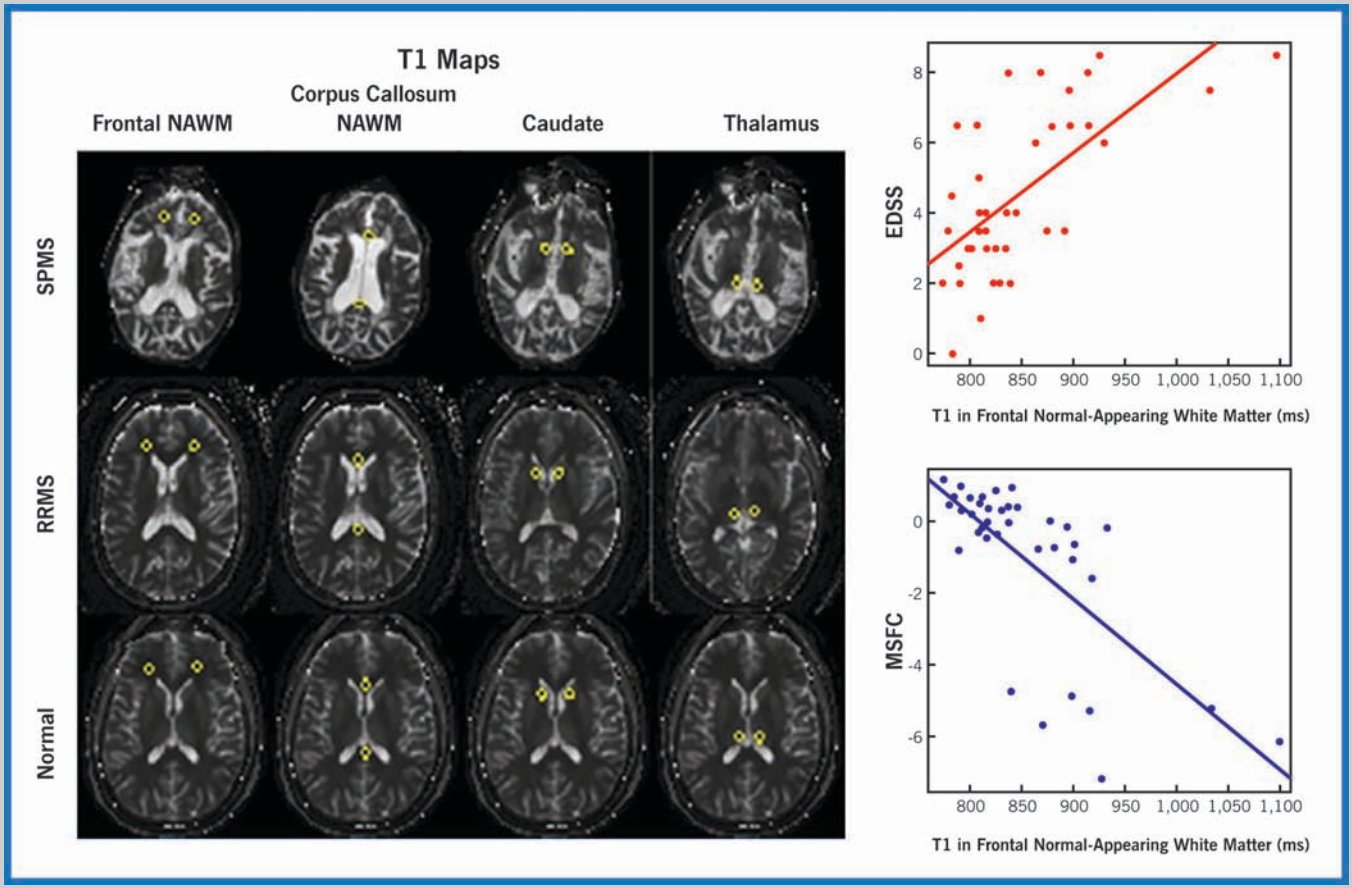
Parkinson disease (PD) is associated with movement abnormalities as well as changes in cognition and behavior. Effective treatments are available for the movement aspects of the disease, but there is little to offer patients for the nonmotor symptoms because the neural changes that underlie the thinking and behavior problems are poorly understood. Researchers within the Center for Neurological Restoration are addressing this knowledge gap in an NIH-funded study of the activity changes in single brain cells and populations of cells while patients perform cognitive tasks during deep brain stimulation surgery for treatment of motor symptoms in PD. This is the first study in humans to link single cell and population activity during response inhibition, an important cognitive process that is impaired in PD and is important for controlling behavior.



Sample spike train from the human subthalamic nucleus during a cognitive task.

Magnetic Resonance Fingerprinting: A New Window Into Multiple Sclerosis

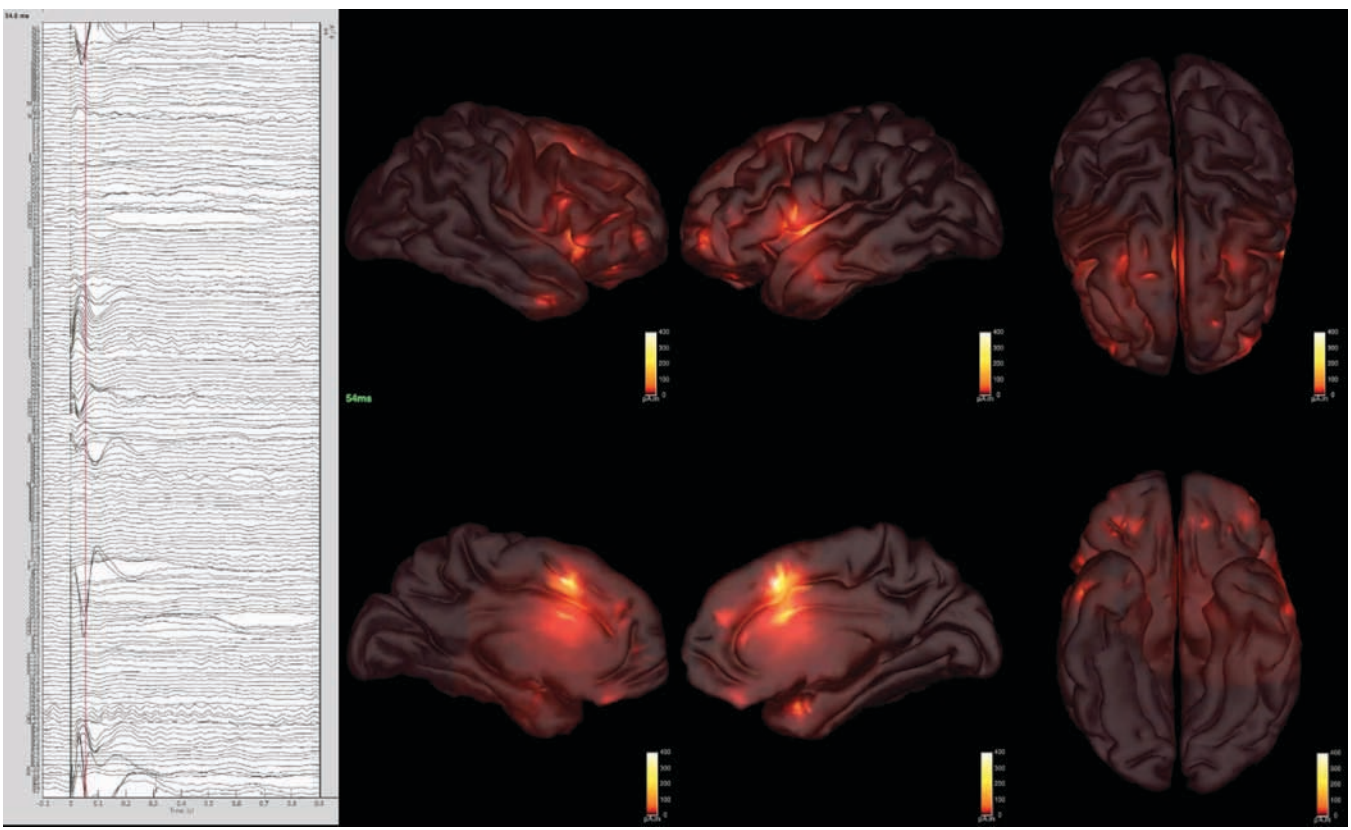
The lack of a biomarker for tissue pathology in multiple sclerosis (MS) is one of the most important obstacles to developing new therapies for progressive MS. Researchers at Cleveland Clinic are studying a new imaging approach called magnetic resonance fingerprinting (MRF) in patients with relapsing and secondary progressive forms of MS. MRF addresses the shortcomings associated with conventional and advanced imaging modalities by directly measuring T1 and T2 relaxation times. This modality shows promise as a more specific diagnostic test for MS and as a clinical trial outcome tool to accelerate drug development for progressive MS.



In regions of interest drawn on T1 maps generated by MRF, strong correlations were found with clinical measures of disability including the Expanded Disability Status Scale (EDSS) and Multiple Sclerosis Functional Composite (MSFC), despite the relatively small sample size (39 patients).

Cortico-Cortical Evoked Potentials: A Novel Application Promises to Advance Mapping of Brain Connectivity

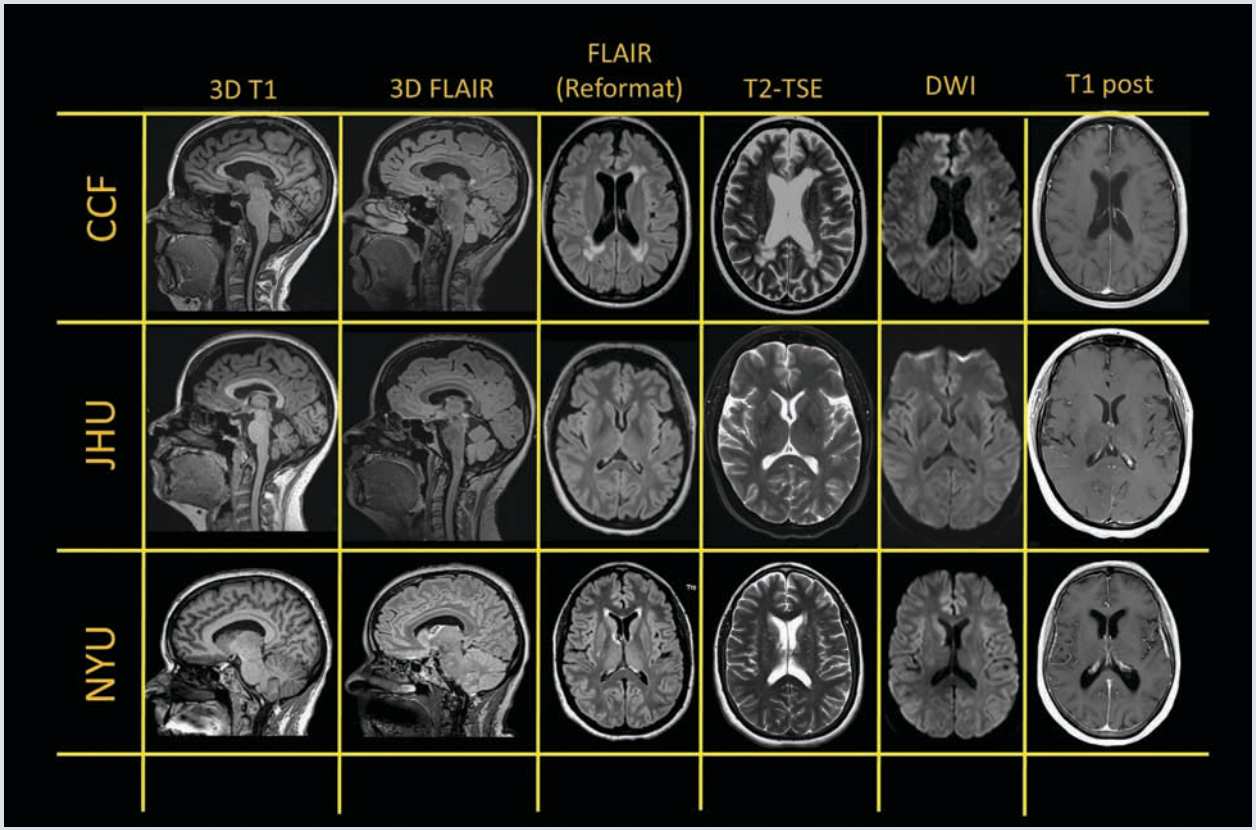
Cleveland Clinic's Epilepsy Center pioneered cortico-cortical evoked potentials (CCEPs), a brain mapping technique using electrodes implanted in patients undergoing invasive monitoring for epilepsy surgery. By stimulating a patient's cortex using low-frequency impulses, connections to nearby and distant cortical regions can be measured and mapped. The center is developing a map of CCEP responses based on research in hundreds of patients, furthering understanding of brain connectivity among motor and language networks, and optimizing approaches to treating patients with epilepsy in the future.



A patient's CCEP responses are depicted as waveforms on the left with response estimates depicted by scaled colors in the MRI scans on the right. Brain currents were estimated using a "minimum energy" constraint that kept the currents to a minimum in the vicinity of the electrodes to generate a working estimate for use in studying brain dynamics.

Multicenter MRI Standardization to Enable Quantitative Metrics in Routine Care of Multiple Sclerosis Patients

Clinical research typically involves costly data collection from small groups of patients and increased burden on healthcare providers. To create a learning system that enables novel research and ultimately improves patient care with minimal impact on provider workflow, neuroradiologists, neurologists, and imaging scientists from Cleveland Clinic, Johns Hopkins, NYU Langone Medical Center, and sponsors Biogen and Siemens are collaborating in the Multiple Sclerosis Partners Advancing Technology and Healthcare Solutions (MS PATHS) initiative. By creating a deidentified database of background and clinical data (including pharmaceutical data and neuroperformance testing) and by standardizing imaging protocols and reporting of multiple sclerosis findings, the partners are using big data to create an integrated learning health system to improve clinical care and research.



Sample of MS PATHS images standardized for multiple institutions.

Contact Information

Neurological Institute Appointments/Referrals

216.636.5860 or
866.588.2264

On the Web at clevelandclinic.org/neuro

Staff Listing

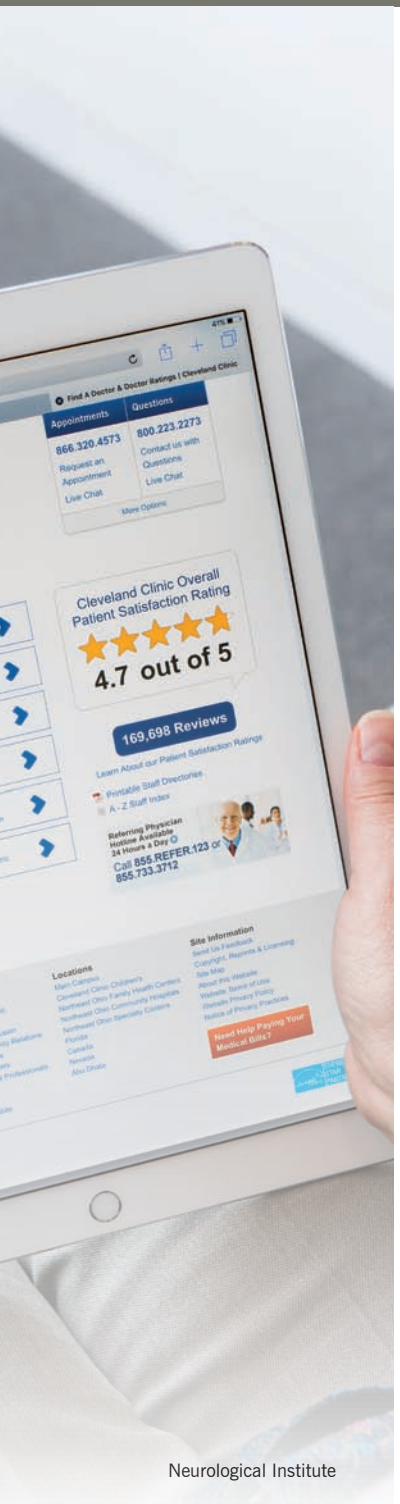
For a complete listing of Cleveland Clinic's Neurological Institute staff, please visit clevelandclinic.org/staff.

Publications

Neurological Institute staff authored ***241*** publications in 2016 as indexed within Web of Science.

Locations

For a complete listing of Neurological Institute locations, please visit clevelandclinic.org/neurolocations.



Additional Contact Information

General Patient Referral

24/7 hospital transfers or physician consults

800.553.5056

General Information

216.444.2200

Hospital Patient Information

216.444.2000

General Patient Appointments

216.444.2273 or 800.223.2273

Referring Physician Center and Hotline

855.REFER.123 (855.733.3712)

Or email refdr@ccf.org or visit clevelandclinic.org/refer123

Request for Medical Records

216.444.2640 or
800.223.2273, ext. 42640

Same-Day Appointments

216.444.CARE (2273)

Global Patient Services/ International Center

Complimentary assistance for international patients and families

001.216.444.8184 or visit clevelandclinic.org/gps

Medical Concierge

Complimentary assistance for out-of-state patients and families

800.223.2273, ext. 55580, or email medicalconcierge@ccf.org

Cleveland Clinic Abu Dhabi

clevelandclinicabudhabi.ae

Cleveland Clinic Canada

888.507.6885

Cleveland Clinic Florida

866.293.7866

Cleveland Clinic Nevada

702.796.8669

For address corrections or changes, please call

800.890.2467

About Cleveland Clinic

Overview

Cleveland Clinic is an academic medical center offering patient care services supported by research and education in a nonprofit group practice setting. More than 3500 Cleveland Clinic staff physicians and scientists in 140 medical specialties and subspecialties care for more than 7.1 million patients across the system annually, performing nearly 208,000 surgeries and conducting more than 652,000 emergency department visits. Patients come to Cleveland Clinic from all 50 states and 185 nations. Cleveland Clinic's CMS case-mix index is the second-highest in the nation.

Cleveland Clinic is an integrated healthcare delivery system with local, national, and international reach. The main campus in midtown Cleveland, Ohio, has a 1400-bed hospital, outpatient clinic, specialty institutes, labs, classrooms, and research facilities in 44 buildings on 167 acres. Cleveland Clinic has more than 150 northern Ohio outpatient locations, including 10 regional hospitals, 18 full-service family health centers, 3 health and wellness centers, an affiliate hospital, and a rehabilitation hospital for children. Cleveland Clinic also includes Cleveland Clinic Florida; Cleveland Clinic Nevada; Cleveland Clinic Canada; Cleveland Clinic Abu Dhabi, UAE; Sheikh Khalifa Medical City (management contract), UAE; and Cleveland Clinic London (opening in 2020). Cleveland Clinic is the largest employer in Ohio, with more than 51,000 employees. It generates $12.6 billion of economic activity a year.

Cleveland Clinic supports physician education, training, consulting, and patient services around the world through representatives in the Dominican Republic, Guatemala, India, Panama, Peru, Saudi Arabia, and the United Arab Emirates. Dedicated Global Patient Services offices are located at Cleveland Clinic's main campus, Cleveland Clinic Abu Dhabi, Cleveland Clinic Canada, and Cleveland Clinic Florida.

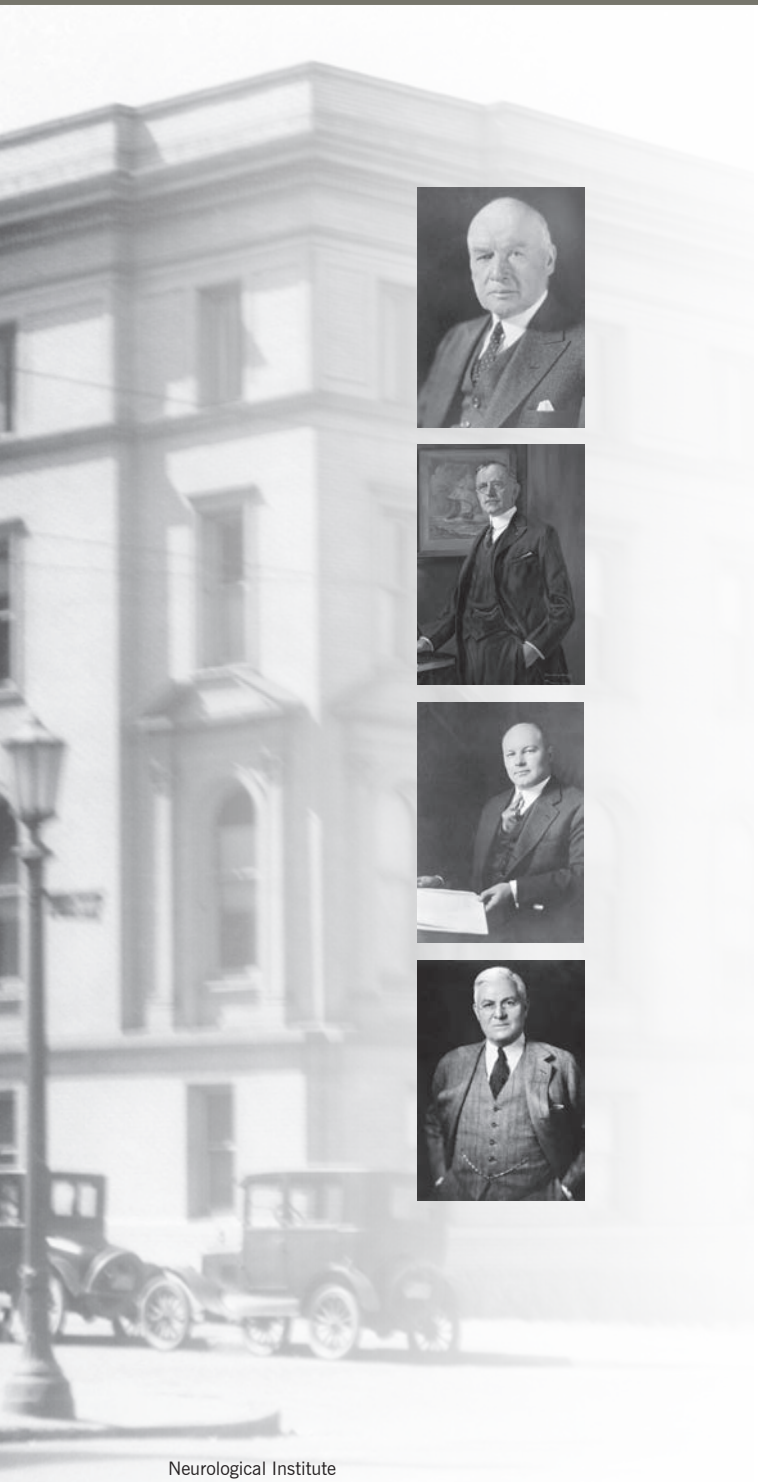
Cleveland Clinic was founded in 1921 by 4 physicians who had served in World War I and hoped to replicate the organizational efficiency of military medicine. The organization has grown through the years by adhering to the nonprofit, multispecialty group practice they established. All Cleveland Clinic staff physicians receive a straight salary with no bonuses or other financial incentives. The hospital and physicians share a financial interest in controlling costs, and profits are reinvested in research and education.

Cleveland Clinic Florida was established in 1987. Cleveland Clinic began opening family health centers in surrounding communities in the 1990s. Marymount Hospital joined Cleveland Clinic in 1995, followed by regional hospitals including Euclid Hospital, Fairview Hospital, Hillcrest Hospital, Lutheran Hospital, Medina Hospital, South Pointe Hospital, and affiliate Ashtabula County Medical Center. In 2015, the Akron General Health System joined the Cleveland Clinic health system.

Internally, Cleveland Clinic services are organized into patient-centered integrated practice units called institutes, each institute combining medical and surgical care for a specific disease or body system. Cleveland Clinic was among the first academic medical centers to establish an Office of Patient Experience, to promote comfort, courtesy, and empathy across all patient care services.

A Clinically Integrated Network

Cleveland Clinic is committed to providing value-based care, and it has grown the Cleveland Clinic Quality Alliance into the nation's second-largest, and northeast Ohio's largest, clinically integrated network. The network comprises more than 6300 physician members, including both Cleveland Clinic staff and independent physicians from the community. Led by its physician members, the Quality Alliance strives to improve quality and consistency of care; reduce costs and increase efficiency; and provide access to expertise, data, and experience.



Cleveland Clinic Lerner College of Medicine

Lerner College of Medicine is known for its small class sizes, unique curriculum, and full-tuition scholarships for all students. Each new class accepts 32 students who are preparing to be physician investigators. In 2015, Cleveland Clinic broke ground on a 477,000-square-foot multidisciplinary Health Education Campus. The campus, which will open in July 2019, will serve as the new home of the Case Western Reserve University (CWRU) School of Medicine and Cleveland Clinic's Lerner College of Medicine, as well as the CWRU School of Dental Medicine, the Frances Payne Bolton School of Nursing, and physician assistant and allied health training programs.

Graduate Medical Education

In 2016, nearly 2000 residents and fellows trained at Cleveland Clinic and Cleveland Clinic Florida in our continually growing programs.

U.S. News & World Report Ranking

Cleveland Clinic is ranked the No. 2 hospital in America by U.S. News & World Report (2016). It has ranked No. 1 in heart care and heart surgery since 1995. In 2016, 3 of its programs were ranked No. 2 in the nation: gastroenterology and GI surgery, nephrology, and urology. Ranked among the nation's top five were gynecology, orthopaedics, rheumatology, pulmonology, and diabetes and endocrinology.

Cleveland Clinic Physician Ratings

Cleveland Clinic believes in transparency and in the positive influence of the physician-patient relationship on healthcare outcomes. To continue to meet the highest standards of patient satisfaction, Cleveland Clinic physician ratings, based on nationally recognized Press Ganey patient satisfaction surveys, are published online at clevelandclinic.org/staff.

Resources

Referring Physician Center and Hotline

Call us 24/7 for access to medical services or to schedule patient appointments at 855.REFER.123 (855.733.3712), email refdr@ccf.org, or go to clevelandclinic.org/Refer123. The free Cleveland Clinic Physician Referral App, available for mobile devices, gives you 1-click access. Available in the App Store or Google Play.

Remote Consults

Anybody anywhere can get an online second opinion from a Cleveland Clinic specialist through our MyConsult service. For more information, go to clevelandclinic.org/myconsult, email myconsult@ccf.org, or call 800.223.2273, ext. 43223.

Request Medical Records

216.444.2640 or 800.223.2273, ext. 42640

Track Your Patients' Care Online

Cleveland Clinic offers an array of secure online services that allow referring physicians to monitor their patients' treatment while under Cleveland Clinic care and gives them access to test results, medications, and treatment plans. my.clevelandclinic.org/online-services

Dr**Connect** (online access to patients' treatment progress while under referred care): call 877.224.7367, email drconnect@ccf.org, or visit clevelandclinic.org/drconnect.

MyPractice Community (affordable electronic medical records system for physicians in private practice): 216.448.4617.

eRadiology (teleradiology consultation provided nationwide by board-certified radiologists with specialty training, within 24 hours or stat): call 216.986.2915 or email starimaging@ccf.org.

Medical Records Online

Patients can view portions of their medical record, receive diagnostic images and test results, make appointments, and renew prescriptions through MyChart, a secure online portal. All new Cleveland Clinic patients are automatically registered for My**Chart**. clevelandclinic.org/mychart

Access

Cleveland Clinic is committed to convenient access, offering virtual visits, shared medical appointments, and walk-in urgent care for your patients. clevelandclinic.org/access

Critical Care Transport Worldwide

Cleveland Clinic's fleet of ground and air transport vehicles is ready to transfer patients at any level of acuity anywhere on Earth. Specially trained crews provide Cleveland Clinic care protocols from first contact. To arrange a transfer for STEMI (ST-elevation myocardial infarction), acute stroke, ICH (intracerebral hemorrhage), SAH (subarachnoid hemorrhage), or aortic syndrome, call 877.379. CODE (2633). For all other critical care transfers, call 216.444.8302 or 800.553.5056.

CME Opportunities: Live and Online

Cleveland Clinic's Center for Continuing Education operates the largest CME program in the country. Live courses are offered in Cleveland and cities around the nation and the world. The center's website (ccfcme.org) is an educational resource for healthcare providers and the public. It has a calendar of upcoming courses, online programs on topics in 30 areas, and the award-winning virtual textbook of medicine, The Disease Management Project.

Clinical Trials

Cleveland Clinic is running more than 2200 clinical trials at any given time for conditions including breast and liver cancer, coronary artery disease, heart failure, epilepsy, Parkinson disease, chronic obstructive pulmonary disease, asthma, high blood pressure, diabetes, depression, and eating disorders. Cancer Clinical Trials is a mobile app that provides information on the more than 200 active clinical trials available to cancer patients at Cleveland Clinic. clevelandclinic.org/cancertrialapp

Healthcare Executive Education

Cleveland Clinic has programs to share its expertise in operating a successful major medical center. The Executive Visitors' Program is an intensive, 3-day behind-the-scenes view of the Cleveland Clinic organization for the busy executive. The Samson Global Leadership Academy is a 2-week immersion in challenges of leadership, management, and innovation taught by Cleveland Clinic leaders, administrators, and clinicians. Curriculum includes coaching and a personalized 3-year leadership development plan.
clevelandclinic.org/executiveeducation

Consult QD Physician Blog

A website from Cleveland Clinic for physicians and healthcare professionals. Discover the latest research insights, innovations, treatment trends, and more for all specialties. consultqd.clevelandclinic.org

Social Media

Cleveland Clinic uses social media to help caregivers everywhere provide better patient care. Millions of people currently like, friend, or link to Cleveland Clinic social media — including leaders in medicine.

Facebook for Medical Professionals
facebook.com/CMEclevelandclinic

Follow us on Twitter
@cleclinicMD

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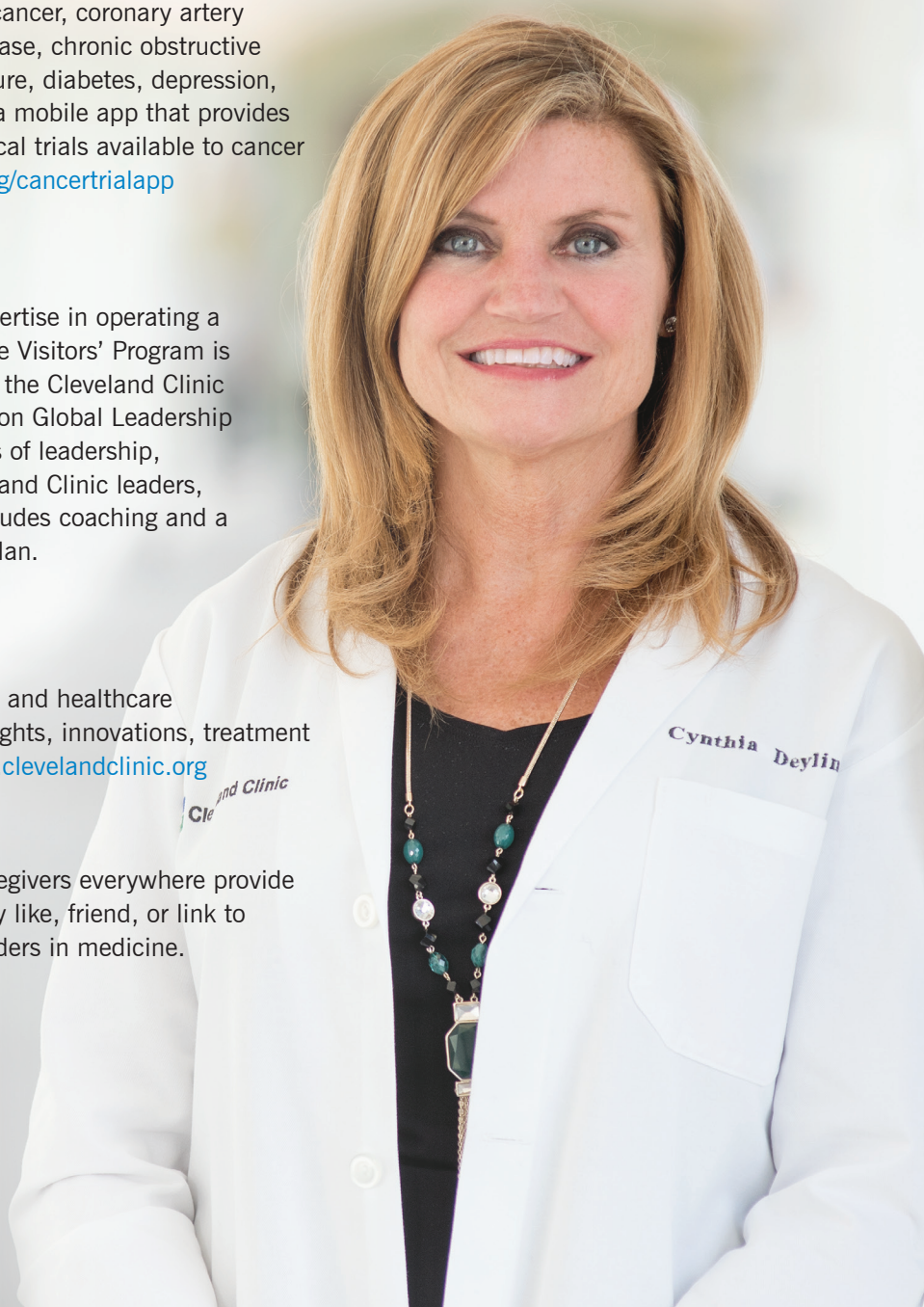

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Every life deserves world class care.

This project would not have been possible without the commitment and expertise of many individuals, but in particular Irene Katzan, MD; Christine Moore; Janet Perryman; Ken Kula; Steven Shook, MD; Nicholas Thompson; and John Urchek.

Graphic design and photography were provided by Cleveland Clinic's Center for Medical Art and Photography.

Photo on p. 4 by Russell Lee.

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