To promote quality improvement, Cleveland Clinic has created a series of Outcomes books similar to this one for many of its institutes. Designed for a physician audience, the Outcomes books contain a summary of our surgical and medical trends and approaches, data on patient volumes and outcomes, and a review of new technologies and innovations.

Although we are unable to report all outcomes for all treatments provided at Cleveland Clinic — omission of outcomes for a particular treatment does not necessarily mean we do not offer that treatment — our goal is to increase outcomes reporting each year. When outcomes for a specific treatment are unavailable, we often report process measures associated with improved outcomes. When process measures are unavailable, we may report volume measures; a volume/outcome relationship has been demonstrated for many treatments, particularly those involving surgical techniques.

In addition to our internal efforts to measure clinical quality, Cleveland Clinic supports transparent public reporting of healthcare quality data and participates in the following public reporting initiatives:

- Joint Commission Performance Measurement Initiative (qualitycheck.org)
- Centers for Medicare & Medicaid Services (CMS) Hospital Compare (hospitalcompare.hhs.gov)
- Ohio Department of Health (ohiohospitalcompare.ohio.gov)
- Cleveland Clinic Quality Performance Report (clevelandclinic.org/QPR)

Our commitment to providing accurate, timely information about patient care also will help patients and referring physicians make informed healthcare decisions.

We hope you find these data valuable, and we invite your feedback. Please send comments and suggestions to us at OutcomesBookFeedback@ccf.org. To view all our Outcomes books, please visit Cleveland Clinic’s Quality and Patient Safety website at clevelandclinic.org/outcomes.
Dear Colleague:

Welcome to Cleveland Clinic’s 2011 Outcomes books. They include data on clinical outcomes, patient volumes, innovations and publications. Cleveland Clinic pioneered the collection and annual publication of outcomes data. This initiative has become part of the national discussion on lowering costs and improving the quality of healthcare.

Cleveland Clinic uses data to manage outcomes across the full continuum of care. Clinical services are delivered through patient-centered institutes, each based around a single disease or organ system. Institutes combine medical and surgical services, along with research and education, under unified leadership. Each institute defines quality benchmarks for its specialty services and reports longitudinal progress.

Cleveland Clinic Outcomes books are available in print and online. Additional data is available through our online Quality Performance Report (clevelandclinic.org/QPR). The site offers data in advance of national and state public reporting sites in key areas, including heart attack, heart failure, stroke and infection prevention.

We hope you will find this information useful.

Sincerely,

Delos M. Cosgrove, MD
CEO and President
Prefer an e-version?

Visit clevelandclinic.org/OutcomesOnline, and we’ll remove you from the hard copy mailing list and email you when next year’s books are online.

what’s inside

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Dear Colleagues,

I am happy to again share with you the annual outcomes data from Cleveland Clinic’s Neurological Institute. This report is an important component of our continuous efforts to longitudinally monitor validated health status measures through our Knowledge Program® interactive patient database.

A major force behind these efforts is the imperative toward value-driven healthcare. That imperative is the foundation for Cleveland Clinic’s institute-based structure and informs much of what is reported and described in this book.

Value in healthcare means taking care of patients in the right way and at the right place so that outcomes are optimized while costs are rationalized and fully appropriate for the level of care needed. Further refining our structure and systems to consistently deliver care in that way has been the Neurological Institute’s focus in the past year. Our sights remain fixed on the fundamental value equation that places outcomes (defined as validated measures of health status, process and patient experience) over costs (defined as event costs, episode costs and per-capita costs.)
Our institute structure aids our efforts to optimize that value equation by allowing us to provide organized subspecialty extensions in various geographic locales, both at regional hospitals in Northeast Ohio and at our locations in Las Vegas and Florida. The tremendous growth of our Center for Regional Neurosciences in recent years, including 2011, has provided the scale needed to enhance our offerings in equipment and technology as well as in the number and geographic reach of providers with highly specialized training. Similarly, our recent launch of a clinical trials network across our locations in three states is speeding patient enrollment in trials of needed therapies for neurocognitive diseases.

In the past year our attention has increasingly turned toward the postacute care space – venues such as skilled nursing facilities, rehabilitation settings and home care. We are focusing more on standardizing care, reducing variability and extending care paths to these venues in an effort to further improve outcomes and define the continuum of care as comprehensively as possible. This focus brings the challenge of ensuring optimal connectivity of these settings to the rest of the care spectrum to enable standardization of care and seamless measuring of outcomes.

That is a challenge we are eager to address moving forward, but of course the entire quest for value in healthcare is – and will remain – a work in progress. This report serves as a snapshot of where the Neurological Institute stands in this quest as of 2011. I invite you to take a look and to let us know if we can assist with your patients’ neurological needs. As always, we welcome your comments.

Michael T. Modic, MD, FACR
Chairman, Neurological Institute
Cleveland Clinic’s multidisciplinary Neurological Institute includes more than 300 medical, surgical and research specialists dedicated to the diagnosis, treatment and rehabilitation of adult and pediatric patients with disorders of the brain and central nervous system. Our institute model allows patients to access the care they need through 16 specialized, disease-specific centers that integrate the expertise of neurologists, neurosurgeons, orthopaedic surgeons, psychiatrists, psychologists, physiatrists, neuroradiologists and allied health professionals. This model also promotes collaboration and ongoing measurement of quality and outcomes.

U.S. News & World Report’s “America’s Best Hospitals” survey has consistently ranked both our adult and pediatric neurology and neurosurgery programs among the top 10 in the nation. These programs, as well as our psychiatry program, are the top-ranked programs in Ohio in their respective categories.

The Neurological Institute consists of the following centers and departments that integrate clinical care with academic training and research:

<table>
<thead>
<tr>
<th>Center Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center</td>
</tr>
<tr>
<td>Center for Behavioral Health</td>
</tr>
<tr>
<td>Lou Ruvo Center for Brain Health</td>
</tr>
<tr>
<td>Cerebrovascular Center</td>
</tr>
<tr>
<td>Center for Home Care and Community Rehabilitation</td>
</tr>
<tr>
<td>Epilepsy Center</td>
</tr>
<tr>
<td>Mellen Center for Multiple Sclerosis Treatment and Research</td>
</tr>
<tr>
<td>Center for Neuroimaging</td>
</tr>
<tr>
<td>Center for Neurological Restoration</td>
</tr>
<tr>
<td>Neurological Center for Pain</td>
</tr>
<tr>
<td>Neuromuscular Center</td>
</tr>
<tr>
<td>Center for Pediatric Neurology and Neurosurgery</td>
</tr>
<tr>
<td>Department of Physical Medicine and Rehabilitation</td>
</tr>
<tr>
<td>Center for Regional Neurosciences</td>
</tr>
<tr>
<td>Sleep Disorders Center</td>
</tr>
<tr>
<td>Center for Spine Health</td>
</tr>
</tbody>
</table>
We provide care across the spectrum of neurological and psychiatric disorders, including:

<table>
<thead>
<tr>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary and metastatic tumors of the brain, spine and nerves</td>
</tr>
<tr>
<td>Pediatric and adult epilepsy</td>
</tr>
<tr>
<td>Headache, facial pain syndromes and associated disorders</td>
</tr>
<tr>
<td>Chronic intractable pain syndromes</td>
</tr>
<tr>
<td>Movement disorders such as Parkinson’s disease, essential tremor and dystonia</td>
</tr>
<tr>
<td>Neurocognitive disorders</td>
</tr>
<tr>
<td>Cerebral palsy and spasticity</td>
</tr>
<tr>
<td>Hydrocephalus</td>
</tr>
<tr>
<td>Metabolic and mitochondrial disease</td>
</tr>
<tr>
<td>Fetal and neonatal neurological problems</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
</tr>
<tr>
<td>Stroke, cerebral aneurysm, carotid stenosis and intracranial atherosclerosis</td>
</tr>
<tr>
<td>Brain and spinal vascular malformations</td>
</tr>
<tr>
<td>Nerve and muscle diseases, including amyotrophic lateral sclerosis, peripheral neuropathy, myasthenia gravis and myopathies</td>
</tr>
<tr>
<td>Sleep disorders</td>
</tr>
<tr>
<td>Mental/behavioral health disorders and chemical dependency</td>
</tr>
<tr>
<td>Impairments and disabilities in mobility, self-care, communication, swallowing and cognition</td>
</tr>
</tbody>
</table>
Specialized Diagnostic Expertise and Equipment

Neurological Institute physicians draw on advanced diagnostic capabilities and experience. Our imaging services include structural and functional MRI, CT, PET, SPECT, myelography, diagnostic cerebral/spinal angiography, interventional endovascular neuroradiology, and carotid and transcranial Doppler ultrasonography. Our neuroimaging experts subspecialize in specific conditions such as epilepsy and cerebrovascular disease, ensuring accurate, in-depth interpretations.

Additional diagnostic tools are found in our epilepsy monitoring units, sleep laboratories, neuropsychological testing facilities, electromyography laboratory, autonomic laboratory and cutaneous nerve laboratory.

The Newest Treatment Methods

Patients can take advantage of leading-edge treatment options at the Neurological Institute, where we continue to advance such innovations as deep brain stimulation (DBS), laser interstitial thermal therapy (LITT) for brain tumors, epilepsy surgery, stereotactic spine radiosurgery, endovascular treatment of cerebral aneurysms and vascular malformations, and neuroendoscopy. The Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center was one of the first such facilities worldwide to integrate the newest intraoperative MRI technology with its pioneering LITT capability to enhance brain tumor treatment. The interventional MRI suite accommodates many other neurosurgical procedures as well, including epilepsy and DBS surgery.

Cleveland Clinic’s main campus and seven of our community hospitals are Joint Commission-designated Primary Stroke Centers, in keeping with our institute’s efforts to standardize stroke treatment protocols across our health system. We are developing structured care paths for additional disorders — a critical step in bridging geography to deliver high-quality, patient-centered care and to function as an integrated enterprise.

Relevant, Wide-Ranging Research

We conduct research directly related to the conditions experienced by our patients. Our neuroscientists pursue translational research, clinical trials of drugs and devices, neuroimaging research, epidemiology and health outcomes studies, behavioral and psychiatric trials and investigations into better diagnostic methods. In 2011, the Neurological Institute conducted some 220 clinical trials supported by more than $19.6 million in neurology-based grants from government and industry.

Concussion and head injury have been the focus of much recent research activity. Neurological Institute investigators are active contributors to an intense interdisciplinary research collaboration at Cleveland Clinic to develop better tools to prevent, diagnose and treat concussion. Related work at the institute is benchmarking protective sports headgear and
developing novel equipment to prevent, diagnose and pinpoint head injuries in athletes. The Lou Ruvo Center for Brain Health has launched a four-year study using annual MRI scans to assess the chronic neurological effects of repeated blows to the head in boxers and mixed martial arts fighters.

The Lou Ruvo Center has also initiated a four-site clinical trial network across three states in Cleveland Clinic health system to broaden and expedite patient recruitment for clinical studies of movement disorders, Alzheimer’s disease and dementia.

**Convenient, Comprehensive Community Care**

We are committed to making access to world-class care convenient for all our patients. Regional facilities extend advanced treatments, technologies and the expertise of Neurological Institute physicians to community hospitals and family health centers throughout Cleveland Clinic health system. As a result, patients can easily access specialists who manage the most complex neurological conditions.

Key components of our regional network include:

- Cleveland Clinic Neurological Institute at Lakewood and Hillcrest hospitals, which provide comprehensive, state-of-the-art services to Cleveland’s suburban residents
- Cleveland Clinic Rehabilitation Hospitals, with nearly 100 acute inpatient rehabilitation beds at facilities across Northeast Ohio
- Cleveland Clinic Rehabilitation and Sports Therapy, a consortium with Cleveland Clinic’s Orthopaedic & Rheumatologic Institute that engages more than 650 physical and occupational therapists across the region
- Center for Home Care and Community Rehabilitation, which brings in-home and distance healthcare to patients in 14 Ohio counties and provides home infusion/pharmacy services in eight states
- Sleep Disorders Center, which conducts overnight sleep studies at nine locations throughout the community, including six conveniently located hotels
- Cleveland Clinic Pediatric Neurology and Neurosurgery services, which are provided at Fairview and Hillcrest hospitals and several family health centers, our pediatric rehabilitation hospital at Shaker Campus and the Lerner Autism School
Extending Our Services

Neurological Institute services extend beyond the region. The Lou Ruvo Center for Brain Health diagnoses, treats and researches Alzheimer’s disease and other neurocognitive disorders from locations in Cleveland and Lakewood, Ohio, as well as Las Vegas, Nevada. Diagnostic tests performed in Nevada are digitally transferred to our main campus and other Cleveland Clinic sites for interpretation by one of the world’s leading neuroimaging centers. At Cleveland Clinic Florida, epileptologists work with their colleagues at the Cleveland Clinic Epilepsy Center to diagnose and treat adults with epilepsy. All Florida epileptologists have dual appointments with the Neurological Institute in Cleveland.

In addition, our Cerebrovascular Center’s Telestroke Network offers medical staff at other hospitals remote access to patient consultation services from our neurological specialists. The network is enabled with a mobile, two-way videoconferencing system and a dedicated link for transmitting imaging studies.

Integrated Nursing Services

The Neurological Institute integrates inpatient and ambulatory nursing to enhance the continuum of patient care. Nurses in the institute engage in problem solving and process improvement. Experienced nurses are encouraged to advance to certification in neuroscience nursing, enabling them to staff areas such as the neurological intensive care and stepdown units. This broad deployment of our nursing talent promotes greater information sharing among providers and improved coordination of care.

Specialized nursing care has been further enhanced by recent reorganization of our hospital beds into “pods” that place patients with similar conditions in blocks of neighboring rooms to enable closer monitoring by nurses with expertise in their condition.

Pioneering Collection of Data and Outcomes

The Neurological Institute’s Knowledge Program® has captured data from more than 1 million self-administered patient questionnaires. One of the world’s first interactive clinical patient databases, the Knowledge Program is demonstrating its value as it evolves, collecting and correlating information on patient health status, quality of life and outcomes.

We are aggregating these patient-generated data with information from other sources (imaging results, data from patient encounters, etc.) to optimize clinical decision making, quality improvement and research opportunities. All of these data are accessible to our physicians through an interface with the patient’s electronic medical record.

The Knowledge Program is one of our latest and most constructive tools for delivering individualized care to improve outcomes and quality of life, in keeping with Cleveland Clinic’s guiding principle: Patients First.
### 2011 Statistical Highlights

<table>
<thead>
<tr>
<th>Role</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff Physicians</td>
<td>249</td>
</tr>
<tr>
<td>Clinical Residents and Fellows</td>
<td>142</td>
</tr>
<tr>
<td>Research Fellows</td>
<td>18</td>
</tr>
<tr>
<td>Advanced Practice Nurses</td>
<td>42</td>
</tr>
<tr>
<td>Physician Assistants</td>
<td>20</td>
</tr>
<tr>
<td>Medical Students (Neuro Rotation)</td>
<td>81</td>
</tr>
</tbody>
</table>

### Inpatient Facilities (Cleveland Clinic Main Campus)

<table>
<thead>
<tr>
<th>Bed Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient General Neuro Beds</td>
<td>50</td>
</tr>
<tr>
<td>Neuro ICU Beds</td>
<td>22</td>
</tr>
<tr>
<td>Neuro Step-Down Beds</td>
<td>17</td>
</tr>
<tr>
<td>Epilepsy Monitoring Unit Beds – Pediatrics</td>
<td>9</td>
</tr>
<tr>
<td>Epilepsy Monitoring Unit Beds – Adult</td>
<td>14</td>
</tr>
<tr>
<td>Chemical Dependency Unit Beds</td>
<td>13</td>
</tr>
<tr>
<td>Inpatient Rehabilitation Beds</td>
<td>12</td>
</tr>
</tbody>
</table>

### Inpatient Facilities (Cleveland Clinic Community Hospitals)

<table>
<thead>
<tr>
<th>Bed Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychiatric Unit Beds</td>
<td>260</td>
</tr>
<tr>
<td>Rehabilitation Beds</td>
<td>81</td>
</tr>
<tr>
<td>Skilled Nursing Unit Beds</td>
<td>96</td>
</tr>
</tbody>
</table>
### Initial Outpatient Visits
(by Center/Department)*

<table>
<thead>
<tr>
<th>Center/Department</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Health</td>
<td>1,394</td>
</tr>
<tr>
<td>Brain Tumor Neuro-Oncology</td>
<td>352</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>318</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>731</td>
</tr>
<tr>
<td>Mellen / Multiple Sclerosis</td>
<td>709</td>
</tr>
<tr>
<td>Neurological Restoration</td>
<td>462</td>
</tr>
<tr>
<td>Neurology</td>
<td>558</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>838</td>
</tr>
<tr>
<td>Pain and Headache</td>
<td>783</td>
</tr>
<tr>
<td>Pediatric Neurology**</td>
<td>720</td>
</tr>
<tr>
<td>Pediatric Neurosurgery**</td>
<td>172</td>
</tr>
<tr>
<td>Physical Medicine and Rehabilitation</td>
<td>331</td>
</tr>
<tr>
<td>Psychiatry and Psychology</td>
<td>409</td>
</tr>
<tr>
<td>Regional Neurosciences</td>
<td>1,357</td>
</tr>
<tr>
<td>Sleep</td>
<td>164</td>
</tr>
<tr>
<td>Spine</td>
<td>1,693</td>
</tr>
</tbody>
</table>

**Initial visits for patients new to Cleveland Clinic.**

### Total Outpatient Visits
(by Center/Department)

<table>
<thead>
<tr>
<th>Center/Department</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Health</td>
<td>5,485</td>
</tr>
<tr>
<td>Brain Tumor Neuro-Oncology</td>
<td>6,631</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>4,219</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>8,712</td>
</tr>
<tr>
<td>Mellen / Multiple Sclerosis</td>
<td>5,598</td>
</tr>
<tr>
<td>Neurological Restoration</td>
<td>6,293</td>
</tr>
<tr>
<td>Neurology</td>
<td>4,311</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>5,935</td>
</tr>
<tr>
<td>Pain and Headache</td>
<td>12,399</td>
</tr>
<tr>
<td>Pediatric Neurology**</td>
<td>8,480</td>
</tr>
<tr>
<td>Pediatric Neurosurgery**</td>
<td>2,127</td>
</tr>
<tr>
<td>Physical Medicine and Rehabilitation</td>
<td>4,819</td>
</tr>
<tr>
<td>Psychiatry and Psychology</td>
<td>48,671</td>
</tr>
<tr>
<td>Regional Neurosciences</td>
<td>28,300</td>
</tr>
<tr>
<td>Sleep</td>
<td>5,279</td>
</tr>
<tr>
<td>Spine</td>
<td>29,407</td>
</tr>
</tbody>
</table>

**Children and adolescents are also included under Epilepsy, Psychiatry and Psychology, and Sleep.**
### Admissions

<table>
<thead>
<tr>
<th>Neurological Institute</th>
<th>16,597</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Tumor Neuro-Oncology</td>
<td>854</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>1,499</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>1,517</td>
</tr>
<tr>
<td>Neurological Restoration</td>
<td>243</td>
</tr>
<tr>
<td>Neurology</td>
<td>646</td>
</tr>
<tr>
<td>Pediatric Neurology*</td>
<td>142</td>
</tr>
<tr>
<td>Pediatric Neurosurgery*</td>
<td>429</td>
</tr>
<tr>
<td>Physical Medicine and Rehabilitation</td>
<td>340</td>
</tr>
<tr>
<td>Psychiatry and Psychology**</td>
<td>9,564</td>
</tr>
<tr>
<td>Regional Neurosciences</td>
<td>118</td>
</tr>
<tr>
<td>Spine</td>
<td>1,245</td>
</tr>
</tbody>
</table>

### Surgical/Interventional Procedures

<table>
<thead>
<tr>
<th>Neurological Institute</th>
<th>9,684</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Tumor Neuro-Oncology</td>
<td>1,019</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>1,002</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>637</td>
</tr>
<tr>
<td>Neurological Restoration</td>
<td>463</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>49</td>
</tr>
<tr>
<td>Pain and Headache</td>
<td>44</td>
</tr>
<tr>
<td>Pediatric Neurology</td>
<td>33</td>
</tr>
<tr>
<td>Pediatric Neurosurgery</td>
<td>441</td>
</tr>
<tr>
<td>Regional Neurosciences</td>
<td>1,435</td>
</tr>
<tr>
<td>Spine</td>
<td>4,561</td>
</tr>
</tbody>
</table>

### Inpatient Days

<table>
<thead>
<tr>
<th>Neurological Institute</th>
<th>100,469</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Tumor Neuro-Oncology</td>
<td>3,644</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>9,537</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>7,037</td>
</tr>
<tr>
<td>Neurological Restoration</td>
<td>893</td>
</tr>
<tr>
<td>Neurology</td>
<td>3,244</td>
</tr>
<tr>
<td>Pediatric Neurology*</td>
<td>567</td>
</tr>
<tr>
<td>Pediatric Neurosurgery*</td>
<td>2,116</td>
</tr>
<tr>
<td>Physical Medicine and Rehabilitation</td>
<td>3,984</td>
</tr>
<tr>
<td>Psychiatry and Psychology**</td>
<td>63,365</td>
</tr>
<tr>
<td>Regional Neurosciences</td>
<td>491</td>
</tr>
<tr>
<td>Spine</td>
<td>5,591</td>
</tr>
</tbody>
</table>

### Neuroimaging Studies***

<table>
<thead>
<tr>
<th>Neurological Institute</th>
<th>31,101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CT Brain Scans</td>
<td>31,101</td>
</tr>
<tr>
<td>Total MR Brain Procedures</td>
<td>40,066</td>
</tr>
<tr>
<td>Total Cerebral Angio Procedures</td>
<td>5,389</td>
</tr>
</tbody>
</table>

---

* Children and adolescents are also included under Epilepsy and Psychiatry/Psychology.

** Includes totals from the following Cleveland Clinic community hospitals: Euclid, Fairview, Huron, Lakewood, Lutheran, Marymount and South Pointe.

*** Studies performed at main campus, Cleveland Clinic satellites and family health centers.
Recognizing that the presence of significant comorbidity affects overall care and eventual disease outcome, all Cleveland Clinic Neurological Institute patients are assessed for overall health status, including health-related quality of life and presence of mental health comorbidity such as depression.

To improve the evaluation of patient health statuses, the Knowledge Program© began in 2007 as a data capture initiative to collect patient- and provider-reported outcomes through the completion of Health Status Measures. At every outpatient visit, Health Status Measures are administered to patients electronically, while providers report outcomes during the usual medical documentation process. The Health Status Measure results are combined with data from existing clinical systems and consolidated into a single data repository called the Knowledge Program database. The program is designed to track individual patient progress over time, report disease-specific outcomes and conduct future research.

**Growth in Health Status Measures Data Collection in the Neurological Institute**

**Patient Visits (Thousands)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>40</td>
</tr>
<tr>
<td>2009</td>
<td>80</td>
</tr>
<tr>
<td>2010</td>
<td>120</td>
</tr>
<tr>
<td>2011</td>
<td>160</td>
</tr>
</tbody>
</table>

**Health Status Measures Completion Rates in the Neurological Institute**

**Completed (%)**

<table>
<thead>
<tr>
<th>Category</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient-reported</td>
<td>77%</td>
</tr>
<tr>
<td>Provider-reported</td>
<td>92%</td>
</tr>
<tr>
<td>Both</td>
<td>72%</td>
</tr>
</tbody>
</table>

For most diseases, Health Status Measures consist of both patient-reported and provider-reported outcomes data. In 2011, patient-reported outcomes were collected at 77 percent of outpatient visits, provider-reported outcomes were collected at 92 percent of outpatient visits, and 72 percent of outpatient visits had both patient- and provider-reported outcomes collected.
The EuroQOL (EQ-5D™) is a five-item, validated, self-reported, generic, health-related quality-of-life measure that has been used to assess individuals with a variety of medical conditions as well as the general population. The EQ-5D assesses five domains: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. A score of 1.0 indicates the best imaginable health state and 0 indicates death.

**Quality of Life by Neurological Disease Category**

2011

**Neurological Disease Category**

- Pain (N = 2,086)
- Spinal Disease (N = 28,275)
- Neuromuscular Disorders (N = 5,244)
- Movement Disorders (N = 5,903)
- Multiple Sclerosis (N = 8,568)
- Headache (N = 8,782)
- Cognitive Disorders (N = 4,226)
- Psychiatric & Psychological Disorders (N = 16,884)
- Cerebrovascular Disease (N = 3,714)
- Epilepsy (N = 4,816)
- Sleep Disorders (N = 6,318)

A cross-sectional analysis of health-related quality of life across multiple neurological disease categories suggests relatively lower health-related quality of life in patients with chronic pain and higher scores in those with sleep disorders.
The Patient Health Questionnaire (PHQ-9) is a nine-item, validated, self-reported screening instrument for depression that is based on the nine diagnostic criteria for depressive disorders according to the DSM-IV and indicates severity of depression symptoms. Scores range from 0 to 27, and scores of 5, 10, 15 and 20 reflect mild, moderate, moderately severe and severe depression, respectively.

**Depressive Symptoms by Neurological Disease Category**

2011

**Neurological Disease Category**

- Cerebrovascular Disease (N = 3,442)
- Epilepsy (N = 4,638)
- Spinal Disease (N = 22,522)
- Multiple Sclerosis (N = 8,047)
- Neuromuscular Disorders (N = 4,951)
- Movement Disorders (N = 5,472)
- Headache (N = 8,607)
- Cognitive Disorders (N = 4,086)
- Sleep Disorders (N = 6,148)
- Psychiatric & Psychological Disorders (N = 13,599)
- Pain (N = 1,728)

A cross-sectional analysis of depressive symptoms across multiple neurological disease categories suggests at least mild depression in all neurological diseases, with the most severe symptoms in those with chronic pain.
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 advancing novel treatment options emerging from the institute’s extensive basic and translational research programs. The primary missions are to offer excellent care through state-of-the-art surgical intervention and to conduct clinical research to enhance patient outcomes. BBTC enrolled over 200 patients in research trials in the last five years (2007 – 2011).

**Brain Tumor Diagnosis Distribution (N = 1,877)**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glioma</td>
<td>748, 40%</td>
</tr>
<tr>
<td>Metastasis</td>
<td>517, 28%</td>
</tr>
<tr>
<td>Meningioma</td>
<td>308, 16%</td>
</tr>
<tr>
<td>Pituitary Tumor</td>
<td>189, 10%</td>
</tr>
<tr>
<td>Schwannoma</td>
<td>115, 6%</td>
</tr>
</tbody>
</table>

Gliomas remain the most common brain tumor seen in patients, accounting for 40 percent of cases.

**Brain Tumor Procedures (N = 848)**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma Knife® Radiosurgery</td>
<td>382, 45%</td>
</tr>
<tr>
<td>Supratentorial Craniotomy</td>
<td>196, 23%</td>
</tr>
<tr>
<td>Novalis® Radiosurgery</td>
<td>121, 14%</td>
</tr>
<tr>
<td>Infratentorial Craniotomy</td>
<td>48, 6%</td>
</tr>
<tr>
<td>Pituitary Surgery</td>
<td>72, 9%</td>
</tr>
<tr>
<td>Brain Biopsy</td>
<td>29, 3%</td>
</tr>
</tbody>
</table>

Gamma Knife® radiosurgery was the most common procedure in 2011, followed by supratentorial craniotomy and Novalis® stereotactic radiosurgery.
Brain Tumors

Brain Tumor Surgical Site Infection Rates

Surgical site infection rates remained under 5 percent in 2011. N = number of clean cases per year. Per Centers for Disease Control and Prevention (CDC) guidelines, “clean cases” are defined as uninfected operative wounds in which no inflammation is encountered and, in the case of brain tumor surgery, neither the respiratory nor the alimentary tract is entered.

Brain Biopsy

Brain Biopsy: Survival

Thirty-day and 180-day (for first six months of 2011) survival was 100 percent and 93 percent, respectively. N = number of brain biopsies performed per year.
Supratentorial Craniotomy

Supratentorial Craniotomy: Inpatient Mortality

Inpatient mortality remained significantly lower than predicted, continuing the trend over the past five years. N = number of supratentorial craniotomies performed for brain tumor per year. For this and all subsequent graphs, expected mortality is based on national normative data and All Patient Refined-Diagnosis Related Groups (APR-DRGs), a method of adjusting for severity of patient illness.1

Supratentorial Craniotomy: Length of Stay (LOS)

Mean length of stay (LOS) remained lower than expected in 2011. For this and all subsequent graphs, expected mean LOS is based on national normative data and APR-DRGs, a method of adjusting for severity of patient illness.1

1. http://solutions.3m.com/wps/portal/3M/en_US/3M_Health_Information_Systems/HIS/Products/APRDRG_Software/
Performance status, as measured by the Karnofsky Performance Scale (KPS), was stable or improved in over 82 percent of patients within 30 days of supratentorial craniotomy. Change in the KPS was defined as a change of 20 points or more.
Thirty- and 180-day (for the first six months of 2011) survival rates were 100 percent in 2011 for supratentorial craniotomy for metastasis and meningioma and showed improvement over last year.
Brain Tumors

Infratentorial Craniotomy

Infratentorial Craniotomy: Inpatient Mortality

Mortality (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>0.0</td>
<td>6.5</td>
</tr>
<tr>
<td>2010</td>
<td>0.0</td>
<td>6.5</td>
</tr>
<tr>
<td>2009</td>
<td>0.0</td>
<td>6.5</td>
</tr>
<tr>
<td>2008</td>
<td>2.0</td>
<td>6.5</td>
</tr>
<tr>
<td>2007</td>
<td>2.0</td>
<td>6.5</td>
</tr>
</tbody>
</table>

N = number of infratentorial craniotomies performed for brain tumor per year.

There have been only six inpatient deaths in those undergoing infratentorial craniotomy for brain tumor at Cleveland Clinic in the last five years, which is below the expected number based on national normative data.

Infratentorial Craniotomy: Length of Stay (LOS)

Mean LOS (Days)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>7.5</td>
<td>6.5</td>
</tr>
<tr>
<td>2010</td>
<td>7.5</td>
<td>6.5</td>
</tr>
<tr>
<td>2009</td>
<td>7.1</td>
<td>6.5</td>
</tr>
<tr>
<td>2008</td>
<td>6.6</td>
<td>6.5</td>
</tr>
<tr>
<td>2007</td>
<td>6.9</td>
<td>6.5</td>
</tr>
</tbody>
</table>
Infratentorial Craniotomy: Karnofsky Performance Scale (N = 35)

2011

Patients (%)

Performance status, as measured by the KPS, was stable or improved in over 85 percent of patients within 30 days of infratentorial craniotomy. Change in KPS status was defined as a change of 20 points or more.
Brain Tumors

Infratentorial Craniotomy: Survival by Tumor Type

### Glioma: Survival

<table>
<thead>
<tr>
<th>Year</th>
<th>30-Day N</th>
<th>180-Day N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>10</td>
<td>2010</td>
</tr>
<tr>
<td>2008</td>
<td>9</td>
<td>2007</td>
</tr>
<tr>
<td>2009</td>
<td>8</td>
<td>2008</td>
</tr>
<tr>
<td>2010</td>
<td>5</td>
<td>2009</td>
</tr>
<tr>
<td>2011</td>
<td>6</td>
<td>2010</td>
</tr>
</tbody>
</table>

### Meningioma: Survival

<table>
<thead>
<tr>
<th>Year</th>
<th>30-Day N</th>
<th>180-Day N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>5</td>
<td>2007</td>
</tr>
<tr>
<td>2008</td>
<td>5</td>
<td>2008</td>
</tr>
<tr>
<td>2009</td>
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<td>2009</td>
</tr>
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<td>2010</td>
<td>10</td>
<td>2010</td>
</tr>
<tr>
<td>2011</td>
<td>3</td>
<td>2011</td>
</tr>
</tbody>
</table>
Metastasis: Survival

Schwannoma: Survival

There were no schwannoma patients in 2010.
Brain Tumors

Pituitary Surgery

Pituitary Surgery: Inpatient Mortality

Mortality (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>2008</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>2009</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>2010</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>2011</td>
<td>0.8</td>
<td>2.0</td>
</tr>
</tbody>
</table>


Pituitary Surgery: Length of Stay (LOS)

Mean LOS (Days)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2008</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2009</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2010</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2011</td>
<td>2.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>


Inpatient mortality has remained low over the past five years, and actual LOS continues to be lower than expected LOS.
Thirty- and 180-day (for the first six months of 2011) survival was 99 percent in both categories. N = number of pituitary tumor surgeries per year with available data.

Pituitary Surgery: Karnofsky Performance Scale (N = 47)

In 98 percent of patients, performance status, as measured by the KPS, remained stable (68 percent) or improved (30 percent) within 30 days of pituitary surgery. Change in KPS status was defined as a change of 20 points or more.
**Stereotactic Radiosurgery: Gamma Knife®**

Thirty- and 180-day (for the first six months of 2011) survival rates remained high in 2011 for Gamma Knife® radiosurgery treatment, independent of tumor type.

**Gamma Knife® Radiosurgery: Meningioma Survival**

![Graph showing 30-Day and 180-Day survival rates for Meningioma from 2007 to 2011.](image)

**Gamma Knife® Radiosurgery: Schwannoma Survival**

![Graph showing 30-Day and 180-Day survival rates for Schwannoma from 2007 to 2011.](image)
Gamma Knife® Radiosurgery: Metastasis Survival

Survival (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>30-Day</th>
<th>180-Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>146</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>151</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>218</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>188</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>245</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gamma Knife® Radiosurgery: Pituitary Tumor Survival

Survival (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>30-Day</th>
<th>180-Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Brain Tumors

Stereotactic Radiosurgery: Novalis®

Novalis® Stereotactic Radiosurgery: Survival

![Survival Chart]

In 2011, 121 patients were treated with Novalis® stereotactic radiosurgery, 98 percent of whom were treated for metastatic tumors to the spine. Thirty- and 180-day (for the first six months of 2011) survival rates for these patients were 97.5 percent and 93.4 percent, respectively.
**Glioblastoma Multiforme**

In 2011, 55 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 = 560)**

2001 – 2008

![Graph showing survival rates for glioblastoma patients at Cleveland Clinic and reference data. The graph displays survival percentages over months since diagnosis, with Cleveland Clinic data as observed survival and reference data as relative survival.](image)

In the graph above, reference data represent relative survival, while Cleveland Clinic data are observed survival, which prevents formal statistical comparison.

**Cerebrovascular Disease**

<table>
<thead>
<tr>
<th>Clinical Measure</th>
<th>Measure Description</th>
<th>GWTG Stroke Performance Award Goal</th>
<th>National Average*</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IV rt-PA 2 Hour</strong></td>
<td>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.</td>
<td>85.0%</td>
<td>75.9%</td>
<td>88.9%</td>
<td>78.6%</td>
<td>86.7%</td>
<td>92.9%</td>
</tr>
<tr>
<td><strong>Early Antithrombotics</strong></td>
<td>Patients with ischemic stroke or TIA who receive antithrombotic therapy by the end of hospital day 2.</td>
<td>85.0%</td>
<td>96.7%</td>
<td>95.3%</td>
<td>97.5%</td>
<td>95.7%</td>
<td>93.9%</td>
</tr>
<tr>
<td><strong>Antithrombotics at Discharge</strong></td>
<td>Patients with ischemic stroke or TIA prescribed antithrombotic therapy at discharge (e.g., warfarin, aspirin, other antiplatelet drug).</td>
<td>85.0%</td>
<td>97.8%</td>
<td>99.7%</td>
<td>99.3%</td>
<td>99.6%</td>
<td>98.9%</td>
</tr>
<tr>
<td><strong>Anticoagulation for Atrial Fibrillation/ Atrial Flutter</strong></td>
<td>Patients with ischemic stroke or TIA with atrial fibrillation/ flutter who are discharged on anticoagulation therapy.</td>
<td>85.0%</td>
<td>93.5%</td>
<td>98.4%</td>
<td>98.7%</td>
<td>97.7%</td>
<td>94.9%</td>
</tr>
<tr>
<td><strong>DVT Prophylaxis</strong></td>
<td>Patients with ischemic stroke, TIA or a hemorrhagic stroke and who are non-ambulatory who receive DVT prophylaxis by end of hospital day 2.</td>
<td>85.0%</td>
<td>91.8%</td>
<td>97.4%</td>
<td>94.8%</td>
<td>93.8%</td>
<td>97.6%</td>
</tr>
<tr>
<td><strong>Lipids Measure (Statin at Discharge)</strong></td>
<td>Ischemic stroke or TIA patients with LDL &gt; 100, or LDL not measured, or on cholesterol-reducer prior to admission, discharged on cholesterol-reducing drugs.</td>
<td>85.0%</td>
<td>89.2%</td>
<td>88.1%</td>
<td>97.2%</td>
<td>97.1%</td>
<td>97.7%</td>
</tr>
<tr>
<td><strong>Smoking Cessation Counseling</strong></td>
<td>Patients with ischemic, TIA or hemorrhagic stroke with a history of smoking cigarettes, who are, or whose caregivers are, given smoking cessation counseling during hospital stay.</td>
<td>85.0%</td>
<td>96.8%</td>
<td>92.4%</td>
<td>92.9%</td>
<td>99.5%</td>
<td>99.5%</td>
</tr>
<tr>
<td><strong>Dysphagia Screening</strong></td>
<td>Patients with ischemic or hemorrhagic stroke who undergo screen for dysphagia with an evidence-based bedside testing protocol approved by the hospital before being given any food, fluids or medications by mouth.</td>
<td>85.0%</td>
<td>78.5%</td>
<td>67.9%</td>
<td>73.7%</td>
<td>84.8%</td>
<td>92.4%</td>
</tr>
<tr>
<td><strong>Stroke Education</strong></td>
<td>Patients with ischemic, TIA or hemorrhagic stroke or their caregivers who were given education and/or educational materials during the hospital stay.</td>
<td>85.0%</td>
<td>81.3%</td>
<td>41.4%</td>
<td>80.6%</td>
<td>89.9%</td>
<td>92.9%</td>
</tr>
<tr>
<td><strong>Rehabilitation Considered</strong></td>
<td>Patients with ischemic or hemorrhagic stroke who were assessed for rehabilitation services.</td>
<td>85.0%</td>
<td>96.6%</td>
<td>98.5%</td>
<td>96.5%</td>
<td>92.5%</td>
<td>85.3%</td>
</tr>
</tbody>
</table>

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 is the recipient of the GWTG Stroke Gold Plus Performance Achievement Award and uses the GWTG aggregate comparative data for internal quality improvement. Rates are taken from the GWTG-Joint Commission Primary Stroke Center Reporting Tool, "Consensus – GWTG/PAA Set," as of February 1, 2012.

Change in Outcomes After Acute Stroke

2009 – 2011

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. The sample size and mean duration to follow-up visit is shown beneath each index. The National Institutes of Health Stroke Scale (NIHSS) is a brief, reliable measure of severity of neurological impairment following stroke. The EuroQOL (EQ-5D) is a standardized measure of health status that provides a simple measure of health applicable to a wide range of conditions and treatments. The Patient Health Questionnaire (PHQ-9) is a self-reported measure of depression. The Barthel Index is a measure of disability widely used for stroke. The Stroke Impact Scale (SIS-16) assesses physical function. The modified Rankin Scale is a global disability scale for overall assessment of disability. All outcome measures, with the exception of the EQ-5D Healthstate 10% Index, are defined as improved or worsened if there is any change in the score. The EQ-5D Healthstate 10% Index is defined as improved or worsened if the change is more than 10 percent; otherwise, it is stable.
Ischemic Stroke

Ischemic Stroke: Length of Stay (LOS)

Mean LOS (Days)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>2009</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>2010</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2011</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Actual mean LOS has remained shorter than expected for ischemic stroke. For this and subsequent graphs, expected mean LOS is based on national normative data and APR-DRGs.¹

Ischemic Stroke: Inpatient Mortality

Number of Deaths

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
<th>SMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>65</td>
<td>80</td>
<td>0.52</td>
</tr>
<tr>
<td>2009</td>
<td>58</td>
<td>70</td>
<td>0.54</td>
</tr>
<tr>
<td>2010</td>
<td>50</td>
<td>60</td>
<td>0.56</td>
</tr>
<tr>
<td>2011</td>
<td>40</td>
<td>50</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Among inpatients treated for ischemic stroke at Cleveland Clinic, actual mortality remained below expected. For this and subsequent graphs, expected mortality is based on national normative data and APR-DRGs.¹

¹ solutions.3m.com/wps/portal/3M/en_US/3M_Health_Information_Systems/HIS/Products/APRDRG_Software/
Hemorrhagic Stroke

Intracerebral Hemorrhage: Length of Stay (LOS)

Mean LOS (Days)

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

Intracerebral Hemorrhage: Inpatient Mortality

Inpatient mortality for intracerebral hemorrhage has remained below the expected rate during the past four years.
Selecting Patients for Intra-arterial Therapy for Acute Ischemic Stroke

Despite national advances in the rate of vessel recanalization as a treatment for stroke, outcomes have not shown substantial improvement. Improved patient selection for intra-arterial therapy for acute ischemic stroke has the potential to reduce mortality and improve outcomes. Pretreatment magnetic resonance imaging (MRI) used to evaluate lesion volume as a predictor of outcome, termed the “hyperacute MRI protocol,” improves the ability to select patients who will benefit the most from intra-arterial therapy, and avoid intervention and potential harm in those patients with a low probability of benefit.

Pretreatment MRI and Patient Selection for Intra-arterial Therapy for Acute Ischemic Stroke (N = 267)

2006 – 2011

Patients Selected for Intra-arterial Therapy (%)

N = 171

Before MRI Protocol

100

90

80

70

60

50

40

30

20

10

0

After MRI Protocol

Using pretreatment brain MRI results to select patients who would benefit the most from intra-arterial therapy led to lower utilization rates.
Pretreatment MRI and Outcomes Following Intra-arterial Therapy for Acute Ischemic Stroke (N = 267)

2006 – 2011

**Median Modified Rankin Scale**

Comparing disability scores in 171 patients treated prior to implementation of the hyperacute MRI protocol to disability scores in 96 patients treated with the protocol, there is less disability in the MRI protocol group overall at the time of hospital discharge and at 30-day follow-up after acute ischemic stroke, irrespective of the treatment received.

Pretreatment MRI and Mortality Following Intra-arterial Therapy for Acute Ischemic Stroke (N = 267)

2006 – 2011

**30-Day Mortality (%)**

There were no statistical differences in the baseline risk factors, NIHSS or baseline modified Rankin Scale between the two groups. The hyperacute MRI protocol group of patients had reduced 30-day mortality, compared with patients treated before implementation of the protocol.
Cerebrovascular Disease

Subarachnoid Hemorrhage

Subarachnoid Hemorrhage: LOS

Mean LOS (Days)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Expected</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td>128</td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td>145</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td>170</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td>153</td>
</tr>
</tbody>
</table>

Subarachnoid Hemorrhage: Inpatient Mortality

Number of Deaths

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Deaths</th>
<th>Expected Deaths</th>
<th>SMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inpatient mortality due to subarachnoid hemorrhage remains below the expected rate.
Intracerebral Hemorrhage, Subarachnoid Hemorrhage and Ischemic Stroke: Discharge Status

2011

<table>
<thead>
<tr>
<th></th>
<th>Intracerebral Hemorrhage</th>
<th>Subarachnoid Hemorrhage</th>
<th>Ischemic Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Rehab</td>
<td>13%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Home</td>
<td>14%</td>
<td>31%</td>
<td>37%</td>
</tr>
<tr>
<td>Home with Home Health Services</td>
<td>5%</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>Skilled Nursing Facility/Interim Care</td>
<td>32%</td>
<td>19%</td>
<td>22%</td>
</tr>
<tr>
<td>Death</td>
<td>26%</td>
<td>21%</td>
<td>9%</td>
</tr>
<tr>
<td>Other</td>
<td>11%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Total Number of Patients</td>
<td>196</td>
<td>153</td>
<td>619</td>
</tr>
</tbody>
</table>

The national average for inpatient death following subarachnoid hemorrhage (ruptured aneurysm) was 29.4 percent in 1990-1991 and 26.5 percent in 2000-2001.²

The Cleveland Clinic Lou Ruvo Center for Brain Health (CCLRCBH) provides state-of-the-art care for patients with cognitive disorders and their family members. The physicians and staff at the CCLRCBH are working toward the development of early diagnosis, conducting clinical trials of promising new medications and advancing understanding of cognitive disorders. Data are presented for Center for Brain Health patients seen in three locations: Cleveland Clinic main campus, Cleveland Clinic Nevada and Cleveland Clinic Florida.

**Change in Health Status in Patients with Cognitive Disorders**

**October 2010 – November 2011**

### Patients (%)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQ-9 Score</td>
<td>1,248</td>
</tr>
<tr>
<td>EQ-5D Index Score</td>
<td>1,272</td>
</tr>
<tr>
<td>EQ-VAS Score</td>
<td>1,161</td>
</tr>
</tbody>
</table>

Health status measures show improvement in depressive symptoms in nearly 50 percent of patients seen for cognitive disorders, as measured with the Patient Health Questionnaire (PHQ-9). Quality of life is measured with the EuroQOL (EQ-5D) and EQ visual analog scale (VAS), and compared from first to last visit in the specified time frame. Average duration between visits was 165 days for the EQ-5D and 157 days for the PHQ-9. N = all patients seen for evaluation and follow-up of cognitive disorders between October 2010 and November 2011, for whom initial and follow-up data were available.
Change in Depressive Symptoms in Patients with Cognitive Disorders (N = 189)

October 2010 – December 2011

Overall PHQ-9 scores improved at one-year follow-up in 47 percent of patients with cognitive impairment, particularly in the symptoms of anhedonia, depressed mood, sleep problems and fatigue. Average duration between visits was 357 days. N = patients seen for initial evaluation of cognitive impairment from October through December 2010 and subsequently seen in follow-up between October and December 2011, for whom initial and follow-up data were available.
While quality of life (EQ-5D) subscores remain stable for the majority of patients with cognitive disorders, 15 percent show improvement in usual activities, 18 percent show improvement in pain and discomfort, and 20 percent show improvement in anxiety and depression. Average duration between visits was 165 days. N = all patients seen for evaluation and follow-up of cognitive disorders between October 2010 and November 2011, for whom initial and follow-up data were available.
Change in Cognitive Function in Patients with Cognitive Disorders (N = 219)

October 2010 – December 2011

Cognitive dysfunction, as measured with the Montreal Cognitive Assessment (MoCA) in this group of patients with a variety of cognitive disorders who were evaluated over at least two visits in 2011, shows improvement or stabilization in 58 percent of patients. Average duration between evaluations was 160 days. N = patients seen for initial evaluation and follow-up of cognitive impairment from October 2010 through December 2011, for whom initial and follow-up data were available.
### Alzheimer’s Disease

Change in Depressive Symptoms in Patients with Alzheimer’s Disease (N = 61)

**October 2010 – December 2011**

<table>
<thead>
<tr>
<th>Patients (%)</th>
<th>Improved</th>
<th>Stable</th>
<th>Worsened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall PHQ-9 Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Difficulty Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anhedonia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressed Mood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep Problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appetite Problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Deprecation Problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentration Problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed of Movement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicidal Ideation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall PHQ-9 scores improved or remained stable at one-year follow-up in 49 percent of Alzheimer’s disease patients, particularly in the symptoms of depressed mood, sleep and appetite problems, and fatigue. Average duration between visits was 362 days. N = patients seen for initial evaluation of Alzheimer’s disease from October through December 2010 and subsequently seen in follow-up between October and December 2011, for whom initial and follow-up data were available.
Overall cognitive function (total MoCA score) worsened in 63 percent of patients with Alzheimer’s disease over the course of the observation period. Across individual subscores, visuospatial/executive function, attention and orientation show the greatest declines, in terms of numbers of patients. Average duration between visits was 203 days. N = patients seen for initial evaluation and follow-up of Alzheimer’s disease between October 2010 and January 2012, for whom initial and follow-up data were available.
Non-Alzheimer’s Disease

Change in Cognitive Function in Non-Alzheimer’s Disease (N = 48)

October 2010 – January 2012

Cognitive function, as measured with MoCA scores, is less likely to worsen in non-Alzheimer’s disease cognitive disorders, compared to Alzheimer’s disease. Overall cognitive function (total MoCA score) improved in 44 percent and remained stable in another 17 percent. Average duration between visits was 203 days. N = patients seen for initial evaluation and follow-up of non-Alzheimer’s disease cognitive disorders between October 2010 and January 2012, for whom initial and follow-up data were available.
Parkinson’s Disease

Change in Depressive Symptoms in Patients with Parkinson’s Disease (N = 20)

October 2010 – December 2011

Overall PHQ-9 scores improved in 60 percent of patients with Parkinson's disease evaluated in the Center for Brain Health, with greater numbers showing improvements in measures of depressed mood, fatigue and appetite. Average duration between visits was 354 days. N = patients seen for initial evaluation of Parkinson's disease from October through December 2010 and subsequently seen in follow-up between October and December 2011, for whom initial and follow-up data were available.
The graph displays mean patient satisfaction scores (outpatient medical practice survey results) for providers at the Lou Ruvo Center for Brain Health in Nevada.

* Benchmark: Regional average for all Press Ganey hospital clients in the surrounding states (American Heart Association Region 9 sites).

Source: Press Ganey, a national hospital survey vendor
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 for the diagnosis and management of patients with epilepsy. The following outcomes highlight our treatment results using our highly integrated multidisciplinary approach. We are reporting our seizure outcomes both for the large subgroups of our patients treated only with medications, as well as for the relatively smaller subgroups also treated with epilepsy surgery.

**Seizure Frequency and Severity**

The effect of medical treatment on seizure severity and frequency was assessed using the Liverpool Seizure Severity Scale (LSSS),¹ a validated, patient-completed questionnaire developed to quantify the patient’s own perception of change in seizure severity. Higher scores reflect more severe seizures.

**Seizure Severity in Medically Treated Adult Epilepsy Patients (N = 1,076)**

2008 – 2011

Seizure severity improved significantly on medical therapy, with the mean LSSS score improving from 32.0 at initial visit to 19.5 at last visit (P < 0.0001). N = number of patients with greater than six months of follow-up. Mean duration of follow-up was 18.7 months. The standard box plots reflect the median and the 25th and 75th quartiles.

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Seizure Frequency in Medically Treated Adult Epilepsy Patients (N = 934)

2008 – 2011

<table>
<thead>
<tr>
<th></th>
<th>Cleveland Clinic</th>
<th>National Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responder rate (≥ 50% reduction in seizure frequency)</td>
<td>38%</td>
<td>12-29%</td>
</tr>
<tr>
<td>Percent seizure-free at 6 months</td>
<td>63%</td>
<td>--</td>
</tr>
<tr>
<td>Percent seizure-free at 12 months</td>
<td>64%</td>
<td>17-29%</td>
</tr>
</tbody>
</table>

Thirty-eight percent of patients seen between 2008 and 2011 and treated with medications alone showed a 50 percent or greater reduction in seizure frequency by last follow-up (average duration of follow-up = 19 months), compared to 12 percent to 29 percent of patients in a recent meta-analysis of series published from multiple epilepsy centers.² In terms of seizure-freedom, 63 percent of patients were completely seizure-free at six months and 64 percent were completely seizure-free at 12 months. One-half of these patients had long-standing intractable epilepsy, with an expected rate of seizure-freedom at 12 months based on national data of only 5 percent to 8 percent,²⁻⁵ and one-half were newly diagnosed, with an expected rate of seizure-freedom at 12 months based on national data varying from 29 percent to 50 percent.³,⁴ As such, the expected rate of seizure-freedom in our patients at one year based on national data should have been 17 percent to 29 percent. Instead, we achieved seizure-freedom in 64 percent.

Seizure Severity in Medically Treated Pediatric Epilepsy Patients (N = 275)

2008 – 2011

In the pediatric age group, the LSSS showed a significant improvement from the initial visit to the last follow-up in patients treated with medications alone (reduction in mean LSSS from 32.0 (± 1.5 s.e.) to 15.6 (± 1.5 s.e.) (P < 0.0001)). N = number of patients with greater than six months of follow-up. Mean duration of follow-up was 18 months. The standard box plots reflect the median and the 25th and 75th quartiles.

Seizure Frequency in Medically Treated Pediatric Epilepsy Patients (N = 275)

2008 – 2011

<table>
<thead>
<tr>
<th></th>
<th>Cleveland Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responder rate (≥ 50% reduction in seizure frequency)</td>
<td>56%</td>
</tr>
<tr>
<td>Percent seizure-free at 6 months</td>
<td>45%</td>
</tr>
</tbody>
</table>

Pediatric patients also saw a reduction in seizure frequency: 56 percent of patients seen between 2008 and 2011 had a 50 percent or greater reduction in seizure frequency. Mean duration of follow-up was 18.0 months. Forty-five percent became completely seizure-free at six months of follow-up after their initial visit.
Seizure Outcomes in Surgically Treated Epilepsy Patients (Adult and Pediatric Patients)

Long-term chances of achieving and maintaining seizure-freedom following various types of epilepsy surgery are shown in the following graphs. Whenever possible, our data were compared to national published data. We used the widely accepted Engel classification\(^6\) of seizure-freedom to classify our seizure outcomes (seizure-free = Engel class 1).

**Long-Term Seizure-Freedom in Adult and Pediatric Patients Following Epilepsy Surgery (N = 1,764)**

**Surgical Dates: 1996 – 2011**

<table>
<thead>
<tr>
<th>Years from Surgery</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
<th>10 Years</th>
<th>12 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seizure-free (overall group)</td>
<td>76%</td>
<td>71%</td>
<td>62%</td>
<td>50%</td>
<td>44%</td>
</tr>
<tr>
<td>% Seizure-free (adult epilepsy)</td>
<td>72%</td>
<td>66%</td>
<td>56%</td>
<td>48%</td>
<td>43%</td>
</tr>
<tr>
<td>% Seizure-free (pediatric epilepsy)</td>
<td>80%</td>
<td>76%</td>
<td>67%</td>
<td>50%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Forty-four percent of patients with previously medically intractable epilepsy remained seizure-free 12 years after surgical treatment at Cleveland Clinic’s Epilepsy Center. Individual curves of seizure outcomes show similar long-term chances of seizure-freedom in adult and pediatric patients who underwent epilepsy surgery at the center between 1996 and 2011.

Long-Term Seizure-Freedom Following Temporal Lobe Epilepsy Surgery (N = 906)

Surgical Dates: 1996 – 2011

Temporal lobe epilepsy surgery is the most common type of brain surgery performed for the treatment of intractable epilepsy. The graph illustrates the percent of adult and pediatric patients who were seizure-free up to 10 to 15 years following a temporal lobe resection. National averages represent a weighted average of recent studies conducted in the United States.7-13

Temporal lobe epilepsy surgery is the most common type of brain surgery performed for the treatment of intractable epilepsy. The graph illustrates the percent of adult and pediatric patients who were seizure-free up to 10 to 15 years following a temporal lobe resection. National averages represent a weighted average of recent studies conducted in the United States.7-13

<table>
<thead>
<tr>
<th>Years from Surgery</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
<th>10 Years</th>
<th>15 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seizure-free (Cleveland Clinic)</td>
<td>77%</td>
<td>72%</td>
<td>63%</td>
<td>57%</td>
<td>40%</td>
</tr>
<tr>
<td>% Seizure-free (national average)</td>
<td>72%</td>
<td>54%</td>
<td>59%</td>
<td>51%</td>
<td>NA</td>
</tr>
</tbody>
</table>

Epilepsy

Frontal lobe resection is the second most commonly performed epilepsy surgery procedure. This type of epilepsy surgery is traditionally considered the most challenging. The graph below reflects seizure outcome in 351 adult and pediatric patients with previously medically intractable frontal lobe epilepsy operated on between 1997 and 2011.

**Long-Term Seizure-Freedom Following *Frontal Lobe* Epilepsy Surgery (N = 351)**

*Surgical Dates: 1997 – 2011*

![Graph showing seizure-free percentage over years from surgery](image)

<table>
<thead>
<tr>
<th>Years from Surgery</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
<th>10 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seizure-free</td>
<td>63%</td>
<td>56%</td>
<td>45%</td>
<td>31%</td>
</tr>
</tbody>
</table>
Improvement in Frontal Lobe Epilepsy Surgical Outcomes over the Years (N = 348)

Surgical Dates: 1997 – 2011

<table>
<thead>
<tr>
<th>Years from Surgery</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seizure-free - 2000 or After</td>
<td>65%</td>
<td>58%</td>
<td>47%</td>
</tr>
<tr>
<td>% Seizure-free - Before 2000</td>
<td>53%</td>
<td>48%</td>
<td>33%</td>
</tr>
</tbody>
</table>

Surgical outcomes of our patients improved over time, likely due to the introduction and use of state-of-the-art diagnostic (including high-resolution magnetic resonance imaging (MRI), magnetoencephalography (MEG) and other postprocessing techniques) and surgical techniques (including stereotactic electroencephalography (SEEG)). Close to one-half the patients operated on at Cleveland Clinic after 2000 are seizure-free at five years, compared to one-third of those operated on before 2000.
Long-Term Seizure-Freedom Following *Posterior Quadrant* Resection (N = 126)

Surgical Dates: 1997 – 2011

Posterior quadrant resection is used to treat intractable epilepsy involving the posterior temporal, parietal and/or occipital regions. The graph reflects the percent of patients who continue to be completely seizure-free up to eight years following a posterior quadrant resection.

<table>
<thead>
<tr>
<th>Years from Surgery</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
<th>8 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seizure-free</td>
<td>81%</td>
<td>79%</td>
<td>75%</td>
<td>75%</td>
</tr>
</tbody>
</table>
Long-Term Seizure-Freedom Following *Hemispherectomy* (N = 222)

**Surgical Dates:** 1997 – 2011

<table>
<thead>
<tr>
<th>Years from Surgery</th>
<th>1 Year</th>
<th>2 Years</th>
<th>5 Years</th>
<th>8 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seizure-free</td>
<td>88%</td>
<td>83%</td>
<td>75%</td>
<td>69%</td>
</tr>
</tbody>
</table>

Patients with life-threatening, catastrophic epilepsy may be candidates for hemispherectomy, one of the most complex types of epilepsy surgery. The graph reflects the percent of patients who continue to be completely seizure-free up to eight years following a hemispherectomy.

Beyond improvements in seizure frequency, several other benefits were observed after hemispherectomy:

- **Seizure medication reduction:** 57 percent of patients discontinued all seizure medications by last follow-up, and 17 percent were only taking one seizure medication.

- **Functional improvement:** 83 percent of patients were walking independently at last follow-up, with an additional 9 percent requiring minimal assistance for ambulation.

- **Cognitive and language development:** With early surgery, seizure-freedom and aggressive postoperative therapy, 36 percent had age-appropriate language and 34 percent had modestly delayed language at last follow-up. Forty-two percent of patients were reading at age-appropriate levels at last follow-up. These rates were actually a few percentage points better than the language performance of our patients before surgery (cognition and language typically worsen with chronic epilepsy and persistent seizures; by stopping seizures, epilepsy surgery can prevent further decline but is not typically expected to improve cognition and language).
Epilepsy Outcomes Beyond Seizure Frequency and Severity

At the Epilepsy Center, we strongly believe that the burden of epilepsy extends beyond a “seizure count” and that the effect of the multidisciplinary and highly integrated care we provide (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 360° assessment of our 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 Mood

Mood disorders, especially depression, are common in patients with epilepsy. We routinely screen for depressive symptoms using the Patient Health Questionnaire (PHQ-9) in order to identify and treat depression as soon as possible, using Primary Care Depression Treatment Guidelines. Early identification and treatment should result in improvement in our patients’ care, given the significant effect of depression on quality of life. In fact, mood did improve in both the medical and surgical groups.

Improvement in Depressive Symptoms in Surgically Treated Adult Epilepsy Patients (N = 153)

2008 – 2011

PHQ-9 Score

The mean PHQ-9 score was 8.6 (± 0.5) before surgery as opposed to 6.5 (± 0.5) at the last follow-up visit, reflecting a 24 percent reduction in score severity (P = 0.007). The main improvement was observed in patients with moderate to severe depression at their initial visit. The standard box plots reflect the median and the 25th and 75th quartiles. N = adult epilepsy patients with greater than six months of follow-up after epilepsy surgery. Mean duration of follow-up was 17.3 months.

The mean PHQ-9 score improved from 7.8 (± 0.3) at the initial visit to 6.3 (± 0.3) at the last follow-up visit, reflecting a 25 percent reduction in depression score severity (P < 0.0001). The standard box plots reflect the median and the 25th and 75th quartiles. N = adult epilepsy patients treated with medications only and with greater than six months of follow-up. Mean duration of follow-up was 16.4 months.
Improvement in Anxiety Symptoms in Surgically Treated Adult Epilepsy Patients (N = 132)

2009 – 2011

Anxiety was assessed using the Generalized Anxiety Disorder questionnaire (GAD-7),\textsuperscript{15} which represents a patient-completed validated measure screening for symptoms of anxiety. The mean GAD-7 score improved from 6.9 (± 0.5) before surgery to 4.9 (± 0.5) at the last follow-up visit in patients who underwent epilepsy surgery (P = 0.006). The standard box plots reflect the median and the 25th and 75th quartiles. N = adult epilepsy patients with greater than six months follow-up. Mean duration of follow-up was 16 months.

Improvement in Anxiety Symptoms in Medically Treated Adult Epilepsy Patients (N = 785)

2009 – 2011

Anxiety also improved in adult patients treated with medications alone: the mean GAD-7 score at the initial visit was 5.8 (± 0.2), significantly higher than the mean score of 4.8 (± 0.2) seen at last follow-up (P = 0.002). The standard box plots reflect the median and the 25th and 75th quartiles. N = adult epilepsy patients with greater than six months follow-up. Mean duration of follow-up was 15.4 months.
Adult Epilepsy: Effect of Treatment on Driving Status

Driving Status in Surgically Treated Epilepsy Patients (N = 233)

2008 – 2011

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 9 percent of our surgical patients were driving before surgery, 39 percent were driving six months or more after surgery (P < 0.0001). N = adult epilepsy patients with greater than six months of follow-up. Mean duration of follow-up was 17.4 months.

Driving Status in Medically Treated Epilepsy Patients (N = 1,314)

2008 – 2011

In the medical group, 37 percent were driving at their first visit as opposed to 48 percent at last follow-up (P < 0.0001). N = adult epilepsy patients with greater than six months of follow-up. Mean duration of follow-up was 19.4 months.
Pediatric Epilepsy: Effect of Treatment on Healthcare Utilization

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

Hospitalization Rates in Surgically Treated Pediatric Epilepsy Patients (N = 234)

2009 – 2011

Mean Hospitalization Rate (per 3 Months)

Healthcare utilization improved significantly from before surgery to the last follow-up visit. The hospitalization rate before surgery decreased from a mean of 0.17 hospitalizations over three months (±0.02 s.e.) to a mean of 0.07(±0.02 s.e.) at last visit (P = 0.009), a 59 percent reduction in frequency of hospitalization. N = pediatric patients with greater than six months of follow-up. Mean duration of follow-up was 16.5 months.
Emergency Room Visits in Surgically Treated Pediatric Epilepsy Patients (N = 231)

2009 – 2011

There was a significant reduction in the frequency of emergency room (ER) visits, from a mean of 0.45 emergency room visits per three months (± 0.06) before surgery to 0.16 at the last follow-up visit (P = 0.0005), a 64 percent reduction in frequency of ER visits. N = pediatric patients with greater than six months of follow-up. Mean duration of follow-up was 16.5 months.
Cervical Dystonia

Improvement Following Botulinum Toxin Treatment (N = 77)

2011

In patients with cervical dystonia (spasmodic torticollis) treated with chemodenervation (botulinum toxin) in 2011, 91 percent rated themselves as improved at their most recent visit, compared to their first visit, using the Patient Global Impression of Improvement (PGI-I) questionnaire.
**Parkinson's Disease**

**Change in Functional Impairment with Treatment of Parkinson's Disease (N = 73)**

2011

In Parkinson's disease patients with an initial visit and at least one follow-up visit in 2011, 60 percent report improvement in motor symptoms between first and second visits, as measured with the Unified Parkinson's Disease Rating Scale Part II (UPDRS II). The UPDRS II is a validated, self-administered Parkinson's disease scale rating functional impairment in activities of daily living including speech, swallowing, dressing, feeding, hygiene, walking, work-related activities and social activities. Because Parkinson's disease is progressive, functional impairment increases over time; treatment is aimed at slowing this progressive decline in function. Average duration of follow-up between first and second visits was 93 days.
In Parkinson’s disease patients with an initial visit and at least one follow-up visit in 2011, 63 percent report improvement in depressive symptoms between first and second visits, as measured with the Patient Health Questionnaire (PHQ-9). Effectively treating nonmotor symptoms is increasingly recognized as critical in managing Parkinson's disease. Depression is a common nonmotor symptom of Parkinson's disease, affecting quality of life. Average duration of follow-up between first and second visits was 90 days.
Improvement in Motor Symptoms with Deep Brain Stimulation (N = 37)

Surgical Dates: June – December 2011

In Cleveland Clinic Parkinson's disease patients operated on between June 2011 and December 2011, mean UPDRS Part III (motor) score without medication, following subthalamic nucleus deep brain stimulation surgery, improved by 42 percent at one month after surgery. This compares favorably to published improvement rates of 29 percent to 39 percent six months after surgery. 1-3 We report one-month data because six-month data were not yet available. Improvement seen at one month is expected to be less than that seen at six months, as stimulator parameters are adjusted gradually over time.


Mellen Center Patient Characteristics (N = 3,828)

### 2011

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean Age</strong></td>
<td>48.1 years (s.d. = 11.7)</td>
<td></td>
</tr>
<tr>
<td><strong>Median Age</strong></td>
<td>49.0 years (range = 5.0 – 83.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,014 (26.5%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2,814 (73.5%)</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>415 (10.8%)</td>
<td></td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>6 (0.16%)</td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>3,196 (83.5%)</td>
<td></td>
</tr>
<tr>
<td>Multiracial</td>
<td>10 (0.26%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>201 (5.3%)</td>
<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>329 (8.6%)</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>2,461 (64.3%)</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>867 (22.6%)</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>66 (1.7%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>105 (2.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical Course</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinically Isolated/Radiologically Isolated Syndromes (CIS/RIS)</td>
<td>201 (5.3%)</td>
<td></td>
</tr>
<tr>
<td>Relapsing-Remitting</td>
<td>2,191 (57.2%)</td>
<td></td>
</tr>
<tr>
<td>Secondary Progressive</td>
<td>661 (17.3%)</td>
<td></td>
</tr>
<tr>
<td>Primary Progressive/Progressive-Relapsing</td>
<td>248 (6.5%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>527 (13.8%)</td>
<td></td>
</tr>
</tbody>
</table>
Changes in Health Status with Disease Duration

Multiple sclerosis (MS) is a disease of great variability, and it is difficult to advise individuals about how their disease will progress over time. To better understand how health status and well-being change over time, we collected and analyzed five health status measures (EuroQOL (EQ-5D), Patient Health Questionnaire (PHQ-9), Multiple Sclerosis Performance Scale (MSPS), Timed 25-Foot Walk (T25FW) and 9-Hole Peg Test (9-HPT)) in 2011 and segmented the data by time since diagnosis in five-year increments.

Quality of Life in Five-Year Increments Since MS Diagnosis

2011

Cross-sectional analysis of quality of life EQ-5D scores show a gradual decline in overall quality of life by years since diagnosis, with significantly worse values in individuals with disease duration of 16 years or more compared to those who have had MS for 15 years or less (overall $P = 0.001$). Lower scores reflect lower quality of life.
These PHQ-9 scores indicate that individuals who have had MS for five years or less have more depressive symptoms compared to those who have had MS for 11 to 15 years (P = 0.001). Higher scores reflect more severe depressive symptoms. While scores do appear to increase beyond 15 years, these increases do not reach statistical significance compared to those in the 11 to 15 years group.

The MSPS is a validated measure of patient-assessed MS-related disability with higher scores indicating greater disability. In this cohort, MSPS scores increased with every five-year increment from time of diagnosis, and those with disease duration of 16 years or more had worse outcomes compared to those who have had MS for 15 years or less (P = 0.001).
Lower Extremity Disability in Five-Year Increments Since MS Diagnosis

2011

The T25FW is a measure of lower extremity disability with higher scores indicating greater disability. In this cohort, scores worsened with every five-year increment and statistically significant differences exist between those with 15 years or less since diagnosis and those with longer duration since diagnosis ($P = 0.001$), and between those with five years or less since diagnosis and those with 11 to 15 years since diagnosis ($P = 0.001$).

Upper Extremity Disability in Five-Year Increments Since MS Diagnosis

2011

The 9-HPT is a measure of upper extremity disability with higher scores indicating greater disability. These data demonstrate that 9-HPT scores generally increase with every five-year increment from time of diagnosis, and differences exist between those with 15 years or less since diagnosis and those with 16 years or more since diagnosis ($P = 0.001$).
**Treatment with Fingolimod**

A major advance in disease management of MS is the introduction of fingolimod, the first FDA-approved oral agent that is taken daily, to the MS disease modifying therapy (DMT) armamentarium. It has been approved as a first line of treatment in the United States. While this drug is associated with some serious adverse events, including potentially fatal infections and bradycardia, it has been found to reduce the risk of disability progression and brain lesion activity as measured by magnetic resonance imaging (MRI). In a cohort of patients initiating fingolimod treatment at the Mellen Center, we assessed routinely collected health status measures before starting the drug and again at six months after treatment initiation using the EQ-5D, PHQ-9, MSPS, T25FW and 9-HPT. Because the medication aims at stabilizing the disease process rather than improving existing impairments, absence of worsening is the desired outcome. No significant change was detected on most health status measures, with the exception of the T25FW.

**Descriptive Statistics of Patients Initiating Fingolimod Treatment (N = 115)**

**Treatment Initiation Dates: January 1 – June 30, 2011**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age at time of treatment initiation</td>
<td>43.8 ± 8.8 s.d.</td>
</tr>
<tr>
<td>Years from MS diagnosis to fingolimod initiation</td>
<td>9.1 ± 6.0 s.d.</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>87 (75.7%)</td>
</tr>
<tr>
<td>Male</td>
<td>28 (24.3%)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>1 (0.87%)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>101 (87.8%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>13 (11.3%)</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>6 (5.2%)</td>
</tr>
<tr>
<td>Married</td>
<td>83 (72.2%)</td>
</tr>
<tr>
<td>Single</td>
<td>23 (20.0%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>3 (2.6%)</td>
</tr>
<tr>
<td>Clinical Course – baseline</td>
<td></td>
</tr>
<tr>
<td>Clinically Isolated Syndrome (including CIS/RIS)</td>
<td>3 (2.7%)</td>
</tr>
<tr>
<td>Relapsing-Remitting</td>
<td>87 (75.7%)</td>
</tr>
<tr>
<td>Secondary Progressive</td>
<td>16 (13.9%)</td>
</tr>
<tr>
<td>Primary Progressive/Progressive-Relapsing</td>
<td>4 (3.4%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>5 (4.3%)</td>
</tr>
</tbody>
</table>
Multiple Sclerosis

Stability in Quality of Life with Fingolimod Treatment (N = 110)

Treatment Initiation Dates: January 1 – June 30, 2011

Quality of life, as measured by the EQ-5D, was stable after six months of treatment (P = 0.98).

Stability in Depressive Symptoms with Fingolimod Treatment (N = 106)

Treatment Initiation Dates: January 1 – June 30, 2011

Depressive symptoms, as measured by the PHQ-9, were slightly elevated after treatment initiation but this change was not statistically significant (P = 0.40).
Stability in MS-Related Disability with Fingolimod Treatment (N = 107)

Treatment Initiation Dates: January 1 – June 30, 2011

**Mean MSPS Score**

![Graph showing MSPS scores before and after treatment](image)

Patient-reported MS-related disability, as measured with the MSPS, showed some worsening of disability after six months of treatment, but this did not reach statistical significance (P = 0.19).

Walking Times Before and After Fingolimod Treatment (N = 75)

Treatment Initiation Dates: January 1 – June 30, 2011

**Mean T25FW Score (Seconds)**

![Graph showing T25FW scores before and after treatment](image)

With one subject removed from this analysis due to being a pronounced outlier, T25FW scores increased (worsened) after treatment (P = 0.03), but this was not felt to be a clinically significant change of 20 percent or more.
Arm Function Before and After Fingolimod Treatment (N = 42)

Treatment Initiation Dates: January 1 – June 30, 2011

Upper extremity function, as measured with the 9-HPT, worsened after six months of treatment with fingolimod, but this was not statistically significant (P = 0.44).
Use of Shared Medical Visits for First Dosing of Fingolimod in MS

Due to a need for a six-hour monitoring after the administration of fingolimod, the Mellen Center has implemented shared medical visits (SMV). These visits provide an opportunity to reduce the wait time to start the therapy and to provide additional education, while monitoring for side effects after first dosing.

Patient Satisfaction with Fingolimod Shared Medical Visit (N = 272)

As part of a quality improvement project, 272 patients (31 percent of the 882 patients started on fingolimod) completed a satisfaction questionnaire at the end of the SMV. The patients expressed a high level of satisfaction with the visit.
Intrathecal Baclofen Therapy

Intrathecal baclofen (ITB) therapy is approved by the FDA for the treatment of severe spasticity of spinal or cerebral origin refractory to other treatment modalities. The Mellen Center has been using this therapeutic modality since its approval, with over 350 patients treated since 1990. The intrathecal infusion device (baclofen pump) is implanted by neurosurgeons in the Center for Neurological Restoration at Cleveland Clinic. Patient selection, testing and postoperative management are performed at the Mellen Center Spasticity Clinic.

Intrathecal Baclofen Therapy Indications and Complications (N = 90)

2007 – 2011

<table>
<thead>
<tr>
<th>Total patients</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age at surgery</td>
<td>47 years</td>
</tr>
<tr>
<td>Female</td>
<td>48%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disease Indications for ITB</th>
<th>Number of Patients (Average Duration of Disease)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple sclerosis</td>
<td>43 (18 years)</td>
</tr>
<tr>
<td>Motor neuron disease</td>
<td>5 (4 years)</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>9 (37 years)</td>
</tr>
<tr>
<td>Traumatic brain injury</td>
<td>2 (22 years)</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>11 (5 years)</td>
</tr>
<tr>
<td>Stroke</td>
<td>4 (5 years)</td>
</tr>
<tr>
<td>Myelopathy</td>
<td>10 (11 years)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (7 years)</td>
</tr>
<tr>
<td>(stiff person syndrome, cerebral arteritis, anoxic brain injury, adrenomyeloneuropathy)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infections</td>
<td>3</td>
</tr>
<tr>
<td>Catheter malfunction</td>
<td>1</td>
</tr>
<tr>
<td>Pump malfunction</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
</tbody>
</table>

From January 2007 to December 2011, 90 patients underwent implantation of a baclofen pump. Three patients opted to discontinue ITB therapy after a complication. No patients discontinued ITB therapy in the absence of a complication.
Improvement in Spasticity with ITB Therapy

2007 – 2011

Group mean spasticity scores on the Modified Ashworth Scale (0 = no increase in tone, 4 = affected parts rigid in flexion or extension) indicate improvement after ITB therapy. There was a statistically significant reduction in spasticity in the first year (P ≤ 0.0001), which was sustained in the following years. The time points reflect average duration of treatment after baclofen pump implantation.

![Graph of Mean Spasticity Score](image)

N = 90 84 57 27 17

Improvement in Spasm Frequency with ITB Therapy

2007 – 2011

Group mean Spasm Frequency Scale scores (0 = no spasms, 4 = more than 10 spasms per hour) indicate improvement after ITB therapy. There was a statistically significant reduction in spasm frequency in the first year (P = 0.0001), which was sustained in the following years.

![Graph of Mean Spasm Frequency Score](image)

N = 90 84 57 27 17
Improvement in Pain with ITB Therapy

2007 – 2011

Mean Pain Score

<table>
<thead>
<tr>
<th>Years Since ITB Surgery</th>
<th>0</th>
<th>0.5</th>
<th>1.5</th>
<th>2.4</th>
<th>3.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Score</td>
<td>4</td>
<td>3.5</td>
<td>3</td>
<td>2.5</td>
<td>3.5</td>
</tr>
</tbody>
</table>

N = 90 84 57 27 17

Pain scores (0 = no pain, 10 = worst pain possible) indicate improvement after ITB therapy. There was a statistically significant reduction in pain in the first year (P = 0.03), with fluctuations over the following years.
Ambulating Following ITB Therapy

The Mellen Center has developed expertise in the use of ITB therapy in ambulatory patients. ITB therapy in this population has the same potential benefits in terms of reduction of bothersome spasticity that may interfere with activities of daily living, sleep and quality of life in general. However, a common concern is that ITB may cause increased weakness with loss of function. Fifty-one percent of the patients in our cohort were ambulatory at the time of surgery.

Stability of Gait Speed with ITB Therapy

2007 – 2011

Following ITB therapy, there was no statistically significant change in mean gait speed ($P = 0.17$), as measured with the T25FW, for the patients who remained ambulatory. A decrease in T25FW score represents an improvement in gait speed.
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 Outpatient Clinic Diagnosis Distribution (N = 6,650)

2011

<table>
<thead>
<tr>
<th>Visit Diagnosis</th>
<th>Number of Visits</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyneuropathy</td>
<td>1,260</td>
<td>19%</td>
</tr>
<tr>
<td>Mononeuropathy</td>
<td>891</td>
<td>13%</td>
</tr>
<tr>
<td>Motor Neuron Disease</td>
<td>619</td>
<td>9%</td>
</tr>
<tr>
<td>Autonomic Disorder</td>
<td>615</td>
<td>9%</td>
</tr>
<tr>
<td>Neuromuscular Junction Disorder</td>
<td>429</td>
<td>6%</td>
</tr>
<tr>
<td>Myopathy</td>
<td>392</td>
<td>6%</td>
</tr>
<tr>
<td>Radiculopathy</td>
<td>208</td>
<td>3%</td>
</tr>
<tr>
<td>Other*</td>
<td>2,236</td>
<td>34%</td>
</tr>
</tbody>
</table>

*Visit diagnosis is based on the assessment of the treating physician at the conclusion of either the initial consultation or follow-up visit. The “Other” category includes patients with undiagnosed signs and symptoms, as well as patients with nonneuromuscular diagnoses.

Neuromuscular diseases can be debilitating, often progressive and sometimes fatal. Weakness, paralysis, respiratory distress, sensory loss and pain dramatically alter quality of life for both patients and their families. Cleveland Clinic's Neuromuscular Center offers state-of-the-art treatment modalities to address these issues, often coordinated with other Cleveland Clinic specialists and allied health professionals, with a goal of optimizing quality of life for our patients.
Sixty-nine percent of patients either remain stable or report an improvement in quality of life, as measured with the EuroQOL (EQ-5D), from the patient’s initial consultation to the last follow-up for the year. Thirty-one percent worsen in this patient population with chronic, debilitating and progressive neuromuscular disorders. N = patients with data available over at least two visits in 2011. The average duration between visits was 103 days.
Monitoring Comorbid Depression in Neuromuscular Disease (N = 454)

2011

Depression is a common comorbidity in patients with neuromuscular disease. We compared Patient Health Questionnaire (PHQ-9) scores at initial consultation and at last follow-up during 2011. At the time of initial consultation, 67 percent of patients suffered from depression, mild to severe, based on PHQ-9 scores. At follow-up, 52 percent of patients had improved in their depression scores, with 57 percent suffering from depression. The percent of patients with severe depression fell from 9 percent at initial consultation to 4 percent at follow-up. Average duration between visits was 114 days.
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 disease (MND) in a multidisciplinary ALS/MND Team Clinic. The Section also conducts clinical investigations, participates in therapeutic trials and conducts basic research to identify causes and effective treatments of ALS and other MND.

The revised ALS Functional Rating Scale (ALSFRS-R) score is used to monitor progression of disability in patients with ALS. The mean rate of decline in the total ALSFRS-R score was comparable to that seen in other tertiary care centers, allowing for the difference in sample size, longer average follow-up duration and broader range of follow-up duration between ALSFRS-R assessments. The average decline over 5.1 months is presented on all patients who had at least two outpatient visits in 2011 (N = 131). Approximately 72 percent of these patients were taking riluzole, the only FDA-approved treatment shown to extend survival in ALS patients.

### Average Decline in ALSFRS-R

#### 2011

<table>
<thead>
<tr>
<th>Patients</th>
<th>ALSFRS-R (Points)</th>
<th>Average Follow-up (Months)</th>
<th>Follow-Up Range (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleveland Clinic</td>
<td>131</td>
<td>3.5</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Some ALS patients suffer from a combination of excessive salivation and difficulty in swallowing. Drooling is a distressing symptom for these patients, causing social embarrassment, coughing spells and risk of aspiration. The Neuromuscular Center has experience managing ALS patients with this issue, utilizing suction machines, oral medications and in some cases botulinum toxin injections to reduce the production of saliva. During 2011, the majority of our ALS patients were either stable or improved as measured by the ALSFRS-R salivation subscores from the first to the last visit. Average duration between visits was 152 days.
**Pseudobulbar Affect**

Pseudobulbar affect (PBA) is a neurological condition characterized by involuntary outbursts of laughing and/or crying incongruous or disproportionate to the patient’s emotional state. Although PBA can occur in a variety of neurological disorders, the prevalence in ALS patients has been estimated at 49 percent.

The Center for Neurologic Study–Lability Scale (CNS-LS) is a seven-item self-assessment of PBA severity and is validated for measuring PBA in ALS. Total scores range from 7 to 35; a score $\geq 13$ is consistent with clinical PBA.

**Disease Severity in Patients with Pseudobulbar Affect (N = 136)**

**2011**

<table>
<thead>
<tr>
<th>Patients (%)</th>
<th>Improved</th>
<th>Stable</th>
<th>Worsened</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In 2011, 136 patients with at least two visits were found to have a score $\geq 13$ on the CNS-LS. Average duration between visits was 126 days. At their last office visit, the majority of these patients (70 percent) had stable to improving CNS-LS scores. Among other treatments, dextromethorphan combined with ultra low-dose quinidine (DMq) can be effective for treating PBA in patients with ALS, a regimen approved by the FDA for the treatment of PBA. Of the 15 ALS patients taking this medication, a slightly greater proportion (80 percent) experienced an improvement in their CNS-LS score at follow-up.
The Headache Program, within the Neurological Center for Pain, 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.

**Improvement in Functional Impairment in Chronic Migraine Patients (N = 108)**

**2010 – 2011**

**Mean HIT-6 Score**

With treatment, chronic migraine patients saw improvements in both functional impairment, as measured by HIT-6, and depressive symptoms, as measured by the Patient Health Questionnaire (PHQ-9), from first to last visit (P < 0.001). Average interval between first and last visits was 118 days.
Infusion Therapy for Headache

Intravenous medication infusions are used to end refractory headaches, as well as for detoxification of patients with medication overuse contributing to headaches. This treatment provides a less expensive alternative to emergency department care and can be useful as a portion of a comprehensive headache management strategy.

Headache and Dizziness Severity Before and After Infusion Treatment (N = 468)

2011

Pain and dizziness improve after infusion therapy (P < 0.001). Average interval between assessments was 16.03 days.
Interdisciplinary Method for the Assessment and Treatment of Chronic Headache (IMATCH)

One of only a few such programs in the country, IMATCH is an intensive, multidisciplinary outpatient program for chronic headache patients who have exhausted other treatment options. IMATCH is a three-week, full-day program that begins with a half-day multidisciplinary evaluation by a neurologist, physical therapist and psychologist. The team then formulates a joint treatment plan with input from the patient, which is used to guide the remainder of treatment.

Average Pain Ratings Before and After IMATCH

Average pain scores decreased following completion of the IMATCH program (P < 0.01).
Headache Impact Test (HIT-6) Before and After IMATCH

Mean Disability Score

<table>
<thead>
<tr>
<th>Admission Year</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>64</td>
<td>68</td>
<td>92</td>
<td>107</td>
</tr>
</tbody>
</table>

Headaches have less of an influence on normal daily function after completion of the IMATCH program (P < 0.01).

Pain Disability Before and After IMATCH

Mean Pain Disability Score

<table>
<thead>
<tr>
<th>Admission Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>28</td>
<td>50</td>
<td>53</td>
<td>82</td>
<td>97</td>
</tr>
</tbody>
</table>

Pain disability, as measured with the Pain Disability Index, improved after completion of the IMATCH program (P < 0.01). Higher scores on the 0 to 70 scale indicate greater disability.
Depression Before and After IMATCH

Depression, as measured with the Depression Anxiety Stress Scale (DASS-42), improved following IMATCH (P < 0.01). Higher scores on the 0 to 42 scale indicate more severe depression.

Anxiety Before and After IMATCH

Anxiety, as measured with the DASS-42, improved following IMATCH (P < 0.01). Higher scores on the 0 to 42 scale indicate more severe anxiety.
Stress Before and After IMATCH

Stress, as measured with the DASS-42, improved following IMATCH (P < 0.01). Higher scores on the 0 to 42 scale indicate more severe stress.
Cleveland Clinic Chronic Pain Rehabilitation Program

The Chronic Pain Rehabilitation Program (CPRP), within the Neurological Center for Pain, is a comprehensive, interdisciplinary program designed to treat patients with disabling chronic pain. The CPRP has been named a 2012 winner of The American Pain Society Clinical Centers of Excellence in Pain Management Award.

<table>
<thead>
<tr>
<th>CPRP Patient Characteristics</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients Enrolled</td>
<td>229</td>
<td>287</td>
<td>294</td>
</tr>
<tr>
<td>Number of Patients Completing</td>
<td>171</td>
<td>230</td>
<td>237</td>
</tr>
<tr>
<td>Number of Patients Identified with Addiction</td>
<td>85</td>
<td>86</td>
<td>119</td>
</tr>
<tr>
<td>Percent Female</td>
<td>65.1</td>
<td>66.2</td>
<td>60.54</td>
</tr>
<tr>
<td>Mean Age (s.d.)</td>
<td>48.1 (13.09)</td>
<td>46.7 (12.58)</td>
<td>45.43 (13.66)</td>
</tr>
</tbody>
</table>

Each year, a number of patients enroll in the CPRP but fail to complete the full daily, three- to four-week program for a variety of medical and nonmedical reasons. While these reasons are tracked, they are not the focus of the data presented; the outcomes presented focus on those patients who complete the full rehabilitation program.

In recognition of the increasing number of patients with both chronic pain and addiction, and the dearth of pain treatment programs to address the needs of this population, the CPRP in late 2009 started a treatment track designed specifically to help patients with both pain and addiction. Although this is not a chemical dependency treatment program, patients in this track receive education about addiction and the role it has played in their lives and their pain. This education helps them start to plan the substance abuse treatment that follows completion of the CPRP.
Pain Intensity Before and After CPRP

Mean Pain Score
(0 = No Pain, 10 = Worst Possible Pain)

Mean pain scores decreased following participation in the CPRP. A 2-point change is considered clinically significant. One-year follow-up was not yet available for 2011. N = number of patients with complete data at each time point.

Depression Before and After CPRP

Mean Depression Score

Depressive symptoms, as measured with the Depression Anxiety Stress Scale (DASS-21) depression subscale, improved following participation in the CPRP. Higher scores indicate more severe depression. Mean admission scores suggest moderate depression, while all discharge and follow-up scores suggest mild depression or no depression. One-year follow-up was not yet available for 2011. N = number of patients with complete data at each time point.
Anxiety symptoms, as measured with the DASS-21 anxiety subscale, improved following participation in the CPRP. Higher scores indicate more severe anxiety. Mean admission scores suggest moderate anxiety, while mean discharge and follow-up scores suggest no anxiety. One-year follow-up was not yet available for 2011. \( N = \) number of patients with complete data at each time point.

Functional status, as measured with the Pain Disability Index, improved at discharge, six months and one year after participation in the CPRP compared with prior to treatment. Higher scores on the 0 to 70 scale indicate greater disability. One-year follow-up was not yet available for 2011. \( N = \) number of patients with complete data at each time point.
Program completion rates, the percent of patients completing the program, tend to be lower for those identified at risk of substance use disorders. N = total number of patients initially enrolled in the CPRP in 2011. Although patients with substance use disorders are much more likely to drop out of treatment, those who complete treatment do as well as patients without substance use disorders. The program is making efforts to understand and improve the problem of program dropout. Cleveland Clinic data suggest that 30 percent of patients with substance use disorders who drop out of the CPRP do so because they do not want to give up the addictive substance.
Depression Before and After CPRP in Patients at Risk for Substance Use Disorders

2011

Mean Depression Score

Depressive symptoms, as measured with the DASS-21 depression subscale, improve following participation in the CPRP. Higher scores indicate more severe depression. Depressive symptoms tend to be higher in those patients identified at risk of substance use disorders. For this and subsequent graphs, SUD = patients enrolled in a Substance Use Disorders Education Track for those identified at risk of substance use disorders. N = number of patients with complete data at each time point.

Anxiety Before and After CPRP in Patients at Risk for Substance Use Disorders

2011

Mean Anxiety Score

Anxiety symptoms, as measured with the DASS-21 anxiety subscale, improve following participation in the CPRP. Higher scores indicate more severe anxiety. Again, anxiety symptoms tend to be higher in those patients identified at risk of substance use disorders. N = number of patients with complete data at each time point.
Pain Intensity Before and After CPRP in Patients at Risk for Substance Use Disorders

2011

Mean Pain Score (0 = No Pain, 10 = Worst Possible Pain)

<table>
<thead>
<tr>
<th>Follow-up</th>
<th>SUD</th>
<th>Non-SUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Discharge</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6 Months</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1 Year</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

N (SUD) = 147
N (Non-SUD) = 129

Clinically significant change in average pain intensity ratings (a 3-point change or more) occurred from admission to discharge in both groups, and between admission and one-year follow-up in the Non-SUD group. N = number of patients with complete data at each time point.

Pain Disability Before and After CPRP in Patients at Risk for Substance Use Disorders

2011

Mean Pain Disability Score

<table>
<thead>
<tr>
<th>Follow-up</th>
<th>SUD</th>
<th>Non-SUD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission</td>
<td>150</td>
<td>139</td>
</tr>
<tr>
<td>Discharge</td>
<td>117</td>
<td>124</td>
</tr>
<tr>
<td>6 Months</td>
<td>43</td>
<td>36</td>
</tr>
<tr>
<td>1 Year</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

N (SUD) = 150
N (Non-SUD) = 139

Functional status is measured here with the Pain Disability Index. Higher scores on the 0 to 70 scale indicate greater disability. Clinically significant improvement, a shift from one category to another (for instance, from moderate to mild disability) occurred in both SUD and Non-SUD groups at all intervals following admission. N = number of patients with complete data at each time point.
CPRP Outcomes in Patients with Comorbid Chronic Pain and Addiction

There has been a steep increase in the prevalence of comorbid chronic pain and addiction. When diagnosed with an addiction, patients in the CPRP receive education and start 12-step meetings. At the time of discharge, recommendations are made for additional treatment. All patients are weaned from habituating substances, regardless of addiction status.

Relapse Rates in Patients with Addiction (N = 219)

January 2007 – October 2011

<table>
<thead>
<tr>
<th>12-Month Relapse Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patients with Addiction</th>
<th>Patients without Addiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>159</td>
</tr>
</tbody>
</table>

There was no difference in relapse rates at one-year follow-up between those with a diagnosis of addiction and those without (P = 0.60). Overall, 21 percent of the 219 patients reported at 12 months they had resumed use of opiates and/or habituating sedatives. Patients resuming opiates and/or habituating sedatives reported higher levels of pain, depression, anxiety and functional impairment both at discharge (P < 0.03) and at 12 months (P < 0.01). Results suggest resumption is related to self-reported levels of pain, mood and functional impairment, and that weaning in the context of interdisciplinary CPRP treatment results in a relatively low resumption rate.
Cleveland Clinic’s Pediatric Neurology and Neurosurgery program is ranked #1 in Ohio for the fifth consecutive year and among the top three programs in America by *U.S. News & World Report* for 2012-2013. Our renowned physician team includes subspecialists in every area. The following outcomes highlight our results for diagnosis and treatment of pediatric neurometabolic disorders, neuromuscular disorders, headache, spasticity and dystonia. Results for treatment of children with epilepsy and sleep disorders are reported in the Epilepsy and Sleep Disorders sections, respectively.

**Pediatric Neurometabolic Clinic**

The term “idiopathic developmental delay” is used to define some 3 percent of the population that has unexplained neurologic and developmental symptoms, including epilepsy. Until recently, this population of children and adults, some with progression of their symptoms for unexplained reasons, remained largely without a diagnosis. With advances in technology and improving diagnostic skills, the ability to reach a conclusive diagnosis in this population has steadily improved. While there is no national standard, tertiary care centers such as ours have the potential to reach a diagnosis 30 to 50 percent of the time.\(^1\)

**Neurometabolic Clinic Diagnostic Yield**

2011

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>350</th>
<th>300</th>
<th>250</th>
<th>200</th>
<th>150</th>
<th>100</th>
<th>50</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Patient Consults</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnosis Established</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In 2011 the Neurometabolic Clinic evaluated 323 patients presenting with unexplained neurologic and/or developmental symptoms, and we were able to establish a diagnosis in 73 patients or 23 percent. In those 73 patients, diagnosis was established using cerebrospinal fluid testing (7 percent), muscle biopsy (5 percent), genetic testing (78 percent), biochemical studies (5 percent) or clinical criteria alone (4 percent). Patients with idiopathic autism are excluded.

Rating of Outpatient Care and Services: Neurometabolic Clinic (N = 11)

2011

Mean Patient Satisfaction Score

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean Score</th>
<th>Benchmark*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Assessment of Care</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Rating of Care Provider's Explanations</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Likelihood of Recommending Care Provider</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Overall Rating of Care Provider</td>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

Providing a diagnosis in a compassionate, comprehensive way greatly impacts patient and family satisfaction. Mean patient satisfaction scores (outpatient medical practice survey results) for a sample of new patients seen in the Neurometabolic Clinic at Cleveland Clinic main campus are higher than benchmark. Higher scores indicate greater patient satisfaction.

*Benchmark: Mean scores for all Press Ganey hospital clients.

Source: Press Ganey, a national hospital survey vendor
**Pediatric Neuromuscular Disease**

**Pediatric Electromyography (EMG)**

Number of Studies

![Graph showing the number of EMG studies from 2007 to 2011.](image)

There are only a few medical centers in the country that provide high-quality EMG for the pediatric population with the option of EMG under sedation, resulting in a more comprehensive examination and less discomfort for the patient.

**Pediatric Headache**

**Improvement in Headache Disability (N = 262)**

2011

**PedsMIDAS© Score/Number of School Days Missed over the Past Three Months**

![Graph showing PedsMIDAS© scores and number of school days missed.](image)

Over 50 percent of pediatric patients treated for headache in 2011 showed an improvement in PedsMIDAS© (Migraine Disability Assessment Score). Nearly 50 percent of patients also noted a reduction in the number of school days missed in the preceding three months. Mean duration of follow-up was 285 days.
**Pediatric Neurological / Neurosurgical Disorders**

**Pediatric Spasticity and Dystonia**

**Pain Level and Spasm Frequency Following Botulinum Toxin Injection**

2011

**Patients (%)**

Overall, botulinum toxin injection appears to have a modest effect on spasticity and dystonia in children, but can produce dramatic improvements in specific cases. Mean duration of follow-up was 222 days for pain level and 198 days for spasm frequency data.

**Goal Attainment Following Botulinum Toxin Injection (N = 40)**

2011

**Patients (%)**

Goal attainment measures how well goals were satisfied after the last botulinum toxin injection. Mean duration of follow-up was 191 days. Goal attainment was as expected or above in all but four patients in 2011.
In this patient sample (of a total of 107 patients treated with botulinum toxin injections in 2011, supplemented by physical therapy), spasticity was well controlled, with few worsening and most remaining stable or improving over a period of up to one year. The Modified Ashworth Scale assesses the degree of spasticity. Adductor Tone Rating estimates the tone of the hip adductor muscles, commonly involved in cerebral palsy and with important implications for daily care. Hip adductor spasticity, if not corrected, promotes hip dislocation. Mobility status is derived from the Gross Motor Functional Classification System (GMFCS), which is a five-level classification system that describes the motor function of patients with spastic/dystonic cerebral palsy. The natural history of children with cerebral palsy, without anti-spasticity management, is slow but progressive worsening of mobility status. The level of mobility as determined by the GMFCS remained either the same or improved in most children with cerebral palsy who received botulinum toxin therapy at Cleveland Clinic.
Outpatient Treatment for Depression

Improvement in Depressive Symptoms in Adult Patients (N = 342)

2011

Mean PHQ-9 Score

Adult outpatients demonstrated a significant improvement in depressive symptoms based on the change in mean Patient Health Questionnaire (PHQ-9) scores from initial evaluation to the last follow-up visit, defined as occurring 90 or more days from the initial evaluation (P = 0.0001). Mean score at follow-up was in the mild illness range (scores from 5 to 10) compared to moderate illness at baseline (scores from 10 to 14). N = patients seen for initial evaluation of major depression from January 1 through December 31, 2011, for whom initial and follow-up data were available. Average duration between initial assessment and follow-up visit was 144 days.
Illness Severity Among Adult Outpatients Treated for Depression

2011

Nearly 70 percent of patients experienced some improvement at follow-up based on the Clinical Global Impression-Improvement scale (CGI-I), which is a seven-point scale that requires the clinician to assess how much a patient’s illness has improved or worsened relative to a baseline assessment. A similar proportion of patients assessed themselves as improved at follow-up based on the self-administered, patient version of the CGI-I, the CGI-P. Nearly 60 percent of patients experienced some therapeutic improvement based on the Clinical Global Impression-Efficacy Index (CGI-E) that assesses the therapeutic effect and side effects of treatment. N = patients seen for initial evaluation of major depression from January 1 through December 31, 2011, for whom initial and follow-up data were available. Average duration of follow-up was 132 days.
Nearly 50 percent of patients experienced an improvement in their overall quality of life as assessed by the EuroQOL (EQ-5D). Outpatients were treated with psychotherapy and/or medication management. N = patients seen for an initial evaluation of major depression from January 1 through December 31, 2011, for whom initial and follow-up data were available. Average duration of follow-up was 133 days.
Consultation Liaison Psychiatry Service

The Consultation Liaison (CL) Psychiatry Service specializes in the interface between medicine and psychiatry. The role of the consultation-liaison psychiatrist is to evaluate, 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. At Cleveland Clinic, the CL Psychiatry Service performs over 3,000 consults annually to adult and child inpatients admitted to medical services.

Reduction in Mental Illness Severity with Inpatient Psychiatry Consultation (N = 130)

May 1 – July 1, 2011

Mean CGI Scale Score

The CGI Severity of Illness Scale is a standardized seven-point scale that requires the clinician to rate the severity of a patient's mental illness at the time of assessment. The CGI is widely used in behavioral health to measure severity of symptoms, with higher scores indicating greater severity of illness. Mean group scores at baseline assessment and at last follow-up are shown for a sample of adult inpatients evaluated and treated by the CL Psychiatry Service from May 1 to July 1, 2011. On average, patients experienced a significant reduction in overall severity of illness following psychiatric consultation (P < 0.0001). Average duration of follow-up from initial consultation to last inpatient assessment was four days.
Inpatient Treatment for Depression

The Mood Disorders Inpatient Unit at Lutheran Hospital opened in late January 2008. Data are presented for patients admitted to this unit from January 1 through July 31, 2011, who completed admission and discharge mood rating scales. Nearly 70 percent of patients were diagnosed with major depression and 23 percent with bipolar disorders (Type I, II, NOS). A total of 208 patients were admitted between January 1 and July 31, 2011; therefore, the 129 patients reported here represent 62 percent of the total patient population.

Improvement in Depressive Symptoms with Inpatient Psychiatric Treatment (N = 129)

January 1 – July 31, 2011

Both the Hamilton Depression Scale and the Montgomery-Asberg Depression Rating Scale (MADRS) are widely accepted and validated instruments to measure severity of depression and response to treatment. Mean group scores on admission and discharge are displayed for patients admitted to the Mood Disorders Unit from January 1 through July 31, 2011. For both scales, there was a statistically significant reduction in mean severity of depression from admission to discharge (P = 0.001). Average duration of hospitalization was 5.5 days.
Mental Illness Severity and Manic Symptoms with Inpatient Psychiatric Treatment (N = 129)

January 1 – July 31, 2011

Mean Score

In 2011, patients treated on the Mood Disorders Unit experienced, on average, a reduction of more than three points in global illness severity (P = 0.001). A CGI score of 2 equates with “minimally ill.” The Young Mania Rating Scale (YMRS) measures the presence of manic or hypomanic symptoms. The majority of patients did not experience excessive activation either at presentation or with treatment, as reflected by low YMRS scores (range 0 to 60) at admission and on discharge. YMRS scores of less than 8 are considered normal. Average duration of hospitalization was 5.5 days.
**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.

**Treatment of Opioid Dependence**

Buprenorphine (Subutex®) and buprenorphine/naloxone (Suboxone®) offer a safer and arguably more effective treatment alternative to methadone for dependence on opioids such as heroin, oxycodone HCl (OxyContin®), acetaminophen and oxycodone (Percocet®), and acetaminophen and hydrocodone (Vicodin®). Buprenorphine attenuates withdrawal symptoms and decreases cravings by partially stimulating the opioid receptor while blocking the effects of other opioids. In addition, support group sessions targeted to the special challenges of this population are mandatory for those early in treatment and encouraged for those with more established sobriety.

**Improvement in Depression and Quality of Life After Six Months of Addiction Treatment (N = 32)**

There is improvement in both PHQ-9 and EQ-5D scores in a cross-sectional sample of newly admitted opiate-dependent patients to the ADRC compared to scores of the same opiate-dependent patients after six months of addiction treatment including buprenorphine. In addition, over the first six months of treatment in the ADRC, 85 percent of patients receiving buprenorphine therapy provided urine samples that tested negative for all nonprescribed substances.
Electroconvulsive (ECT) Therapy

Cleveland Clinic offers electroconvulsive therapy (ECT) services at its main campus as well as at Lutheran Hospital for both inpatients and outpatients. ECT is an effective, safe, traditional form of neuromodulation therapy. ECT may be recommended for individuals with a diagnosis of depression, mania, psychosis or schizophrenia. The ECT service includes a team of specially trained professionals, including psychiatrists, anesthesiologists and nurses.

Improvement in Depressive Symptoms Before and After ECT (N = 30)

Patients show a significant decrease in depressive symptoms with ECT based on PHQ-9 and MADRS scores (P < 0.0001).
Sleep Disorders

Cleveland Clinic’s Sleep Disorders Center provides multidisciplinary care for adults and children with sleep and wake disorders. Comprehensive care is provided through integration of specialists in Neurology, Internal Medicine, Pulmonary and Critical Care Medicine, Psychiatry and Psychology, Pediatrics and Otolaryngology.

**Adult Sleep Studies**

**2011**

**Number of Studies**

<table>
<thead>
<tr>
<th>Year</th>
<th>PSG/EEG</th>
<th>PAP</th>
<th>Split Study</th>
<th>MSLT/MWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
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<td>2010</td>
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<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
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</tr>
</tbody>
</table>

PSG/EEG = Polysomnogram alone or in combination with standard electroencephalography
PAP = Positive airway pressure titration study
Split Study = Combination PSG and PAP titration study
MSLT = Multiple sleep latency test/MWT = Maintenance of wakefulness test

The number of adult sleep studies performed in nine locations across Northeast Ohio has continued to increase over the past five years.
Pediatric Sleep Studies

The number of pediatric sleep studies continues to increase yearly. Children ages 12 and older without special needs can be tested at any one of nine sleep laboratory locations.
Sleep Disorders

Sleep Apnea

Obstructive sleep apnea (OSA) is a common disease that affects millions of people, with an estimated prevalence of 24 percent in men and 9 percent in women. Untreated OSA is associated with multiple medical and psychosocial problems, including hypertension, heart disease, depression and obesity, as well as daytime sleepiness, occupational difficulties, academic struggles and motor vehicle accidents. Positive airway pressure therapy (PAP) is a first-line treatment for OSA that has been shown to reduce or reverse these adverse consequences. The following outcomes reflect data collected on approximately 85 percent of patients followed in the Sleep Disorder Center in 2011.

Positive Airway Pressure (PAP) Adherence in Patients with Sleep Apnea

2011

<table>
<thead>
<tr>
<th>Adherence Rate</th>
<th>Cleveland Clinic</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>(percent of sleep apnea patients using PAP ≥ 4 hours/night)</td>
<td>79%</td>
<td>50%</td>
</tr>
</tbody>
</table>

PAP therapy adherence is most commonly defined as four or more hours of use per night. Most studies report PAP adherence rates in the range of 50 percent in patients with OSA. Patients with OSA who were treated in the Sleep Disorder Center in 2011 had higher adherence rates compared to the national average, due in part to the implementation of a standardized care pathway that ensures regular follow-up visits with health status assessments, aggressive trouble-shooting for challenging cases and close integration of Cleveland Clinic Home Care therapists into the treatment team.
Sleepiness and Fatigue in Patients with OSA Before and After PAP Treatment

2011

Daytime sleepiness, as measured with the Epworth Sleepiness Scale (ESS), decreased in OSA patients who were adherent with PAP therapy. An ESS score less than 10 is considered normal (less sleepy). Daytime fatigue, as measured with the Fatigue Severity Scale (FSS), decreased in OSA patients who were adherent with PAP therapy. Lower FSS scores reflect less daytime fatigue. Average duration of follow-up was 94 days.

Functional Status and Depressive Symptoms Before and After PAP Treatment

2011

Functional status, as measured by the Functional Outcomes of Sleep Questionnaire (FOSQ), improved among OSA patients who were adherent with PAP treatment. The FOSQ is a condition-specific functional status measure designed to evaluate the influence of sleep disorders on activities of daily living. Higher scores indicate higher levels of sleep-related quality of life. Depressive symptoms, as measured with the Patient Health Questionnaire (PHQ-9), improved in PAP-adherent patients. Lower scores indicate fewer depressive symptoms, and a score less than 5 is considered normal. Average duration of follow-up was 94 days.
In a group of OSA patients who were prescribed PAP therapy between 2008 and 2011, depressive symptoms, as measured by PHQ-9 scores, decreased significantly more in patients who were adherent with PAP treatment compared to those who were not. The average PHQ-9 score decreased by almost 4 points in patients who used PAP more than four hours a night, and by 2 points in patients who used PAP less than four hours a night (P = 0.0002). Average duration of follow-up was 94 days.
Insomnia

Insomnia is the inability to sleep when sufficient opportunity to sleep is available, resulting in a decrease in one's daytime ability to function. Insomnia is common; it is estimated that as many as 50 percent of adults have occasional episodes of insomnia, and that 10 percent of adults deal with chronic insomnia. Insomnia is associated with many psychiatric and medical comorbidities, in addition to an economic burden related to increased health care utilization and increased absenteeism from work or school. The preferred treatment for insomnia is Cognitive Behavioral Therapy for Insomnia (CBT-I), which does not involve sedative-hypnotic medications.

Total Sleep Time Before and After Cognitive Behavioral Therapy for Insomnia (CBT-I) (N = 144)

Patients who were evaluated and treated for insomnia by a behavioral sleep medicine expert experienced, on average, an increase in total sleep time of 30 minutes per night after three sessions of CBT-I. CBT-I strategies include stimulus control, sleep restriction and sleep hygiene education. Patients may also engage in biofeedback to learn relaxation techniques. CBT-I can be individualized or can take place in a small group setting. Meta-analyses have shown better outcomes in insomnia patients using CBT-I compared to those using sedative-hypnotic medications alone.
Overall, 63 percent of patients with insomnia who were treated by a behavioral sleep medicine expert with CBT-I showed improvement in the severity of insomnia as measured by the Insomnia Severity Index (ISI) after three sessions. The improvement in ISI score was greatest in patients with severe insomnia. Average duration of follow-up was 92 days.

**Pediatric Sleep Disorders**

**Daytime Sleepiness in Adolescents (N = 29)**

Daytime sleepiness in adolescents, as measured with the Cleveland Adolescent Sleepiness Questionnaire (CASQ), decreased in patients who were seen by a pediatric sleep specialist. The CASQ is used in patients ages 11 to 17 years. Average duration of follow-up from first to last visit was 267 days.
Spinal Disease

The Center for Spine Health provides comprehensive care for a continuum of spinal disorders. Comprehensive care includes medical management, physical therapy, surgical interventions, minimally invasive injection procedures, specialized exercise programs, acupuncture, osteopathic manipulation and referral to an in-house Functional Restoration program, all intended to maximize return to participation in vocational, family and recreational activities.

The Center for Spine Health consists of surgeons, all board-certified in either neurosurgery or orthopedic surgery, and medical specialists board-certified in various fields that include rheumatology, physical medicine and rehabilitation, neurology, internal medicine, sports medicine, pain medicine, psychiatry and psychology.

Lumbar Disc Herniation

Improvement in Functional Status Following Lumbar Microdiscectomy for Disc Herniation

2011

Patients (%)

<table>
<thead>
<tr>
<th></th>
<th>PHQ-9 Score</th>
<th>EQ-5D Score</th>
<th>PDQ Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>74</td>
<td>90</td>
<td>65</td>
</tr>
</tbody>
</table>

Eight-five to 90 percent of patients with symptomatic disc herniation who underwent surgery noted improvement in symptoms of depression as measured by the Patient Health Questionnaire (PHQ-9), health-related quality of life as measured by the EuroQOL (EQ-5D) and physical functioning as measured by the Pain Disability Questionnaire (PDQ).
Patients with disc herniation who elected to receive spinal injections noted improvements in mood, general sense of health, functional ability and pain at a mean time point of greater than 58 days after a single injection. Improvement in pain was noted by nearly 90 percent of patients and was maintained through 130 days, while improvement in other measures was experienced by greater than 70 percent of injection recipients.

Patients who improve following spinal injections to treat painful disc herniation noted, on average, a decrease in depressive symptoms from mild (score 5-10) to minimal (score < 5), as measured by the PHQ-9.

Patients who improve following spinal injections to treat painful disc herniation noted a 55 percent improvement, on average, in health-related quality of life, as measured by the EQ-5D.
Cervical Myelopathy

Improvement in Functional Status Following Spinal Decompression for Cervical Myelopathy

2011

Greater than 85 percent of patients with progressive cervical myelopathy noted improvement in health-related quality of life following surgery as measured by the EQ-5D. Greater than 70 percent of patients who underwent surgery noted improvement in mood and functional status as measured by the PHQ-9 and PDQ, respectively.

Degree of Improvement in Depressive Symptoms in Patients Who Improve Following Spinal Decompression for Cervical Myelopathy (N = 46)

2011

Patients who improved following surgery noted, on average, a 36 percent improvement in depressive symptoms after surgery.

Degree of Improvement in Quality of Life in Patients Who Improve Following Spinal Decompression for Cervical Myelopathy (N = 57)

2011

Cervical spondylotic myelopathy tends to occur in older patients who often have comorbidities that may affect their health-related quality of life. The degree of improvement in health-related quality of life is modest, in those patients who improve following surgery.
Degree of Improvement in Pain Disability in Patients Who Improve Following Spinal Decompression for Cervical Myelopathy (N = 39)

In those patients who improve following surgery for cervical myelopathy, there is a 31 percent improvement in group mean disability scores. Lower PDQ scores reflect less functional impairment.

Degree of Worsening in Pain Disability in Patients Who Do Not Improve Following Spinal Decompression for Cervical Myelopathy (N = 15)

In those patients who do not improve following surgery for cervical myelopathy, there is a 30 percent worsening in group mean disability scores.
Degenerative Spondylolisthesis and Spinal Stenosis: Surgical Treatment

Lumbar degenerative spondylolisthesis is a slippage of one or more vertebral bodies relative to the adjacent vertebral body. This slippage may cause back and leg pain from neurological compression (stenosis) that may impair walking, standing and many aspects of daily function. Surgical treatment typically involves decompression and instrumented fusion.

Improvement in Functional Status Following Lumbar Decompression with Fusion for Spinal Stenosis

2011

Seventy percent of patients who underwent lumbar fusion for spinal stenosis experienced improvement in mood, health-related quality of life and pain disability, as measured by the PHQ-9, EQ-5D and PDQ, respectively.
Patients who underwent successful lumbar fusion for spinal stenosis noted significant reduction in symptoms of depression after surgery. Depressive symptoms decreased from the moderate range to the mild range, with a 46 percent reduction in group mean PHQ-9 scores.

Patients who underwent successful spinal fusion for spinal stenosis experienced very large gains in their global assessment of health. Post-operatively, patients had a global health assessment that approached normal for the population over 55 years of age.
Degree of Improvement in Pain Disability in Patients Who Improve Following Lumbar Decompression with Fusion for Spinal Stenosis (N = 59)

2011

Mean PDQ Score

In patients who improve following surgery for spinal stenosis, there is a 40 percent improvement in group mean pain disability scores.

Degree of Worsening in Pain Disability in Patients Who Do Not Improve Following Lumbar Decompression with Fusion for Spinal Stenosis (N = 23)

2011

Mean PDQ Score

Although 72 percent of patients did improve, 28 percent failed to improve in physical ability after undergoing decompression and fusion to relieve symptoms of spinal stenosis. In those patients who did not improve following surgery, group mean disability scores worsened by 26 percent; postsurgical scores remained in the mild/moderate disability range.
Spinal Disease

Improvement in Functional Status Following Lumbar Decompression Without Fusion for Spinal Stenosis

2011

Patients (%)

<table>
<thead>
<tr>
<th>Patients (N)</th>
<th>PHQ-9 Score</th>
<th>EQ-5D Score</th>
<th>PDQ Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>203</td>
<td>226</td>
<td>168</td>
</tr>
</tbody>
</table>

Over 70 percent of patients who underwent lumbar decompression without fusion noted improvement in their pain disability after surgery. Nearly 80 percent of patients noted improvement in depression symptoms after surgery, and more than 80 percent of patients rated their health-related quality of life improved after surgery.

Degree of Improvement in Depressive Symptoms in Patients Who Improve Following Lumbar Decompression Without Fusion for Spinal Stenosis (N = 159)

2011

Mean PHQ-9 Score

Before | After

Surgery
Degree of Improvement in Quality of Life in Patients Who Improve Following Lumbar Decompression Without Fusion for Spinal Stenosis (N = 189)

2011

Mean EQ-5D Index Score

Health-related quality of life improved by 50 percent after surgery when compared to presurgical status, even though patients with lumbar spinal stenosis tend to be elderly and may have other comorbidities that contribute to a lower baseline assessment of global health.

Degree of Improvement in Pain Disability in Patients Who Improve Following Lumbar Decompression Without Fusion for Spinal Stenosis (N = 120)

2011

Mean PDQ Score

Patients who improved following lumbar decompression without fusion for spinal stenosis noted nearly a 50 percent improvement in physical function. Function improved from severe to mild-moderate impairment.
Degenerative Spondylolisthesis and Spinal Stenosis: Nonsurgical Interventions

Symptomatic lumbar spinal stenosis may produce leg pain with walking or standing. In carefully selected patients, particularly those who are older with significant comorbidities, spinal epidural steroid injections performed by a Center for Spine Health interventionalist may provide an effective alternative to surgery.

Improvement in Functional Status Following Epidural Injection for Lumbar Spinal Stenosis

患者 (%)

<table>
<thead>
<tr>
<th></th>
<th>Improved 20%</th>
<th>Slightly Improved &lt; 20%</th>
<th>Stable or Worsened</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQ-9 Score</td>
<td>79</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>EQ-5D Score</td>
<td>108</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>PDQ Score</td>
<td>66</td>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>Pain Score</td>
<td>112</td>
<td>32</td>
<td>1</td>
</tr>
</tbody>
</table>

N =

Patients with symptomatic spinal stenosis noted sustained improvement beyond a mean of 67 days after injection. More than 90 percent of patients undergoing a single injection noted improvement in pain. More than 70 percent of patients noted improvement in mood and health-related quality of life, as measured by the PHQ-9 and EQ-5D, respectively. More than 60 percent of patients noted improvement in function after a single injection.
Improvement in Functional Status Following Acupuncture for Lumbar Spinal Stenosis

2011

Patients (%)

Of patients who completed more than six sessions of acupuncture, more than 65 percent reported improvement in mood and more than 70 percent reported improvement in quality of life as measured by the PHQ-9 and EQ-5D, respectively. More than 80 percent saw an improvement in pain level.
Mortality

Thirty-Day Postoperative Mortality Rate Following Spinal Surgery (N = 1,908)

2011

The 30-day postoperative mortality rate following spinal surgery in 2011 was 0.0026, compared to a rate of 0.003 for the NSQIP Database\(^1\) and a rate of 0.004 for the Medicare database.\(^2\)

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Surgical Site Infections

Surgical Site Infection Rates for Spinal Surgery (N = 1,395)

2011

![Bar chart showing surgical site infection rates for spinal surgery.](chart)

An ongoing effort to reduce infection includes a nasal Staphylococcus aureus decolonization protocol, a preoperative decontamination shower at home and a new perioperative scrub protocol. The overall postoperative infection rate of 2.9 percent compares to an overall infection rate of 2.1 percent reported in the literature recently, with the latest available level I prognostic data providing a range of 1.4 to 4.2 percent. Surgeries without spinal implants (non-instrumented) have a lower infection rate. Surgeries with spinal instrumentation are often longer and more complicated surgeries with a correspondingly higher infection rate. The mean infection rate for instrumented fusion was 3.8 percent in 2011, compared to a reference rate of 4.2 percent for adult kyphosis.

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Improvement in Comorbid Depressive Symptoms Following Outpatient Physical Medicine and Rehabilitation (N = 411)

The Department of Physical Medicine and Rehabilitation offers full cross-disciplinary rehabilitation for patients with physical, psychosocial, cognitive and vocational impairments. Both Neurological and Musculoskeletal patient groups experienced improvement in depressive symptoms, as measured with the Patient Health Questionnaire (PHQ-9), comparing first visit with last visit in 2011. Mean duration between visits was 138 days for patients with a primary neurological diagnosis and 119 days for patients with a primary musculoskeletal diagnosis. Musculoskeletal diagnoses include spondylosis, lumbago, back pain, disc disorders, spinal stenosis and joint disorders, with spine-related disorders accounting for more than 45 percent of all outpatient encounters with board-certified physiatrists. Neurological conditions include stroke with hemiplegia, multiple sclerosis, movement disorders, peripheral neuropathy, mononeuritis, muscular dystrophy and pain.
Improvement in Quality of Life Following Outpatient Physical Medicine and Rehabilitation (N = 455)

2011

<table>
<thead>
<tr>
<th></th>
<th>Initial Visit</th>
<th>Final Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurological Disorders</td>
<td>0.75</td>
<td>0.80</td>
</tr>
<tr>
<td>Musculoskeletal Disorders</td>
<td>0.38</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Both Neurological and Musculoskeletal patient groups experienced improvement in quality of life, as measured with the EuroQOL (EQ-5D), comparing first visit with last visit in 2011. Mean duration between visits was 118 days for patients with a primary neurological diagnosis and 113 days for patients with a primary musculoskeletal diagnosis.
Outpatient Occupational Therapy

Improvement in Upper Limb Function Following Therapy for Musculoskeletal Disorders (N = 344)

2011

Mean QuickDASH Score

QuickDASH (Disabilities of the Arm, Shoulder and Hand) is a widely used tool in both clinical and research settings and has proven to be a useful self-report outcome measure for people with musculoskeletal upper-limb disorders (injuries or disorders involving the soft tissue, peripheral nerves, bones or ligaments of the upper extremity). The QuickDASH uses 11 items to measure physical function and symptoms in persons with one or more musculoskeletal disorders of the upper limb. The scores range from 0 to 100, and a higher score indicates greater disability. Patients seen by Cleveland Clinic occupational therapists had an average initial QuickDASH score of 53.4. At the final visit, the group average score decreased to 18.8. Average duration between visits (average course of therapy) was 65 days.
Rehabilitation in Inpatient Rehabilitation Facilities

Length of Stay (LOS) Efficiency for Stroke Inpatient Rehabilitation

Change in FIM Score / LOS

<table>
<thead>
<tr>
<th>Year</th>
<th>Cleveland Clinic</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2.00</td>
<td>1.75</td>
</tr>
<tr>
<td>2008</td>
<td>2.10</td>
<td>1.80</td>
</tr>
<tr>
<td>2009</td>
<td>2.20</td>
<td>1.90</td>
</tr>
<tr>
<td>2010</td>
<td>2.30</td>
<td>2.00</td>
</tr>
<tr>
<td>2011</td>
<td>2.40</td>
<td>2.10</td>
</tr>
</tbody>
</table>

Outcomes are shown for all stroke patients at Cleveland Clinic Rehabilitation Hospitals, also known as inpatient rehabilitation facilities, using the Uniform Data System for Medical Rehabilitation (UDS-MR) data set (Rehabilitation Impairment Category/RIC Group 01). Length of stay (LOS) efficiency compares the functional improvement (FIM) gains made during the rehab stay with the LOS required to make the gains (FIM change/LOS). Data are aggregated from Cleveland Clinic Rehabilitation Hospitals at Euclid Hospital (46 beds), Lakewood Hospital (15 beds) and Cleveland Clinic’s main campus (10 beds) and compared to the national average, and is case-mix adjusted by the UDS-MR database. Case mix values for each unit are 1.54 at Euclid, 1.28 at Lakewood and 1.38 at main campus. Data suggest that Cleveland Clinic Rehabilitation Hospitals return patients to a higher level of function in a shorter amount of time than the national average.
Physical and Occupational Therapy in Acute Hospital Setting

Changes in Functional Status Following Therapy in Acute Hospital Setting

2011

The goal of rehabilitation is to enable a patient to become more independent in performing activities of daily living, such as bed mobility, dressing and transferring. Patients admitted to Cleveland Clinic acute care hospitals were evaluated at admission and at discharge. Ninety-three percent of our acute care patients had stable or improved ability to perform these functional tasks. Data above represent the 35 percent to 46 percent of all acute care patients treated by physical and occupational therapy at Cleveland Clinic's main campus for whom complete data could be collected at both admission and discharge. Data were obtained from the MediLinks® rehabilitation clinical information system.

For the next three graphs, the patient’s ability to independently perform the indicated task was scored as follows: independent or supervised = patient was able to perform the task independently or with some supervision; moderate to minimum assist = patient required some assistance; and total or maximum assist = patient required maximum assistance from caregivers to perform the task. Data were obtained from the MediLinks rehabilitation clinical information system.
Improvement in Bed Mobility (N = 7,559) 2011

Bed mobility, a functional task, was evaluated at admission to the acute care unit and at discharge from the unit; average duration between evaluations was nine days.

Improvement in Dressing Ability (N = 7,101) 2011

The ability to dress independently, a functional task, was evaluated at admission to the acute care unit and at discharge from the unit, with average duration between evaluations of nine days.

Improvement in Transfer Ability (N = 9,455) 2011

The ability to transfer independently, a functional task, was evaluated at admission to the acute care unit and at discharge from the unit, with average duration between evaluations of nine days. Data represent the 46 percent of all patients treated by physical therapy for whom complete data could be collected at both admission and discharge. At the end of the acute hospital stay, the number of patients with a high level of independence more than doubled.
The responsibility for interpretation of CT and CT angiography (CTA) for Cleveland Clinic and its regional hospitals was transferred to the Center for Neuroimaging in 2011. Current guidelines dictate that a patient presenting with an acute stroke (brain attack) should receive a noncontrast head CT, with the interpretation communicated to the responsible licensed caregiver within 20 minutes of acquisition.

Brain Attack Head CT Reporting Turnaround Times (N = 1,827)

2011

Mean Turnaround Time (Minutes)

The numbers 1 through 11 reflect Cleveland Clinic’s main campus and regional hospitals (Euclid Hospital, Fairview Hospital, Hillcrest Hospital, Huron Hospital, Lakewood Hospital, Lutheran Hospital, Marymount Hospital, Medina Hospital, South Pointe Hospital and Ashtabula County Medical Center). CCHS Overall is the mean reporting turnaround time for all hospitals in Cleveland Clinic’s Health System. N = the number of brain attack head CTs performed at these locations in 2011.
Across Cleveland Clinic’s main campus and regional hospitals in 2011, 90 percent of results were communicated within 20 minutes of acquisition. Although variability still remains within the health system, compliance remains high and centralization has helped to standardize and streamline the process. The numbers 1 through 11 reflect individual hospitals. \( N \) = the number of brain attack head CTs performed at these locations in 2011.
During 2011, the Center for Neuroimaging modified its call paradigm to provide true 24/7 coverage for the entire Cleveland Clinic health system. In 2010, the second shift responsibilities were modified to provide prompt interpretations of all inpatient, emergency room and STAT neuroradiology studies across the enterprise. Third shift duties were expanded in early 2011 to mirror the responsibilities of the first two shifts. As a result, all STAT inpatient and emergency room studies that occur during the third shift are now read more expeditiously to manage the most critical patients. This arrangement also now makes one of the Center’s neuroradiology staff more readily available for consultation around the clock. Targets for turnaround time for exam-to-notification are 30 minutes for emergency room patients, 6 hours for inpatients and 12 hours for outpatients. Although still within the goal of 12 hours, we are working to reduce the mean turnaround time for outpatients during the second shift.
National Surgical Quality Improvement Program

The American College of Surgeons’ National Surgical Quality Improvement Program (NSQIP) objectively measures and reports risk-adjusted surgical outcomes based on a defined sampling and abstraction methodology. The outcome data below reflect Cleveland Clinic’s surgical cases between July 1, 2010, and June 30, 2011.

Overall Multispecialty Outcomes (N = 4,643)

July 2010 – June 2011

Neurosurgery Outcomes

July 2010 – June 2011

Overall multispecialty mortality was lower than expected, and 30-day morbidity was higher than expected; the differences were statistically significant.

Neurosurgery morbidity and surgical site infection were higher than expected; however, the differences were not statistically significant.
Surgical Care Improvement Program (SCIP) — Appropriateness of Care

This composite metric, based on 10 hospital surgical quality process measures developed by the Centers for Medicare and Medicaid Services (CMS), shows the percentage of patients who received all of the recommended care for which they were eligible.

Surgical Appropriateness of Care

2010 – 2011

Cleveland Clinic has set a target of UHC’s 90th percentile, and results are trending positively.

* Source: University HealthSystem Consortium (UHC) Clinical Database
https://www.uhc.edu
Cleveland Clinic is dedicated to delivering excellent clinical outcomes and the best possible experience for our patients and their families. Patient feedback is critical in driving priorities and assessing results. Based on this feedback, Cleveland Clinic’s Office of Patient Experience implements training programs to improve service and communication as well as educational initiatives to help patients understand what to expect when they are in our care.

**Outpatient — Neurological Institute**

**Overall Rating of Outpatient Care and Services During Outpatient Visit**

**2010 – 2011**

<table>
<thead>
<tr>
<th>Percent</th>
<th>2010 (N = 2,682)</th>
<th>2011 (N = 4,696)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Good</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Fair</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very Poor</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Press Ganey, a national hospital survey vendor
### Rating of Outpatient Care Provider
#### 2010 – 2011

![Bar chart showing the rating of outpatient care provider from 2010 to 2011. The chart compares the percent of patients rating their care provider very good, good, fair, poor, and very poor in 2010 (N = 2,682) and 2011 (N = 4,696).]

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

### Likelihood of Recommending Outpatient Care Provider
#### 2010 – 2011

![Bar chart showing the likelihood of recommending outpatient care provider from 2010 to 2011. The chart compares the percent of patients rating their likelihood of recommending their care provider very good, good, fair, poor, and very poor in 2010 (N = 2,682) and 2011 (N = 4,696).]

*Source: Press Ganey, a national hospital survey vendor*
Inpatient — Neurological Institute

The Centers for Medicare and Medicaid Services (CMS) 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 hospitalcompare.hhs.gov.

HCAHPS Overall Assessment
2010 – 2011

<table>
<thead>
<tr>
<th>Percent</th>
<th>2010 (N = 1,528)</th>
<th>2011 (N = 1,310)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate Hospital % 9 or 10 (0 – 10 scale)</td>
<td>72%</td>
<td>74%</td>
</tr>
<tr>
<td>Would Recommend % “definitely yes”</td>
<td>80%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Source: Press Ganey, a national hospital survey vendor
HCAHPS Domains of Care
2010 – 2011

Source: Press Ganey, a national hospital survey vendor
The Neurological Institute staff authored more than 600 publications in 2011.

For a complete list of publications authored by Neurological Institute staff in 2011, go to clevelandclinic.org/outcomes

Brain Tumor and Neuro-Oncology Center


Center for Neurological Restoration


Center for Pediatric Neurology and Neurosurgery

Selected Publications

**Center for Regional Neurology**


**Center for Spine Health**


Cerebrovascular Center


Number of new patients enrolled in clinical research projects in 2011 was 1,362.
**Epilepsy Center**


**Lou Ruvo Center for Brain Health**


**Mellen Center for Multiple Sclerosis**


Neurological Center for Pain


Neuromuscular Center


**Department of Physical Medicine & Rehabilitation**


**Department of Psychiatry & Psychology**


Selected Publications


Sleep Disorders Center


Imaging Institute Selected Publications


**Emergency Services Institute Selected Publications**


Cerebrovascular Center

Utilizing the Pipeline™ Embolization Device to Treat Intracranial Aneurysms

The Cerebrovascular Center is one of the first centers in the United States approved to use the Pipeline™ Embolization Device (Pipeline or PED), which received FDA premarket approval in April 2011. Pipeline allows for true reconstruction of large or giant wide-necked intracranial aneurysms. It is a fine-mesh stent that diverts blood flow away from the aneurysm in order to provide a complete and durable embolization while maintaining patency of the parent vessel. Essentially, it provides a potential cure for patients who otherwise have very poor long-term prognoses.

Proximal carotid artery aneurysms larger than 1 cm in diameter, which are often dysplastic, are notorious for returning after surgery or endovascular procedures. The Pipeline stent, which has seen success in Europe and South America for more than a year, allows for aneurysm repair that previously would have been dangerous or impossible.

Previously, even for experienced neurosurgeons, the risks and outcomes with these large and giant aneurysms have been difficult to predict. There were three choices:

- palliative treatment only,
- traditional brain surgery, in which a hairpin clip is inserted under the cranium, pinching the bubble of the aneurysm shut and allowing the brain and vessels to return to their natural shape, or
- an endovascular procedure, in which a catheter is inserted at the thigh and, under X-ray, navigated to the head to allow the insertion of a stent. In some cases, these stents successfully circumvented the aneurysm but were not successful in preserving the blood vessel. In addition, for aneurysms with no defined bubble, such as dysplastic aneurysms, placement of the stent was challenging.

Pipeline gives the Cerebrovascular Center another option, one specifically designed for this type of large aneurysm, which, even if surgery or an endovascular procedure is successful, often will recur.

Previous generations of stents have allowed us to remodel the vessel around the aneurysm. Stents in general led to good outcomes in many cases by generating not only mechanical benefits (i.e., propping up the vessel wall), but biological benefits as well. As the vessel remodels itself, the vessel lining can actually grow over the stent, further strengthening the vessel. However, older stents, because of their mesh construction, have not been completely successful at redirecting blood flow; blood can, in fact, simply flow through the mesh.
The new device provides a mesh so tightly woven that it redirects blood flow past the aneurysm so that the aneurysm can clot off and heal over itself. The international success rate with this flow-diverting stent has been impressive: 90 to 95 percent of the aneurysms treated with PED have not recurred.\(^1,2\)


Epilepsy Center

Expanding the Capability for Integrated Continuous Video EEG Monitoring

Over the past three years, the Epilepsy Center has expanded the scope of video EEG monitoring to include a larger epilepsy monitoring unit, an expanded pediatric monitoring unit and portable units throughout the hospital with a focus on ICU patients. In addition, we have started to develop a network of affiliated hospitals that will also have video EEG reviewed and interpreted by Epilepsy Center staff. On any given day, video EEG might be used to monitor status epilepticus in a coma patient in the ICU, a patient with invasive electrodes for presurgical localization/mapping of the epileptic focus and patients undergoing diagnostic evaluations. An integrated structure and system for the continuous monitoring of this diverse patient population was devised to offer comprehensive care in a 24-hour-per-day coverage model. The continuous monitoring room allows us not only to provide continuous EEG for many needs in the hospital and network, but also to assure requesting physicians that the EEG is being constantly reviewed and interpreted.
Lou Ruvo Center for Brain Health

Providing a Growing Number of Clinical Trials to Advance Treatments for Dementia

The rising number of patients with Alzheimer’s disease (AD) and other disorders associated with aging requires the development of new, more effective treatments. The high volume, high quality and distributed geography of Cleveland Clinic optimally position it to integrate translational research into clinical care. The Lou Ruvo Center for Brain Health is committed to using its multisite organizational structure to conduct clinical trials and develop new therapies for AD and related disorders.

There has been tremendous growth in the number of trials conducted by the Center between January 2011 and January 2012. Offering patients the opportunity to participate in clinical trials is a critical part of the mission of the Lou Ruvo Center for Brain Health.

Most of the growth in clinical trials conducted by the Center has involved patients with AD (growing from six trials in January 2011 to 17 in January 2012). However, the Lou Ruvo Center for Brain Health in Nevada collaborates with the Center for Neurorestoration to also conduct trials in Parkinson’s disease and Huntington’s disease. In addition, the Center is actively engaged in trials of boxers and mixed martial arts combatants to better understand the effects of repeated traumatic brain injury.

The Center has a diverse portfolio of types of trials, which have changed over time. As of January 2012, the Center conducted trials of new medications (Phase II and Phase III) and devices (magnetic brain stimulation) as well as observational studies involving multiple biomarkers (as part of the AD Neuroimaging Initiative (ADNI)), brain imaging and blood-based biomarkers.

Biomarkers have become increasingly important in AD diagnosis, dementia differential diagnosis and drug development for AD. Trials currently being conducted by the Center include volumetric magnetic resonance imaging (MRI), amyloid imaging with the positron emission tomography (PET) ligand av-45, cerebrospinal fluid (CSF) biomarkers, fluorodeoxyglucose (FDG) PET imaging and a dopamine system biomarker using PET ligand av-133.
Mellen Center for Multiple Sclerosis Treatment and Research

Utilizing Shared Medical Visits to Deliver Quality Multiple Sclerosis Care Efficiently

The Advanced Practice Clinicians (APCs) at the Mellen Center introduced a model of Shared Medical Visits in 2011 when a new drug, fingolimod (Gilenya™), was FDA approved for relapsing-remitting multiple sclerosis (MS). The FDA required a six-hour monitoring visit with the first dose of this new oral agent. The Shared Medical Visit (SMV) was seen as an opportunity to provide patients with education regarding the new medication and appropriate monitoring, as well as an efficient way to make this new, high-demand oral drug available to patients in a reasonable time frame. The SMV concept allowed the Center to provide this drug to approximately 880 patients in 2011.

What Is a Shared Medical Visit?

SMVs include one-on-one time between the clinician and the patient in a group setting. These unique visits allow the clinician to address each patient’s individual medical needs, while allowing the patient to benefit from common patient issues by discussing these as a group. The focus throughout is on delivering quality medical care efficiently.

Shared Medical Visits:
- provide access to one of our busiest services,
- decrease wait time for follow-up patients,
- leverage resources to boost productivity,
- provide access to additional services as needed,
- increase physician and staff satisfaction,
- provide more time with the clinician,
- offer relaxed, personalized quality care,
- offer more effective patient education,
- provide more attention to patients’ psychosocial needs,
- provide help and support from other patients, and
- allow closer follow-up care.
How does the visit occur?

- Prior to the SMV for first dose, the APC reviews all charts to ensure all pre-fingolimod testing has been completed and patient has been cleared to start new medication.
- Patients are informed in advance that the visit will be in a group setting.
- At the onset of the session, patients sign a HIPAA waiver form.
- If family members or other support persons are present, they must also sign a HIPAA waiver form.
- The medical assistant initiates vital sign monitoring which is repeated throughout the session.
- The APC reviews all vital signs, and obtains and dispenses medication.
- The APC gives a formal educational presentation.
- The APC initiates group conversation answering all questions.
- After the general educational session, each patient is individually assessed.

As part of a quality improvement project, 272 patients completed a satisfaction questionnaire at the end of the SMV for fingolimod first dose. Overall, patients were satisfied with the visit format.
Utilizing the GAITRite™ Electronic Walkway to Assess Gait and Efficacy of Treatment

The Mellen Center neurorehabilitation clinic is an important component of the Mellen Center’s mission to provide comprehensive care to MS patients. The rehabilitation effort includes a specific focus on the management of spasticity and walking limitations in MS. To better characterize gait disorders and to measure the efficacy of rehabilitation, symptomatic medications and assistive devices, both in the clinic and in research studies, the Center routinely conducts gait analysis using the GAITRite electronic walkway. The GAITRite system allows the collection and analysis of spatiotemporal parameters of gait within a few minutes, making it compatible with the flow of a busy outpatient clinic.

We reviewed all MS patients who underwent gait analysis between January 1, 2010, and November 30, 2011, in our neurorehabilitation clinic, analyzing the differences in gait pattern resulting from various instructions given to patients (“walk at a comfortable pace” versus “walk at maximum but safe pace”) and at various levels of walking disability. Data demonstrate that subtle changes in the instructions given to patients can produce significant differences in gait patterns. The GAITRite system provides a valuable tool to assess multiple quantitative gait parameters and is being used to evaluate efficacy of specific therapies. For instance, we used the GAITRite system to demonstrate the efficacy of a music therapy technique called Rhythmic Auditory Stimulation (RAS) on walking performance in ambulatory MS patients. Ten patients with MS and gait disturbance were randomly assigned to receive RAS versus no intervention for two weeks. Participants receiving RAS were provided songs whose tempo was 10 percent above the participant’s spontaneous cadence and were instructed to walk to the music 20 minutes daily. Quantitative gait parameters were assessed using the GAITRite system. Results demonstrated significant improvement in multiple gait parameters after one week of treatment.

**Center for Neuroimaging**

**Identifying Candidates for Intra-Arterial Stroke Therapy with Hyperacute Stroke MRI**

A multimodality CT study has been the standard at many institutions to make decisions regarding acute intra-arterial therapy for patients presenting with acute strokes. The Center for Neuroimaging and the Cerebrovascular Center have investigated the utility of a Hyperacute Stroke MRI protocol in those patients with large vessel occlusion and minimal or no evidence of a hyperacute infarct on CT angiography (CTA) and CT, respectively.

After more than one year of clinical experience, a retrospective comparison of two groups, one before and one after implementation of the Hyperacute Stroke MRI protocol, demonstrated better outcomes after implementation (see pages 36-37). Extensive coordination between our services, the Emergency Department and Critical Care transport has been successful in improving throughput for these patients and overcoming the MR safety concerns.

**Standardizing the Interpretation of Brain Attack CT Studies Across Cleveland Clinic Health System**

Brain attack CT studies have become increasingly important as all the hospitals in Cleveland Clinic health system are certified or are in the process of becoming certified as Joint Commission-designated Primary Stroke Centers in the Cleveland area under the guidance of the Cerebrovascular Center. Because the decision to treat brain-attack patients with intravenous or intra-arterial therapy is critical for acute patient management and the decision-making process pertaining to patient transfer to neurological hospitals in the health system, the Center for Neuroimaging has assumed responsibility for interpreting the CTs and CTAs in the multimodality CT study across the entire health system. This arrangement has not only improved and standardized the interpretation of the studies, but also has served as an impetus to improve and standardize the acute stroke patient throughput in our Emergency and Radiology departments.
Implementing Voxel-Based Morphometry to Identify Epilepsy-Associated Lesions

Epilepsy is a lifelong devastating disease, but is potentially curable if the seizure-generating focus in the brain can be surgically resected. The practical problem is correct identification of this focus. One of the strongest predictors of successful surgery is an MRI-visible structural lesion; however, many patients have developmental lesions that are barely visible or completely invisible. We are starting to implement advanced image processing techniques to increase the conspicuity of MRI lesions that are barely visible and may go unnoticed by a neuroradiologist during routine review of the images. Called voxel-based morphometry (VBM), this method aids the Epilepsy Center by effectively serving as a computer-aided detection mechanism, similar to strategies used in mammography to improve the detection of breast lesions. Initial studies are under way, demonstrating the utility of VBM for MRIs initially read as normal, and two grants have been received to extend these studies to verify their clinical utility.

Figure 1. Example of VBM highlighting a subtle developmental abnormality in an epilepsy patient whose MRI was initially read as normal. Retrospectively the lesion can be seen on MRI, but these small abnormalities can be difficult to identify within the numerous folds of the brain. Thus, VBM acts as computer-aided detection, helping to identify regions of the brain that warrant closer inspection for subtle lesions.
Measuring Brain Connectivity More Efficiently

Newly invented techniques to measure brain connectivity represent a new chapter in the study of the brain, particularly in diseased states. Although there are many methods available in MRI to measure brain connectivity, growing research indicates that “probabilistic” methods are superior to “deterministic” methods. The drawback of the probabilistic methods is that they may require an inordinate amount of computing time and power. We have invented a method that equivalently solved the deterministic images, but with markedly increased speed. In effect, the method mathematically performs a massively parallel computation and reduces the calculation time from hours to seconds. This will permit the clinical application to track connecting white matter pathways within the brain, between any arbitrary points, regardless of their distance.

Figure 2. Example comparison of probabilistic tracking between two arbitrary points in the human brain, which is important to measure anatomic connectivity. The left image shows a color map of the density of tracks between two points, which took 10 hours to compute on a powerful computer cluster. The right image shows the same computation performed using a partial-differential equation method, in effect a mathematically massively parallel computation of the left image, that was performed within several seconds.
Reducing Motion-Related Artifacts in Magnetic Resonance Spectroscopy

Patient motion during magnetic resonance spectroscopy (MRS) leads to incorrect diagnoses. This is especially problematic when identifying neurotransmitters like GABA, which rely on special spectral editing techniques. We implemented a program to monitor real-time MRS signal for motion-related artifacts. If motion is detected during the online acquisition of data, the technologist is immediately alerted. The technologist then proceeds to stop the acquisition and provides feedback to the subject being scanned. The project is in the final stages of execution and will result in a significant reduction in the frequency of motion-corrupted data, thus improving the efficiency and quality of our MRS research studies.

Improving Efficiency of Motion Correction in Functional MRI

Head motion-induced signal change is a major unsolved problem in functional MRI. Recent advances in microcoil active marker technology have resulted in a possible solution, but at a high cost of efficiency. One of our research staff members has developed a method to remove this efficiency cost with the active marker method. The method is now under active development through Cleveland Clinic Innovations.

Compensating for Image Distortion in Stereotactic Radiosurgery

Stereotactic localization of a lesion in the brain for Gamma Knife® radiosurgery demands a high-resolution, isotropic MRI data set to enable the intraoperative guidance system for the Neurosurgery service. Unfortunately, the stereotactic frame itself causes magnetic field inhomogeneities that induce slight geometric distortions in the MRI images that are significant enough to reduce the accuracy of the 3D spatial localization. One member of our research staff has developed a method to compensate for this image distortion simply by acquiring two slightly different 3D data sets and combining the data through postprocessing, thereby improving the accuracy of the spatial localization for treatment planning.

Assessing Extent of Traumatic Brain Injury with Diffusion Tensor Imaging

Because diffusion tensor imaging (DTI) is sensitive to microstructural differences in axons in cerebral white matter (WM), it has been suggested that diffusion tensor measures can be used to assess axonal damage subsequent to traumatic brain injury (TBI). Previous studies have shown that boxer populations exhibit a significant difference in DTI parameters when compared to a control group. To our knowledge, no study has attempted to relate MRI-derived diffusion measures to measures of fight exposure, such as the number of fights or knock-out history. We investigated the correlation between prior fight exposure (i.e., number of fights and number of concussions) of a fighter population to regional DTI measures, and we found that transverse diffusivity in the body and posterior corpus callosum is positively correlated to the number of knock-outs a fighter has experienced.
Investigating the Effects of Electroconvulsive Therapy on Brain Function Using MRI

Electroconvulsive therapy (ECT) for treatment-resistant major depression has a success rate greater than other therapies, but the mechanisms of action are unknown. Our research staff has collaborated with staff in the Department of Psychiatry in a pilot study investigating the effects of ECT on brain function using functional MRI, functional connectivity MRI, MRS and diffusion-weighted MRI. Preliminary results have concluded that orbitofrontal cortex hyperdeactivation to negative emotional content in treatment-resistant major depression patients is reduced following ECT.

Sleep Disorders Center

Developing an Interactive Online Program to Improve Stress Management and Sleep

GO! to Sleep is an interactive online program developed by specialists in Cleveland Clinic’s Sleep Disorders Center and Wellness Center. This six-week program’s proven methods help patients improve their sleep from the comfort and privacy of their homes. The GO! to Sleep program explains the basic science of sleep and why certain behaviors are detrimental to sleep. Activities, articles, tips and progress charts reinforce participants’ learning to help them get the sleep they need. Each day, participants complete an online sleep log that calculates a daily sleep score. The sleep log is available as a mobile phone app to make tracking sleep even easier. Participants receive individualized feedback and sleep improvement recommendations based on their log and score. Throughout the program, they gain access to six effective relaxation practices designed to improve stress management and sleep.
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24/7 hospital transfers or physician consults
800.553.5056

**Neurological Institute Appointments/Referrals**
216.636.5860 or toll-free 866.588.2264

On the Web at clevelandclinic.org/neuroscience

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**Hospital Patient Information**
216.444.2000

**General Patient Appointments**
216.444.2273 or 800.223.2273

**Referring Physician Center and Hotline**
Cleveland Clinic’s Referring Physician Center has established a 24/7 hotline — 855.REFER.123 (855.733.3712) — to streamline access to our array of medical services. Contact the Referring Physician Center Hotline for information on our clinical specialties and services, to schedule and confirm appointments, for assistance in resolving service-related issues, and to connect with Cleveland Clinic specialists.

**Request for Medical Records**
216.444.2640 or 800.223.2273, ext. 42640

**Medical Concierge**
Complimentary assistance for out-of-state patients and families
800.223.2273, ext. 55580, or email medicalconcierge@ccf.org

**Global Patient Services/International Center**
Complimentary assistance for international patients and families
001.216.444.8184 or visit clevelandclinic.org/gps

**Cleveland Clinic Florida**
Toll-free 866.293.7866

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800.890.2467
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**Avon Lake Family Health Center**
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**Beachwood Family Health and Surgery Center**
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**Broadview Heights Family Health Center**
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**Brunswick Family Health Center**
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**Chagrin Falls Family Health Center**
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Overview

Cleveland Clinic uses a scorecard approach to measure quality, safety and patient experience. In addition, real-time dashboard data are leveraged to drive performance improvement. Although not an exact match to publicly reported data, more timely internal data provide transparency for leaders at all levels of the organization to support improved care in their clinical locations. The following are examples of Cleveland Clinic’s 2011 focus areas and main campus results.

Appropriateness of Care
2010 – 2011

Cleveland Clinic’s goal is for all patients to receive all the recommended care for which they are eligible. An aggregated “all or nothing” measurement approach to monitoring multiple publicly reported process-of-care measures for heart failure, acute myocardial infarction, pneumonia and surgical patients is trending positively.

Mortality
2010 – 2011

Cleveland Clinic’s observed/expected (O/E) mortality ratio outperformed the University HealthSystem Consortium (UHC) academic medical center 50th percentile throughout 2011.

*Source: Performance Accelerator Suite Program maintained by the University HealthSystem Consortium (UHC)
https://www.uhc.edu/
Cleveland Clinic established a 2011 target ICU surveillance rate of 1.33 central line-associated bloodstream infections (CLABSI) per 1,000 central line days, with the goal of reducing our rate by an additional 50 percent over the 2010 results. This 2011 target was met by the end of the year.

* PSI 3 Stage III/IV Pressure Ulcers, PSI 6 Iatrogenic Pneumothorax, PSI 7 CLABSI, PSI 8 Post-Op Hip Fracture, PSI 9 Post-Op Hemorrhage/Hematoma, PSI 11 Post-Op Respiratory Failure, PSI 12 Post-Op PE or DVT, PSI 13 Post-Op Sepsis, PSI 14 Post-Op Wound Dehiscence, PSI 15 Accidental Puncture/Laceration
Hospital-acquired pressure ulcers in Cleveland Clinic ICU patients were below the national average in 2010 and 2011.

Falls in Cleveland Clinic stepdown unit patients were below the national average for most of 2010 and 2011. In 2011, Cleveland Clinic supplemented proactive falls-reduction strategies with after-event huddles to evaluate causality and develop prevention strategies.
Critical Response Outcomes

Medical Emergency Team Event Volume*
2009 – 2011

Events

<table>
<thead>
<tr>
<th>Year</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>2,000</td>
</tr>
<tr>
<td>2010</td>
<td>2,500</td>
</tr>
<tr>
<td>2011</td>
<td>3,000</td>
</tr>
</tbody>
</table>

*Excluding events originating in ORs and ICUs

Percent of Medical Emergency Team Events Resulting in ICU Transfer
2009 – 2011

Percent

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>30</td>
</tr>
<tr>
<td>2010</td>
<td>20</td>
</tr>
<tr>
<td>2011</td>
<td>18</td>
</tr>
</tbody>
</table>

Medical Emergency Teams (METs) bring critical care experience to patients across the hospital and provide early intervention that can prevent unplanned transfers to ICUs. As adult MET activations increased from 2009 through 2011, post-event adult ICU transfers decreased.
Patient Experience — Cleveland Clinic

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey is the standard national tool for measuring patients’ perspectives of hospital care. Results are available at hospitalcompare.hhs.gov.

HCAHPS Rate and Recommend Hospital
2010 – 2011

![Bar chart showing HCAHPS Rate and Recommend Hospital](chart.png)

HCAHPS Hospital Domain Scores
2010 – 2011

![Bar chart showing HCAHPS Hospital Domain Scores](chart.png)

“Patients First” is the guiding principle of Cleveland Clinic, which was among the first major academic medical centers to make improving the patient experience a strategic goal. The Office of Patient Experience collaborates with physician and nursing leadership to establish best practices and implement standardized protocols that ensure delivery of patient-centered care. Campus-wide HCAHPS survey results are trending favorably in every domain.
Overview

Cleveland Clinic is a nonprofit multispecialty academic medical center that integrates clinical and hospital care with research and education. Across the health system, 2,800 Cleveland Clinic physicians and scientists practice in 120 medical specialties and subspecialties, annually recording more than 4.6 million physician visits and nearly 188,000 surgeries. Patients come for treatment from every state and from more than 125 countries annually.

Cleveland Clinic’s main campus, with 50 buildings on 180 acres in Cleveland, Ohio, includes a 1,400-bed hospital, outpatient clinic, specialty institutes, and supporting labs and facilities. The hospital currently has the highest CMS case-mix index in America. Cleveland Clinic also operates 18 family health centers, eight community hospitals, one affiliate hospital, a rehabilitation hospital for children, Cleveland Clinic Florida, Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Cleveland Clinic Canada, and Sheikh Khalifa Medical City. Cleveland Clinic Abu Dhabi (United Arab Emirates), a multispecialty care hospital and clinic, is scheduled to open in 2013. With 41,000 employees, Cleveland Clinic is the second largest employer in Ohio and is responsible for an estimated $9 billion of economic activity every year.

The Cleveland Clinic Model

Cleveland Clinic was founded in 1921 by four 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 model set forth by the founders. 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.

In 2007, Cleveland Clinic restructured its practice, bundling all clinical specialties into integrated practice units called institutes. An institute combines all the specialties surrounding a specific organ or disease system under a single roof. Each institute has a single leader and focuses the energies of multiple professionals on the patient. Institutes are improving the patient experience at Cleveland Clinic.
Cleveland Clinic Lerner Research Institute

At the Lerner Research Institute, hundreds of principal investigators, project scientists, research associates and postdoctoral fellows are involved in laboratory-based, translational and clinical research. Total research expenditures from external and internal sources exceeded $240 million in 2010. Research programs include cardiovascular, cancer, neuralgic, musculoskeletal, allergic and immunologic, eye, metabolic, and infectious diseases.

Cleveland Clinic Lerner College of Medicine

Celebrating its 10th anniversary in 2012, the Lerner College of Medicine of Case Western Reserve University is known for its small class size, unique curriculum and full-tuition scholarships for all students. The program graduated 31 students as physician investigators in 2011.

Graduate Medical Education

In 2011, nearly 1,800 residents and fellows trained at Cleveland Clinic and Cleveland Clinic Florida, the most ever hosted by Cleveland Clinic and part of a continuing upward trend.

U.S. News & World Report Ranking

Cleveland Clinic is consistently ranked among the top hospitals in America by U.S. News & World Report, and our heart and heart surgery program has been ranked No. 1 since 1995.

For more information about Cleveland Clinic, please visit clevelandclinic.org.
Referring Physician Center and Hotline

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Remote Consults

Online medical second opinions from Cleveland Clinic’s MyConsult are particularly valuable for patients who wish to avoid the time and expense of travel. Cleveland Clinic offers online medical second opinions for more than 1,000 life-threatening and life-altering diagnoses. For more information, visit clevelandclinic.org/myconsult, email eclinicalclevelandclinic@ccf.org or call 800.223.2273, ext. 43223.

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Track Your Patient’s Care Online

DrConnect offers referring physicians secure access to their patients’ treatment progress while at Cleveland Clinic. To establish a DrConnect account, visit clevelandclinic.org/drconnect or email drconnect@ccf.org.

Medical Records Online

Cleveland Clinic continues to expand and improve electronic medical records (EMRs) to provide faster, more efficient and accurate care by sharing patient data through a highly secure network. Patients using MyChart can renew prescriptions and review test results and medications from their personal computers. MyChart provides a link to Microsoft HealthVault, a free online service that helps patients securely gather and store health information. It connects to Cleveland Clinic’s social media and Internet site, currently the most visited hospital website in America. For more information, visit clevelandclinic.org/mychart.

Critical Care Transport Worldwide

Cleveland Clinic’s critical care transport team and fleet of mobile ICU vehicles, helicopters and fixed-wing aircraft serve critically ill and highly complex patients across the globe.

To arrange a transfer for STEMI (ST elevated myocardial infarction), acute stroke, ICH (intracerebral hemorrhage), SAH (subarachnoid hemorrhage) or aortic syndrome, call toll-free 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 one of the largest and most successful CME programs in the country. The Center’s website (ccfcmecom) is an educational resource for healthcare providers and the public. Available 24/7, it houses programs that cover topics in 30 areas – if not from A to Z, at least from Allergy to Wellness – with a worldwide reach. Among other resources, the website contains a virtual textbook of medicine (Disease Management Project) and myCME, a system for physicians to manage their CME portfolios. Live courses, however, remain the backbone of the Center’s CME operation. Most live courses are held in Cleveland, but outreach plans are under way. In 2011, the Center offered 15 simultaneous courses at Arab Health, a major world healthcare forum.
This project would not have been possible without the commitment and expertise of many individuals, but in particular Jocelyn Bautista, MD; Irene Katzan, MD; Christine Moore; Janet Perryman; and John Urchek.
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Every life deserves world class care.