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

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

In addition to these institute-based books of clinical outcomes, 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 transparent reporting of accurate, timely information about patient care reflects Cleveland Clinic’s culture of continuous improvement and may help referring physicians make informed decisions.

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

OutcomesBooksFeedback@ccf.org or scan here.

To view all our Outcomes books, please visit Cleveland Clinic’s Quality and Patient Safety website at clevelandclinic.org/outcomes.
Dear Colleague:

Welcome to this 2012 Cleveland Clinic Outcomes book. We distribute Outcomes books for more than 14 specialties. These publications are unique in healthcare. Each one provides a summary overview of medical or surgical trends, innovations, and clinical data for a Cleveland Clinic specialty over the past year.

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. The individual institute defines quality benchmarks for its specialty services and reports longitudinal progress.

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

Our practice of releasing annual outcomes reports has received favorable notice from colleagues, media, and healthcare observers. We appreciate your interest and hope you find this information useful and informative.

Sincerely,

Delos M. Cosgrove, MD
CEO and President
what’s inside

Chairman’s Letter 4
Introduction 5
Institute Overview 6

Quality and Outcomes Measures

Surgical Overview 8
Ischemic Heart Disease 13
Cardiac Rhythm Disorders 21
Valve Disease 27
Aortic Disease 37
Hypertrophic Obstructive Cardiomyopathy 47
Congenital Heart Disease 49
Pericardial Disease 53
Heart Failure and Transplant 55
Lung and Heart-Lung Transplant 58
Peripheral Vascular Diseases 60
Venous Disease 66
Cerebrovascular Disease 67
Thoracic Surgery 68
Preventive Cardiology and Rehabilitation 74
Anesthesia 81
Surgical Quality Improvement 82
Patient Experience — Heart & Vascular Institute 84
Cleveland Clinic — Improving Quality, Safety, and the Patient Experience 86
Innovations 92
Staff Listing 98
Contact Information 107
Institute Locations 108
Alliances and Affiliations 110
About Cleveland Clinic 112
Resources 114
Institute Resources 116

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.
On behalf of the Sydell and Arnold Miller Family Heart & Vascular Institute, I would like to thank you for your interest in our 2012 Outcomes. This is the 15th year we have shared our clinical outcomes with physicians across the country.

Our commitment to quality, safety, innovation, and patient satisfaction helps us remain among the top U.S. hospitals year after year. Our outcomes are enhanced by our dedication to collaboration among experts in Cleveland Clinic’s various institutes. Our patients, some of whom are among the most critically ill in the world, greatly benefit from our ability to share information and develop unique treatment plans.

As the number of options to treat cardiovascular disease continues to grow, so does the challenge of selecting those that are the most effective for each patient. We believe in treating every patient with a level of care that is individualized to their particular needs while providing the greatest efficacy and safety. This requires an equally strong commitment to integrity, excellence, and education.

Bruce W. Lytle, MD
Chairman, Miller Family Heart & Vascular Institute
Cleveland Clinic leads the nation in cardiovascular care and is home to heart, vascular, and thoracic specialists who are among the best in the world. They work with referring physicians to coordinate care and ensure the best possible outcomes and experience for every patient.

The Sydell and Arnold Miller Family Heart & Vascular Institute is located at Cleveland Clinic's main campus. Here, 189 staff physicians, 117 residents and fellows, and 1,400 nurses devote their time and skills to caring for patients with cardiovascular, thoracic, and vascular disease. Comprehensive care includes collaboration with 54 vascular surgery and cardiovascular intensive care anesthesiologists and 3,000 Cleveland Clinic staff physicians in 120 medical and surgical specialties and subspecialties.
## Heart & Vascular Institute Overview

### 2012

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Visits</td>
<td>431,101</td>
</tr>
<tr>
<td>Admissions</td>
<td>13,609</td>
</tr>
<tr>
<td>Beds</td>
<td>416</td>
</tr>
<tr>
<td>Coronary Intensive Care</td>
<td>24</td>
</tr>
<tr>
<td>Heart Failure Intensive Care</td>
<td>10</td>
</tr>
<tr>
<td>Cardiac, Vascular, and Thoracic Surgery IC</td>
<td>76</td>
</tr>
<tr>
<td>Private Patient Rooms</td>
<td>278</td>
</tr>
<tr>
<td>Same-Day Recovery</td>
<td>28</td>
</tr>
</tbody>
</table>

### Surgical Procedures

#### Cardiac Surgery

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac Surgeries</td>
<td>4,262</td>
</tr>
<tr>
<td>Valve Surgeries</td>
<td>2,773</td>
</tr>
<tr>
<td>Coronary Artery Bypass Grafting (Isolated and Concomitant)</td>
<td>1,287</td>
</tr>
<tr>
<td>Surgeries for Septal Myectomy</td>
<td>178</td>
</tr>
<tr>
<td>Congenital Heart Surgeries (Adult and Pediatric)</td>
<td>401</td>
</tr>
<tr>
<td>Robotically Assisted Cardiac Surgeries</td>
<td>116</td>
</tr>
</tbody>
</table>

#### Transplant Surgery

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Transplants</td>
<td>47</td>
</tr>
<tr>
<td>Lung Transplants</td>
<td>104</td>
</tr>
</tbody>
</table>

#### Thoracic Surgery

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Thoracic Surgeries</td>
<td>1,541</td>
</tr>
<tr>
<td>Esophageal Surgeries</td>
<td>189</td>
</tr>
</tbody>
</table>

#### Vascular Surgery

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular Surgeries (Open and Endovascular)</td>
<td>3,133</td>
</tr>
<tr>
<td>Bypass Surgeries</td>
<td>218</td>
</tr>
<tr>
<td>Arteriovenous Access Surgeries</td>
<td>428</td>
</tr>
</tbody>
</table>

The data reported in the Institute Overview reflect volumes at Cleveland Clinic’s main campus only. Data in other areas of the book may reflect volumes for main campus and other Cleveland-area Cleveland Clinic hospitals. A complete list of these hospitals can be found in the Institute Locations section of this book, which begins on Page 108.
In 2012, patients traveled from all 50 states to Cleveland Clinic for their cardiovascular care. Patients from 82 countries came to Cleveland Clinic for their cardiovascular care in 2012.

In 2012, patients traveled from all 50 states to Cleveland Clinic for their cardiovascular care.
Reoperations accounted for 29% of the 4,262 cardiac surgeries performed at Cleveland Clinic's main campus in 2012. Reoperations are more complex and are associated with greater risk than primary (first-time) operations.

Cleveland Clinic surgeons perform procedures at the main campus and at Cleveland Clinic hospitals throughout greater Cleveland. In 2012, they performed 11,446 procedures. A complete list of Cleveland Clinic hospitals is available in the Institute Locations section, which begins on Page 108 of this book.

The majority of surgical procedures performed in 2012 were cardiac surgery at the Heart & Vascular Institute at the main campus.
Cleveland Clinic performs more cardiac surgery than any other hospital in the United States and has the best quality outcomes (lowest observed/expected mortality ratio).

Hospital mortality rates for isolated procedures performed at Cleveland Clinic were lower than the expected rate in 2012. Isolated procedures are those performed without any other surgical procedure.


Abbreviations: CABG, coronary artery bypass graft.
Hospital Mortality — Combined Procedures (N = 329) 2012

The hospital mortality rate for combined procedures at Cleveland Clinic was lower than the expected rate for comparable hospitals in 2012. Combined procedures involve more than one procedure during surgery and are generally more complex than isolated procedures.

O/E Ratio = 0.18 0 0.70

Abbreviations: CABG, coronary artery bypass graft.


Cleveland Clinic surgeons performed 1,541 thoracic surgeries in 2012.
Most of the 7,475 vascular surgeries performed in 2012 were at Cleveland Clinic’s main campus. The remainder were performed at Cleveland Clinic hospitals throughout greater Cleveland. A complete list of these locations is available on Page 108 of this book.

Primary procedures accounted for the majority of cardiovascular procedures at Cleveland Clinic in 2012. The mortality rates for both these primary procedures and reoperations were low.

Major Thoracic Surgery by Type (N = 1,541) 2012

The majority of thoracic surgeries performed at Cleveland Clinic in 2012 were pulmonary procedures.

Vascular Surgery Volume
Main Campus and Other Cleveland Clinic Hospitals
2003 – 2012

Cardiovascular Surgery Volume, Incidence and Mortality
2010 – 2012
Vascular Surgery by Approach (N = 7,475) 2012

The majority of vascular procedures in 2012 were performed using an endovascular approach. The use of endovascular surgery reduces patient morbidity and mortality and results in a shorter recovery time.

Hospital Mortality — Vascular Surgery 2008 – 2012

The 2012 hospital mortality rate for vascular surgery at Cleveland Clinic was 1.84%, which was well below the adjusted average at national teaching hospitals.

Source: Solucient.
Cardiac Catheterization Laboratory Procedures (N = 10,818)

Cleveland Clinic is a regional and national referral center for percutaneous coronary intervention (PCI). In 2012, staff performed 10,818 procedures to treat patients with simple and complex ischemic heart disease.

The data comparisons below demonstrate outcomes at Cleveland Clinic compared with those at hospitals included in the American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR) CathPCI Registry® that perform more than 500 PCIs per year. Data are based on a one-year rolling average; therefore, totals reported here may differ from those reported elsewhere in this book.

Risk Factors Among Patients Undergoing PCI Procedures (N = 1,730)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Cleveland Clinic</th>
<th>Comparable ACC-NCDR Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (&gt; 75 years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute Care Transfer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior MI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior Heart Failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior CABG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe LV Dysfunction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multivessel Disease</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Patients who had PCI procedures at Cleveland Clinic in 2012 had more complex medical backgrounds than patients at comparable hospitals.

Abbreviations: CABG, coronary artery bypass grafting; LV, left ventricular; MI, myocardial infarction.

Use of Adjunctive Medications Before and After PCI Procedures (N = 1,730)

<table>
<thead>
<tr>
<th>Medication</th>
<th>Cleveland Clinic</th>
<th>Comparable ACC-NCDR Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin on Admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thienopyridines</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One of the ACC-NCDR key performance measures is the use of appropriate adjunctive medications before and after PCI procedures. Cleveland Clinic meets or exceeds the administration rates as compared with similar high-volume interventional centers.
The rates of complications associated with PCI procedures were, in most cases, better than those at comparable hospitals.

In 2012, mortality rates among patients who had PCI procedures at Cleveland Clinic were lower than at comparable hospitals.

The American College of Cardiology/American Heart Association (ACC/AHA) practice guidelines recommend PCI balloon inflation within 90 minutes of arrival in the emergency department for patients with ST-elevated myocardial infarction (STEMI). Early reperfusion reduces the risks of morbidity and mortality.
Surgical Treatment for Ischemic Heart Disease (N = 1,287)

CABG Volume
2012

Cleveland Clinic surgeons performed 1,287 coronary artery bypass grafting (CABG) procedures in 2012. Isolated procedures are those performed without any other operation. The majority of CABG procedures were performed in combination with another procedure.

CABG Volume, Primary and Reoperations
2012

The majority of CABG procedures done at Cleveland Clinic in 2012 were primary operations. A primary operation is the first time a patient has a particular procedure.

CABG + Other, Mortality
2012

The mortality rate among patients who had CABG plus another procedure at Cleveland Clinic in 2012 was lower than expected.

Source: University HealthSystem Consortium 2012 discharges.
Isolated CABG Procedures Mortality

Cleveland Clinic surgeons performed 517 isolated CABG procedures in 2012. The mortality rate was lower than expected.


Isolated CABG Mortality — Primary and Reoperation

2012

Many patients are referred to Cleveland Clinic for CABG reoperations due to the complexity of their medical condition and higher risk of mortality. Despite these risks, mortality rates remain lower than expected.

Source: University HealthSystem Consortium 2012 discharges.

STS CABG Quality Ratings*

Overall

Use of Internal Mammary Artery

Medications

Avoidance of Mortality

Avoidance of Morbidity

Cleveland Clinic is among the 15% of hospitals that achieved an overall three-star rating from The Society of Thoracic Surgeons (STS) for CABG surgery. The rating reflects the highest quality of cardiac surgery.

*Based on data comparisons from January 2012 through December 2012.
Primary Isolated CABG: Age-Related Risk of Mortality

2012

As the age of a patient increases, so does the complexity of CABG procedures. The majority of patients who had primary isolated CABG surgery at Cleveland Clinic in 2012 were Age 60 and older. Mortality rates were low.

<table>
<thead>
<tr>
<th>Age</th>
<th>Observed Mortality (%)</th>
<th>Expected Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 years (N = 32)</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>50–59 years (N = 95)</td>
<td>0.0</td>
<td>0.8</td>
</tr>
<tr>
<td>60–69 years (N = 166)</td>
<td>0.6</td>
<td>1.5</td>
</tr>
<tr>
<td>70–79 years (N = 107)</td>
<td>1.9</td>
<td>2.7</td>
</tr>
<tr>
<td>≥ 80 years (N = 38)</td>
<td>2.6</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Total (N = 438)</strong></td>
<td><strong>0.9</strong></td>
<td><strong>1.8</strong></td>
</tr>
</tbody>
</table>

Isolated CABG: Additional Outcomes

Deep Sternal Wound Infection

2012

Cleveland Clinic’s incidence of deep sternal wound infection after isolated CABG surgery was at the expected level in 2012.

Ventilator Time > 24 Hours

2012
It is expected that 10% of patients who have isolated CABG surgery will spend more than 24 hours on a ventilator. At Cleveland Clinic in 2012, the rate was 8.9%.


In-Hospital Reoperation

2012
In 2012, the rate of in-hospital reoperation after isolated CABG surgery was lower than expected.


Postoperative Stroke

2012
A total of 0.8% of patients who had isolated CABG surgery at Cleveland Clinic in 2012 had a stroke following surgery. This is lower than the expected rate of 1.1%.

**Postoperative Renal Failure**

**2012**
The rate of postoperative renal failure among patients who had isolated CABG surgery at Cleveland Clinic in 2012 was lower than the expected rate for comparable hospitals.


**Process Measures**

**2012**
Cleveland Clinic achieved and maintained 100% compliance with all Society of Thoracic Surgeons process measures in 2012. These include the use of a perioperative beta blocker; beta blocker, statin, and aspirin at discharge; and use of an internal mammary artery during isolated CABG surgery.


**Acute Myocardial Infarction Appropriateness of Care**

**2011 – 2012**
This composite metric, based on seven acute myocardial infarction (AMI) hospital quality process measures developed by the Centers for Medicare and Medicaid Services, shows the percentage of patients who received all the recommended care for which they were eligible. Cleveland Clinic has set a target of UHC’s 90th percentile.

*These data are prepared using the University HealthSystem Consortium (UHC) Clinical Database. uhc.edu*
**Acute Myocardial Infarction**

The Centers for Medicare and Medicaid Services (CMS) calculates two AMI outcome measures: all-cause mortality and all-cause readmission rates. Each are based on Medicare claims and enrollment information. Cleveland Clinic’s performance appears below.

**AMI All-Cause 30-Day Mortality (N = 401)**

*July 2009 – June 2012*

<table>
<thead>
<tr>
<th>Percent</th>
<th>Cleveland Clinic</th>
<th>National Average*</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.9</td>
<td></td>
<td>15.2</td>
</tr>
</tbody>
</table>

**AMI All-Cause 30-Day Readmission (N = 664)**

*July 2009 – June 2012*

<table>
<thead>
<tr>
<th>Percent</th>
<th>Cleveland Clinic</th>
<th>National Average*</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.1</td>
<td></td>
<td>18.3</td>
</tr>
</tbody>
</table>

*These data are prepared using the University HealthSystem Consortium (UHC) Clinical Database. [uhc.edu](http://uhc.edu)*

There is no significant difference between Cleveland Clinic’s AMI patient mortality or readmissions rate and the respective national averages. To further reduce avoidable readmissions, a multidisciplinary team is tasked with improving transitions from hospital to home or post-acute facility. Specific initiatives have been implemented in each of these focus areas: communication, education, and follow-up.
Patients Undergoing Electrophysiology Laboratory Procedures (N = 4,952)

2012
Cleveland Clinic electrophysiologists use specialized approaches to diagnose and treat patients with a wide variety of arrhythmias. They are noted for their expertise in ablation procedures and management of patients with pacemakers and defibrillators. The total number of procedures includes some that are not detailed in the graph below.*

Volume

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Extractions</td>
<td>200</td>
<td>200</td>
<td>600</td>
<td>1,000</td>
</tr>
<tr>
<td>CRT (N = 61)</td>
<td>200</td>
<td>200</td>
<td>600</td>
<td>1,000</td>
</tr>
<tr>
<td>Non-CRT (N = 595)</td>
<td>400</td>
<td>400</td>
<td>600</td>
<td>1,400</td>
</tr>
<tr>
<td>CRT (N = 337)</td>
<td>600</td>
<td>600</td>
<td>600</td>
<td>1,800</td>
</tr>
<tr>
<td>Non-CRT (N = 463)</td>
<td>800</td>
<td>800</td>
<td>800</td>
<td>2,400</td>
</tr>
<tr>
<td>CRT (N = 1,353)</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>3,600</td>
</tr>
<tr>
<td>PVAI (N = 819)</td>
<td>1,600</td>
<td>1,600</td>
<td>1,600</td>
<td>4,800</td>
</tr>
<tr>
<td>Other Arrhythmias (N = 381)</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>600</td>
</tr>
<tr>
<td>Ventricular Arrhythmias (N = 236)</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>600</td>
</tr>
</tbody>
</table>

*Other procedures include electrophysiology study, ICD testing, temporary pacer, loop recorders, and electrophysiology specials (endomyocardial biopsy, esophageal pacing, right heart catheterization, venography, and other).

Abbreviations: CRT, cardiac resynchronization therapy; CRT, cardiac resynchronization therapy-defibrillator; ICD, implantable cardioverter defibrillator; PVAI, pulmonary vein antrum isolation.

Pulmonary Vein Antrum Isolation Procedures

Volume

2008 - 2012

Pulmonary vein antrum isolation (PVAI) essentially disconnects the pathway of the abnormal heart rhythm and prevents atrial fibrillation.
Success Rates of PVAI
Success is defined as a restored sinus rhythm without recurrence of atrial fibrillation after the patient has stopped taking antiarrhythmic medications for at least 12 months after the procedure. This is influenced by a number of factors, including the length of time the patient has been in atrial fibrillation (AF) and the presence or absence of underlying heart disease.

In a recent study of 831 patients who underwent pulmonary vein antrum isolation at Cleveland Clinic, 81% of patients with paroxysmal AF were arrhythmia-free while off antiarrhythmic drugs at 12 months post-ablation. Paroxysmal AF is defined as AF that terminates within days without cardioversion. A total of 7.8% of this patient population had AF after one year post-ablation (late-recurrence AF).

The success rate is lower for patients with persistent or long-standing persistent AF (65% for a single ablation procedure) and is affected by the presence of valvular heart disease or other underlying problems.

A total of 161 patients who had early recurrence of AF had a repeat ablation procedure. At 14 months after this ablation, 78.9% were arrhythmia-free while off antiarrhythmic drugs. Of the 27 patients who had late-recurrence AF and a repeat ablation, 74.1% were arrhythmia-free while off antiarrhythmic drugs at 17 months post-second ablation.


PVAI Complications
2012
The overall risk associated with PVAI in 2012 was 2.7%.

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pericardial Tamponade/Pericardiocentesis</td>
<td>9</td>
<td>1.1</td>
</tr>
<tr>
<td>Pericardial Tamponade/Surgical</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Cerebrovascular Accident</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Pulmonary Vein Stenosis</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Atrial Septal Defect</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Pseudoaneurysm</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Hematoma Requiring Transfusion</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Bleeding Requiring Transfusion</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Gastroparesis</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Pacemaker Lead Dislodged</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Priapism</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
<td><strong>2.4</strong></td>
</tr>
</tbody>
</table>

Complications related to the use of cryoballoon ablation: Four patients experienced temporary phrenic nerve paralysis that resolved within six months of the procedure. One additional patient who experienced phrenic nerve paralysis had partial resolution by four months post-ablation and is awaiting additional follow-up testing.

Atrial septal defect was related to sheath size and required percutaneous closure.
Ablation of Ventricular Arrhythmia (N = 236)

2012

Cleveland Clinic is a national referral center for patients with ventricular arrhythmias. A total of 236 ablations to correct ventricular arrhythmias were performed in 2012 with a complete success rate of 81%.

<table>
<thead>
<tr>
<th>Volume</th>
<th>236</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Success Rate</td>
<td>81%</td>
</tr>
</tbody>
</table>

The procedure was partially successful in another 16%. Partial success means at least one arrhythmia was ablated in patients who had multiple arrhythmias. A total of 3% of procedures were unsuccessful. All ventricular arrhythmias were eliminated in 81% of patients.

Complications

A major complication is defined as one that leads to prolongation of hospital stay or to another hospitalization, requires additional intervention for treatment, and/or results in significant injury or death (Aliot et al., 2009, EHRA/HRS Expert Consensus on Catheter Ablation of Ventricular Arrhythmias).

Patients With Ejection Fraction < 50% (N = 128)

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death Within 7 days</td>
<td>1</td>
<td>0.78</td>
</tr>
<tr>
<td>Death Within 30 days</td>
<td>1</td>
<td>0.78</td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>1</td>
<td>0.78</td>
</tr>
<tr>
<td>Complete Heart Block</td>
<td>1</td>
<td>0.78</td>
</tr>
<tr>
<td>Deep Venous Thrombosis</td>
<td>1</td>
<td>0.78</td>
</tr>
<tr>
<td>Pseudoaneurysm</td>
<td>2</td>
<td>1.56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
<td><strong>5.46</strong></td>
</tr>
</tbody>
</table>

Patients With Ejection Fraction ≥ 50% (N = 108)

<table>
<thead>
<tr>
<th>Complications</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial Infarction</td>
<td>1</td>
<td>0.93</td>
</tr>
<tr>
<td>Pericardial Tamponade/Surgical Intervention</td>
<td>2</td>
<td>1.85</td>
</tr>
<tr>
<td>Pericardial Tamponade/Pericardiocentesis</td>
<td>1</td>
<td>0.93</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
<td><strong>3.71</strong></td>
</tr>
</tbody>
</table>
Atrial Fibrillation Surgical Procedure Volume (N = 404)

2012
Cleveland Clinic surgeons performed 404 procedures to treat atrial fibrillation in 2012. These included minimally invasive “keyhole” and classic Maze procedures. In most cases, the surgery included treatment for AF and another cardiac procedure. The overall mortality rate was 0.8% (N = 4).

- **64%** AF + Valve Surgery
  (N = 304; Hospital Mortality, N = 3)

- **21%** AF + Valve Surgery + CABG
  (N = 100; Hospital Mortality, N = 1)

- **7%** AF + CABG (N = 32; Hospital Mortality, N = 0)

- **6%** AF + Other Procedures (N = 7; Hospital Mortality, N = 0)

- **2%** Isolated AF Procedures (N = 7; Hospital Mortality, N = 0)

---

2008 – 2012

- **1.7 average number of leads extracted per procedure**
- **90.7 months average lead age at removal**
- **66.5 months median lead age at removal**
Device Implants (N = 1,456)

Volume

2012

<table>
<thead>
<tr>
<th></th>
<th>ICDs</th>
<th>Pacemakers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>800</td>
<td>656</td>
</tr>
</tbody>
</table>

In 2012, Cleveland Clinic physicians in the electrophysiology laboratory implanted 1,456 devices.

Initial Pacemaker or ICD Implantation Complications*

2012

<table>
<thead>
<tr>
<th></th>
<th>Pacemaker (N = 410)</th>
<th>ICD (N = 389)</th>
<th>Overall (N = 799)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>Infection &lt; 30 Days</td>
<td>1 (0.24)</td>
<td>1 (0.26)</td>
<td>2 (0.25)</td>
</tr>
<tr>
<td>Infection &lt; 90 Days</td>
<td>1 (0.24)</td>
<td>1 (0.26)</td>
<td>2 (0.25)</td>
</tr>
<tr>
<td>Dislodgement or Need for Lead Revision</td>
<td>2 (0.49)</td>
<td>8 (2.06)</td>
<td>10 (1.25)</td>
</tr>
<tr>
<td>Pericardial Effusion With Intervention</td>
<td>3 (0.73)</td>
<td>1 (0.26)</td>
<td>4 (0.50)</td>
</tr>
<tr>
<td>Death Within 30 days</td>
<td>1 (0.24)</td>
<td>0</td>
<td>1 (0.13)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8 (1.94)</strong></td>
<td><strong>11 (2.84)</strong></td>
<td><strong>19 (2.38)</strong></td>
</tr>
</tbody>
</table>

*Initial implant refers to patients with no prior device implants, including devices for bradycardia and tachycardia. Exclusions include devices such as laptop and loop recorders, as well as replacement and device upgrades to ICD or CRT devices.

Device Lead Extractions Leads in Place > 1 Year (N = 1,242)

2008 – 2012

Electrophysiologists at Cleveland Clinic perform the greatest number of lead extractions in the world. Many patients have complex conditions that result in referral to Cleveland Clinic physicians. Leads may need removal because of electrical malfunctions, blocked blood vessels or infection. In most cases, the leads can be removed without opening the chest or heart. Major complications are defined as those causing death or intrathoracic bleeding.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Success Rate*</td>
<td>98%</td>
</tr>
<tr>
<td>Major Complications</td>
<td>1%</td>
</tr>
</tbody>
</table>

*Success rate is defined as removal of all the required leads without causing bleeding from the veins or heart.
Cleveland Clinic was the first hospital in the country to integrate a patient database for pacemaker and implantable cardioverter defibrillator follow-up with electronic medical records. This innovative approach to follow-up allows staff to keep track of patients’ health conditions regardless of their location. Remote monitoring is also associated with increased longevity and decreased need for in-person follow-up.

The institute uses the MyChart® function in Epic, Cleveland Clinic’s electronic medical record system, to quickly notify patients of their device status.
Valve Disease

Valve Surgery

Volume (N = 2,773)
2008 – 2012

Cleveland Clinic surgeons performed 2,773 valve surgeries in 2012. The majority were primary operations (N = 1,936).

Comparative Valve Volume

2012

Cleveland Clinic performs more valve surgeries than any other hospital in the United States.

Abbreviations: AVR, aortic valve replacement; CABG, coronary artery bypass grafting; MV, mitral valve; MVR, mitral valve replacement.

Cleveland Clinic recently received The Society of Thoracic Surgeons' (STS) prestigious three-star rating for aortic valve replacement. The rating is awarded to hospitals across the country that demonstrate the highest quality of cardiac surgery. Cleveland Clinic was awarded the rating based on data comparisons from July 2011 through June 2012.

Distribution of Isolated and Combined Valve Operations (N = 2,773)

- **35%** Isolated Primary Valve Surgeries (N = 961)
- **35%** Combined Primary Valve Surgeries (N = 975)
- **13%** Isolated Valve Reoperations (N = 370)
- **17%** Combined Valve Reoperations (N = 467)

Seventy percent of the valve surgeries performed at Cleveland Clinic in 2012 were combined primary procedures. Reoperations, which are typically more complex, accounted for 30% of the total volume.

Valve Surgery Mortality

2012

The 2012 mortality rates for all types of valve surgery were lower than expected at Cleveland Clinic.

Source: University HealthSystem Consortium (UHC) Comparative Database, January through November 2012 discharges.

Abbreviations: AVR, aortic valve replacement; CABG, coronary artery bypass grafting; MV, mitral valve; MVR, mitral valve replacement.
Aortic Valve Surgery

Volume (N = 1,745)
2008 – 2012

Cleveland Clinic continues to be the leader in aortic valve (AV) procedures. A total of 1,745 operations were done in 2012. The majority (88%) were valve replacements. Valve repairs and valve-sparing surgery each accounted for 6% of the total volume.

Combined Aortic Valve Replacement Mortality
2012

Despite the complexity of aortic valve replacement in combination with other procedures, the mortality rates for both primary procedures and reoperations were low.

Mitral Valve Surgery

Volume (N = 1,219)

2012

The majority (68%) of mitral valve procedures done at Cleveland Clinic in 2012 were repairs (N = 828). Thirty-two percent were replacements (N = 391).

Isolated Aortic Valve Replacement Complications

2012

The complication rates for patients who had an isolated aortic valve replacement procedure at Cleveland Clinic in 2012 were lower than expected.

Mitral valve repair is the preferred treatment for patients with mitral valve disease. Valve repair, rather than replacement, is associated with better survival, improved lifestyle, better preservation of heart function, and lower risk of stroke and infection (endocarditis). Patients do not need anticoagulation therapy following the procedure. The majority of mitral valve repairs at Cleveland Clinic are performed using a minimally invasive technique.

Isolated Mitral Valve Surgery Hospital Mortality
2012

The 2012 mortality rates for patients who had isolated mitral valve surgery at Cleveland Clinic (replacement, 1%; repair, 0%) were below the expected rates (repair, 1%; replacement, 4.3%).

Valve Disease (continued)

Valve Replacement Prostheses Volume and Type

2008 – 2012

Bioprostheses (biologic tissue valves) were used in the majority of valve replacement procedures performed at Cleveland Clinic in 2012. Bioprostheses are preferred in most cases because they are durable, and most patients do not require lifelong anticoagulant therapy after surgery.

Surgical Treatment of Infective Endocarditis

Bacterial (infective) endocarditis is a life-threatening infection of the heart valves or the heart’s inner lining (endocardium). The condition causes growths on or holes in the valves or scarring of the valve tissue, most often resulting in a leaky heart valve. Cleveland Clinic surgeons treat patients with infective endocarditis, including those with advanced disease and prosthetic valve endocarditis.

Volume and Hospital Mortality

2008 – 2012

In 2012, Cleveland Clinic surgeons performed 97 surgical procedures to treat patients with infective endocarditis.
A total of 13 patients had percutaneous mitral valvuloplasty at Cleveland Clinic in 2012. This procedure is associated with a consistent 0% mortality rate and shorter recovery compared with traditional surgery.

Robotic Assisted Mitral Valve Repair Volume
2008 – 2012

Cleveland Clinic surgeons performed 116 robotically assisted mitral valve repair surgeries in 2012 — more than any other U. S. academic hospital.

The hospital mortality rate for robotically assisted valve surgeries was 0% in 2012. The expected rate was 2.5%.

Source: University HealthSystem Consortium 2012 discharges.
**Percutaneous Valve Treatments**

Cleveland Clinic is a national leader in the use of percutaneous treatment options for patients with valve disease.

**Transcatheter Aortic Valve Replacement Volume and Hospital Mortality**

2008 – 2012

In 2012, Cleveland Clinic performed 154 percutaneous aortic valve replacements. The procedure, also referred to as transcatheter aortic valve replacement (TAVR), is FDA-approved to treat patients who meet specific criteria. Cleveland Clinic continues to participate in the Placement of Aortic Transcatheter Valves (PARTNER) trial to assess use of this procedure to treat other patient populations.


**PARTNER II Trial**

Cleveland Clinic is currently recruiting patients for the second arm of the Placement of Aortic Transcatheter Valves (PARTNER II) trial. This phase involves a randomized study of patients who have a moderately high risk associated with traditional surgery to treat severe aortic stenosis. Researchers are studying the use of percutaneous aortic valve replacement in this patient population. The procedure is done through the transfemoral or left subclavian artery or via a transapical approach. Research also includes an approach through the ascending aorta via a mini-J incision.
The transfemoral approach was used most often for Cleveland Clinic patients who had TAVR in 2012.

Cleveland Clinic was one of the first hospitals to perform the TAVR procedure. The femoral approach has been consistently associated with low mortality. TAVR is used to treat some of the most critically ill patients with aortic valve disease.
Valve Disease (continued)

Valve Surgery Volume and Incidence of Reoperation
2010 – 2012

The majority of valve procedures at Cleveland Clinic are first-time operations. However, the surgeons have extensive experience in treating patients who need a reoperation.

Valve Surgery Mortality by Reoperation
2012

Patients who require another valve surgery are at somewhat increased risk, as their overall health status will have worsened over time. Highly experienced surgical and postoperative care teams at Cleveland Clinic use systematic, evidence-based protocols to provide optimal patient care and reduce the risk of mortality.

Cleveland Clinic uses a comprehensive, multidisciplinary approach to treat patients with aortic disease. Using conventional, minimally invasive, and endovascular techniques, surgeons treat all sections of the aorta, from the aortic valve to the blood supply to the pelvic vasculature.

The majority of the 1,163 aortic surgeries performed at Cleveland Clinic in 2012 were open repairs of the ascending aorta/arch.

Cleveland Clinic’s **Acute Aortic Treatment Center** provides rapid transport, treatment, and follow-up for patients with aortic dissection and impending aneurysm rupture. More than 4,200 patients were transported by Cleveland Clinic’s Critical Care Transport team in 2012. More than one-third of the patients transported were treated in the Heart & Vascular Institute, and many had acute aortic syndromes.

Call **877.379.CODE** (2633) to expedite the transfer of patients with acute aortic syndromes.
In 2012, Cleveland Clinic surgeons performed 728 open repairs of the ascending aorta and arch.

Emergency treatment of the ascending aorta and arch accounted for 197 aortic procedures in 2012. These procedures are particularly challenging, yet Cleveland Clinic surgeons maintained a 5.1 percent mortality rate.

In 2012, Cleveland Clinic surgeons performed 531 elective ascending aorta and arch surgeries. The rate of stroke was 0.6%, and the mortality rate was 0.4%.
Aortic Arch Aneurysm Repairs (N = 193)

Aortic arch aneurysms are one of the most complicated conditions to treat. Despite the complexity, Cleveland Clinic surgeons consistently maintain low rates of stroke and mortality for both elective and emergency procedures.

Elective Arch Aneurysm Operations Volume, Stroke, and Mortality (N = 144)
2008 – 2012

Emergency and Urgent Arch Aneurysm Operations Volume, Stroke, and Mortality (N = 49)
2008 – 2012

3-D reconstruction of an aortic arch branch graft. There are branches for the innominate and left common carotid arteries. This technique allows treatment of very complex anatomy without opening the chest.
Cleveland Clinic surgeons are internationally recognized as some of the best-trained surgeons to treat patients with extensive thoracic aneurysmal disease. They use a comprehensive, multidisciplinary approach that allows each patient to receive the best possible individual treatment.

**Elephant Trunks: Modified, Frozen and Reverse, and Simplified**

Patients with arch and multisegment thoracic aortic disease require complex operations to achieve durable repair. Cleveland Clinic cardiovascular surgeons have led the way in developing new ways to apply “elephant trunk” strategies that are tailored to the specifics of each patient’s anatomy, disease process, and morphology. Some patients require a single-stage hybrid approach that combines open and endovascular techniques, or the so-called frozen elephant trunk. Others require a two-stage stent-graft-first approach, also known as reverse frozen elephant trunk. Other variations of these hybrid techniques have been applied to specific pathologies such as Kommerell’s diverticulum and acute or chronic aortic dissection.

### Descending Thoracic Aortic Disease

Aortic dissections and ruptured aneurysms commonly occur in the descending thoracic aorta (DTA). Patients with these conditions need prompt evaluation and treatment. Cleveland Clinic surgeons use open and endovascular repair techniques.

### DTA Repair Volume and Type (N = 780)

#### 2008 – 2012

- **9%** Open Emergency (N = 67)
- **21%** Open Elective (N = 167)
- **23%** Endovascular Emergency (N = 178)
- **47%** Endovascular Elective (N = 368)

The majority of the 780 DTA repairs performed at Cleveland Clinic from 2008 through 2012 were done using an endovascular approach.

### DTA Repair Hospital Mortality

#### 2008 – 2012

Cleveland Clinic surgeons have extensive experience in treating patients with DTA disease that requires repair, including patients who have the most complex cases. In 2012, the mortality rate for elective repairs remained low. The rate for emergency repairs was reduced to less than 10% overall.

#### Mortality (%)

<table>
<thead>
<tr>
<th>Type</th>
<th>2008–2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Elective</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

### Novel device used in first-in-world trial

Cleveland Clinic is leading the first in-human device trial of a novel stent graft. The device has a built-in branch to accommodate the left subclavian artery at the time of descending aortic stent grafting. It is currently estimated that the left subclavian artery is covered in more than 40% of thoracic stent graft cases. The trial is part of a new program within the U.S. FDA Innovation Pathway to bring first-in-the-world technology to patients in the United States.
Improving Spinal Cord Function after Thoracoabdominal Aortic Aneurysm Repair

Spinal cord injury after thoracoabdominal aortic aneurysm (TAAA) repair can be a challenging complication that impedes recovery and has a major impact on the quality of a patient’s life. Cleveland Clinic surgeons have adopted a staged approach to treatment. This means that not all stents are placed at once. Instead, the patient has them placed over the course of several procedures, and the aneurysm is gradually repaired. This has been shown to decrease the severity of spinal ischemia after surgery. The staged approach also helps preserve the collateral beds, leading to a 50% reduction in spinal cord ischemia among patients who had all collateral vessels preserved\(^1\).


Durability of Branched Endografts

Cleveland Clinic surgeons are the most experienced in the world in the use of fenestrated endografts. Because the technology is so new, the durability of these repairs is still being evaluated. Over the course of nine years, fenestrated endografts have been used to treat 650 patients at Cleveland Clinic. Analysis of these patients shows that the 30-day, one-year, and five-year rates of freedom from intervention were 98%, 94%, and 84%, respectively. The rates of reintervention were 0.6% for celiac stents, 4% for superior mesenteric artery stents, 6% for right renal artery stents and 5% for left renal artery stents. These data support continued use of endovascular techniques for treatment of patients with thoracoabdominal aneurysms\(^1\).

TAAA Surgeries
The most challenging aortic procedures involve patients with TAAA. Cleveland Clinic surgeons have extensive experience using both open and endovascular techniques to treat these patients.

TAAA Surgeries by Type
2008 – 2012

In 2012, the majority of TAAA surgeries involved patients with Type IV aneurysms.

Crawford Classification of Aortic Aneurysms

Type I
Aneurysms involve most or all of the descending thoracic aorta to the level of the renal arteries.

Type II
Aneurysms involve most or all of the descending thoracic aorta, with abdominal extension to below the renal arteries.

Type III
Aneurysms involve the lower portion of the descending thoracic aorta, extending to the abdominal aorta below the level of the renal arteries.

Type IV
Aneurysms involve the upper half or all of the abdominal aorta.
New off-the-shelf options for emergency TAAA procedures

Pararenal Branch Devices have small pivot branches that accommodate many different renal artery positions. These are new off-the-shelf endovascular options that can be used to treat patients with justarenal aneurysms. They also provide an advanced treatment option for ruptured or symptomatic justarenal aneurysm procedures. Mortality rates are high with traditional treatment options; however, this innovative technique has the potential to improve survival rates1.


TAAA Surgery Volume and Type
2008 – 2012

From 2008 through 2012, Cleveland Clinic surgeons performed 727 procedures to treat patients with TAAAs.

TAAA Surgery Mortality
2008 – 2012

The complex nature of TAAA procedures is associated with a greater risk of mortality. Cleveland Clinic continuously strives to maintain the lowest mortality rates possible. In 2012, the mortality rate for endovascular branch vessel procedures was 3.09%. The rate for open elective repairs was 6.9%. Emergency repairs require open surgery. The mortality rate for these procedures was 15.28%.
**Abdominal Aortic Aneurysms**  
The abdominal aorta is second to the ascending aorta for aneurysm formation. Cleveland Clinic treats patients with abdominal aortic aneurysms (AAAs) both below and adjacent to the renal arteries. Surgeons use both open and endovascular repair procedures.

**AAA Procedure Volume and Type**  
**2008 – 2012**

- **60% Endovascular (N = 564)**
- **40% Open (N = 381)**

The majority of the 945 AAA repair procedures performed at Cleveland Clinic from 2008 to 2012 were endovascular.

**Open AAA Repair Volume and Type (N = 381)**  
**2008 – 2012**

- **84% Elective (N = 319)**
- **16% Emergency (N = 62)**

Cleveland Clinic surgeons performed 381 open AAA repairs from 2008 through 2012. Although open repairs are associated with greater risk, the institute maintains high volumes and excellent outcomes.

**Rescuing Failed Endografts**
Endovascular abdominal aortic aneurysm repairs (EVAR) fail in approximately 1% of patients treated. Failure can be due to progression of aneurysmal degeneration of the aortic wall in the sealing segment or due to device component failure. Cleveland Clinic has the world’s largest experience with conversion of EVAR to open repair. It has performed more than 100 of these procedures. Even when done electively, this procedure has been associated in most cases with a mortality rate as high as 20%. Cleveland Clinic has published a 3.3% mortality rate for elective EVAR conversions, which is less than the 4% mortality rate for elective, original open AAA repair found in the Medicare population.

—Lyden S, Turney E, *The First Hundred Late EVAR Explants, Presented at Society of Vascular Surgery Annual Meeting 2013*
Aortic Disease (continued)

In 2012, Cleveland Clinic surgeons achieved a 0% mortality rate for elective open AAA repairs. The mortality rate for emergency open AAA repairs was 14.29%.

Cleveland Clinic surgeons performed 564 endovascular AAA repair procedures from 2008 to 2012. A total of 56 fenestrated grafts were used to repair juxtarenal aneurysms.

The mortality rate for elective endovascular AAA repair was 1.28% in 2012. The rate for emergency repairs was 14.29%.

0% mortality rate for patients with juxtarenal aneurysms treated with fenestrated graft procedures (N = 56) from 2008 to 2012.
Hypertrophic obstructive cardiomyopathy (HOCM) is thickening of the lower chambers of the heart. The septal muscle, which divides the right and left chambers, is especially affected. The condition can impede blood flow from the heart to the aorta. Cleveland Clinic physicians use a comprehensive approach to diagnose and treat patients with HOCM. This approach includes a physical exam, EKGs, chest X-ray, and MRI. Cleveland Clinic has a special interest in HOCM and is actively screening patients and their family members for genetic abnormalities associated with the disease.

<table>
<thead>
<tr>
<th>Patient Volume</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>Total HOCM Outpatient Visits</td>
<td>1,630</td>
</tr>
<tr>
<td>New Patients With HOCM</td>
<td>389</td>
</tr>
</tbody>
</table>

Hypertrophic obstructive cardiomyopathy (HOCM) is thickening of the lower chambers of the heart. The septal muscle, which divides the right and left chambers, is especially affected. The condition can impede blood flow from the heart to the aorta. Cleveland Clinic physicians use a comprehensive approach to diagnose and treat patients with HOCM. This approach includes a physical exam, EKGs, chest X-ray, and MRI. Cleveland Clinic has a special interest in HOCM and is actively screening patients and their family members for genetic abnormalities associated with the disease.

Cleveland Clinic surgeons are national leaders in treating patients with HOCM. A total of 178 surgical procedures were performed to treat patients with this condition in 2012. The mortality rate was 0.6%.
Surgical Procedure Distribution (N = 178)

2012

Septal myectomy is used to treat patients with HOCM. Patients who require this procedure often require additional procedures.

- **41%** Isolated Septal Myectomy (N = 73)
- **33%** Septal Myectomy + Valve (N = 59)
- **9%** Septal Myectomy + Valve + Other (N = 16)
- **7%** Septal Myectomy + Other (N = 12)
- **5%** Septal Myectomy + Coronary Artery Bypass (N = 10)
- **2%** Septal Myectomy + Coronary Artery Bypass + Valve (N = 3)
- **2%** Septal Myectomy + Coronary Artery Bypass + Other (N = 3)
- **1%** Septal Myectomy + Coronary Artery Bypass + Valve + Other (N = 2)

Septal Myectomy Mortality

2012

Cleveland Clinic has excellent outcomes for patients who have a septal myectomy. In 2012, the expected mortality rate was 3%; however, Cleveland Clinic surgeons achieved a 0.6% mortality rate.

Source: University HealthSystem Consortium (UHC) Comparative Database, 2012 discharges.
Congenital Heart Disease

Congenital heart disease affects an estimated 1 million people in America. Each year, approximately 1 in every 120 babies born in the United States has a congenital heart defect. In some cases, the disease is life-threatening at birth. However, many people with a congenital heart condition do not know about it for years. Experts at Cleveland Clinic have extensive experience in the diagnosis and treatment of patients with all forms of congenital heart disease. The Center for Pediatric and Adult Congenital Heart Disease's services are further enhanced by the Special Delivery Unit. The unit provides in utero diagnosis of complex heart conditions and immediate treatment after birth.

Adult Congenital Heart Disease Volume (N = 1,450)

2012
Cleveland Clinic’s Adult Congenital Heart Disease Center is staffed by cardiologists who specialize in adult care, pediatric care, intervention, and cardiovascular surgery. This collaboration offers patients unique care and treatment options designed to provide the best outcomes possible for their particular needs. The center saw 1,450 patients in 2012, including 487 new referrals.

Percutaneous Interventional Procedures for Adult Congenital Heart Disease

Volume and Outcomes (N = 214)

2012
Many of the 214 patients who received interventional treatment for congenital heart disease had complex cases. Despite this increased level of care, Cleveland Clinic physicians achieved a 100% success rate and 0% mortality.

| Total Adult Congenital Heart Disease Patient Visits | 1,450 |
| New Referral Visits for Adult Congenital Heart Disease | 487 |

Percutaneous Closure Procedures

Volume and Outcomes (N = 66)

2012
A total of 66 patients had percutaneous closure procedures at Cleveland Clinic in 2012. The success rate was 99%, with 0% mortality.

| Percutaneous ASD Closures | 28 |
| Percutaneous PFO Closures | 38 |
| Successful Repair* | 99% |
| 30-Day Mortality | 0% |
| Patients Requiring Repeat Procedure | 1% |

*Based on one complication, including stroke, myocardial infarction, or need for surgery. Abbreviations: ASD, atrial septal defect; PFO, patent foramen ovale.
Congenital Heart Surgery Mortality (Adult and Pediatric)

2012
Cleveland Clinic’s Department of Congenital Heart Surgery treats adults and children using a wide variety of treatments. The mortality rate associated with these procedures was 1.3% in 2012, which was well below the expected rate of 3.6%.

Pediatric Congenital Heart Surgery Volume and Type (N = 117)

2012
In 2012, Cleveland Clinic surgeons performed 117 pediatric congenital heart surgeries of varying complexity. The procedures within the majority “other” category included coarctation repair, truncus arteriosus repair, etc.

Abbreviations: ASD, atrial septal defect; AV, atrioventricular; ECMO, extracorporeal membrane oxygenation; PA, pulmonary artery; PDA, patent ductus arteriosus; RV, right ventricle; TOF, tetralogy of Fallot; VSD, ventricular septal defect.
Treatment of Patient With Persistent Left Superior Vena Cava

During normal heart development, the heart starts with two superior vena cavae. The left superior vena cava usually regresses but can persist in some cases. This normally has no consequences other than rerouting the venous blood flow from the left arm into the coronary sinus (a venous structure), which becomes larger than normal. In rare cases, the persistent left superior vena cava can abnormally connect to the left atrium. In such cases, blood low in oxygen can drain into the left atrium (where blood high in oxygen coming back from the lungs normally drains).

A patient with prior operative repairs of atrial and ventricular septal defects presented to the Adult Congenital Heart Disease Clinic with progressive fatigue and diminished oxygen saturation at rest that worsened with exercise. CT scan imaging suggested the presence of an abnormal communication between the persistent left superior vena cava and the left atrium. Treatment involved catheterization and placement of sheaths (IV lines) in the left neck and right groin. The right superior vena cava was injected by a catheter placed via the right groin (SVC = superior vena cava; RA = right atrium).
The persistent left superior vena cava (LSVC) was injected through a catheter placed via the left neck (upper right of picture). This showed a communication to the left atrium, through which a catheter was placed (arrow).

This diagram shows superimposed anatomic borders, which cannot be seen without separate contrast injections (LA = left atrium; RA = right atrium; SVC = superior vena cava). The arrow points to the abnormal communication from the LSVC to the LA.

An 8 mm Amplatzer™ Vascular Plug II was placed into the abnormal communication. The device needs to be carefully sized and placed to adequately occlude the defect and prevent dislodgement (arrow). It is critically important to perform angiograms before delivering the device. Flow is expected to be seen initially beyond the device.

The final injection of the LSVC shows the Amplatzer Vascular Plug II in good position (arrow). There is no longer any blood flow beyond it. The patient’s oxygen saturation increased after the procedure, and the fatigue significantly improved.
Pericardial Disease

**Pericardial Disease: Patient Volume**

2008 – 2012

Pericardial disease includes a group of conditions that affect the pericardium, the double-layered sac that surrounds the heart. Cleveland Clinic’s Center for the Diagnosis and Treatment of Pericardial Disease is dedicated to the diagnosis and treatment of patients with acute, recurrent, and constrictive pericarditis. Its multispecialty approach includes cardiologists, surgeons, and imaging specialists, which enhances collaboration in the management of these diseases. In 2012, there were 1,232 visits to the Pericardial Disease Center.

![Graph showing patient volume from 2008 to 2012](image)

**Pericardial Disease Syndromes in Outpatient Clinic Volume, New and Consult (N = 507)**

2012

Recurrent pericarditis and pericardial effusion with pericarditis were the most common reasons patients were seen at Cleveland Clinic’s Center for the Diagnosis and Treatment of Pericardial Disease in 2012. A total of 74% of patients with pericardial syndromes had conditions associated with pericardial effusion.

![Bar chart showing pericardial disease syndromes](image)

Patients traveled from **34 states** for treatment.
Outcomes 2012

The most commonly performed pericardial procedures in 2012 were window surgery and pericardiocentesis. During window surgery, an opening is made in the pericardium through a small chest incision. The fluid is drained and a diagnosis can be made. Pericardiectomy is the removal of a portion of or the entire pericardium. Pericardiocentesis is used to drain large pericardial effusions. This percutaneous procedure is used for patients whose condition develops postoperatively or from a viral or idiopathic cause. The procedure is guided by echocardiography, which helps improve outcomes.

Pericardial Disease Etiology (N = 507)
2012
The majority of patients with pericardial disease who were seen at Cleveland Clinic in 2012 had disease that was idiopathic in nature.

- 64% Idiopathic (N = 324)
- 21% Postoperative Cardiac Surgery (N = 107)
- 8% Viral (N = 41)
- 4% Autoimmune (N = 20)
- 3% Other (N = 15)

Pericardial Procedures (N = 158)
2012
The most commonly performed pericardial procedures in 2012 were window surgery and pericardiocentesis. During window surgery, an opening is made in the pericardium through a small chest incision. The fluid is drained and a diagnosis can be made. Pericardiectomy is the removal of a portion of or the entire pericardium.

- 41% Window (N = 64)
- 40% Pericardiocentesis (N = 64)
- 19% Pericardiectomy (N = 30)

A. Cardiac MRI showing acute pericarditis and pericardial late gadolinium enhancement, (see arrow) which indicates activity of the disease.
B. Cardiac MRI post-treatment showing resolution of inflammation with no late gadolinium enhancement.
Heart Transplant Volume

July 2008 – June 2012

Volume

In 2012, Cleveland Clinic performed 47 heart transplant procedures.

Heart Transplant Patient Survival

Survival (%)

There are 146 transplant centers in the United States. In 2012, Cleveland Clinic was one of two that had better-than-expected one-year survival rates for patients who had a heart transplant. Three-year survival rates are also better than expected.

*Expected based on risk adjustment.
Source: Scientific Registry of Transplant Recipients. Center and OPO-Specific Reports, March 2012. Ohio, Heart Centers, Cleveland Clinic. Table 11. sstr.org
Mechanical Circulatory Support Device Volume

2008 – 2012

Cleveland Clinic has 25 years of experience using mechanical circulatory support devices in patients with heart failure. These devices help preserve heart function until transplantation (bridge-to-transplant) or are used as a final treatment option (destination therapy).

Left Ventricular Assist Device In-Hospital Mortality

2008 – 2012

Mortality rates among patients who are placed on a left ventricular assist device have been reduced since 2008. Cleveland Clinic continues to make improvements to further reduce these rates.

Ventricular Assist Device Mortality

2012

The mortality rate among Cleveland Clinic patients placed on ventricular assist devices was much lower than expected in 2012.

Source: University HealthSystem Consortium (UHC) Comparative Database, January through November 2012 discharges.
Heart Failure

The Centers for Medicare and Medicaid Services (CMS) calculates two heart failure outcome measures: all-cause mortality and all-cause readmission rates, each based on Medicare claims and enrollment information. Cleveland Clinic’s performance appears below.

Heart Failure Appropriateness of Care
2011 – 2012

This composite metric, based on three heart failure hospital quality process measures developed by CMS, shows the percentage of patients who received all the recommended care for which they were eligible. Cleveland Clinic has set and exceeded a target of UHC’s 90th percentile.

Heart Failure All-Cause 30-Day Mortality (N = 777)
July 2009 – June 2012

There is no significant difference between Cleveland Clinic’s heart failure patient mortality or readmissions rate and the respective national averages. To further reduce avoidable readmissions, a multidisciplinary team is tasked with improving transitions from hospital to home or post-acute facility. Specific initiatives have been implemented in each of these focus areas: communication, education, and follow-up.
Cleveland Clinic’s Lung and Heart-Lung Transplant Program is the best in Ohio and among the top programs in the country. In 2012, surgeons transplanted 104 lungs.

Lung Transplant Procedures
2008 – 2012

Primary Disease of Lung Transplant Recipients (N = 104)
January 2011 – December 2011

- 56.2% Idiopathic Pulmonary Fibrosis (N = 59)
- 24.8% Emphysema/Chronic Obstructive Pulmonary Disease (N = 26)
- 10.5% Cystic Fibrosis (N = 11)
- 5.7% Idiopathic Pulmonary Arterial Hypertension (N = 6)
- 2.9% Other (N = 3)

Source: Scientific Registry of Transplant Recipients. March 2012. Ohio, Lung Centers, Cleveland Clinic. Table 7. srtr.org
Patients waiting for lung transplantation can become poorer candidates while waiting because of the use of extracorporeal membrane oxygenation (ECMO). This is a method used in very ill patients to add oxygen and to remove carbon dioxide from the blood.

Traditionally, ECMO requires the patient to stay in bed. This causes the muscles to weaken, and patients become less likely to be eligible for transplantation.

Cleveland Clinic is aggressively developing ambulatory ECMO technology to improve transplant candidacy, save lives, and improve outcomes.

Patients who undergo lung transplantation at Cleveland Clinic live longer than the expected rate after three years.

*Expected survival rate based on risk adjustment. Not statistically significant. Source: Scientific Registry of Transplant Recipients. March 2013, Ohio, Lung Centers, Cleveland Clinic. Table 10. srtr.org.

The mortality rate among Cleveland Clinic patients waiting for a lung transplantation is lower than expected.

The difference between observed and expected mortality is not statistically significant.

*Expected survival rate based on risk adjustment. Statistically significant. Source: Scientific Registry of Transplant Recipients. March 2012, Ohio, Lung Centers, Cleveland Clinic. Table 3. srtr.org.
In 2012, 99% of venous duplex ultrasound studies were read in 24 hours; 99% of all other vascular studies were finalized within 48 hours.

**Lower Extremity Interventional Procedures**

Cleveland Clinic’s team of vascular surgeons and interventional cardiologists performs a variety of procedures to treat patients with peripheral artery conditions. They are skilled at angioplasty, atherectomy, stenting, thrombectomy, and thrombolysis.

<table>
<thead>
<tr>
<th>Lower Extremity Interventional Procedure Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
</tr>
<tr>
<td>Angioplasty</td>
</tr>
<tr>
<td>Atherectomy</td>
</tr>
<tr>
<td>Stenting</td>
</tr>
<tr>
<td>Thrombolysis</td>
</tr>
</tbody>
</table>

**Lower Extremity Surgery Volume and Mortality (N = 201)**

A total of 153 lower extremity bypass surgeries were performed in 2012. The 30-day mortality rate was 2%. Cleveland Clinic’s vascular surgeons have expertise in this area and find an autologous vein for graft 75% of the time.

**2012 Volume**

<table>
<thead>
<tr>
<th>Bypass</th>
<th>153</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombectomy</td>
<td>48</td>
</tr>
</tbody>
</table>

**2012 30-Day Mortality (%)**

<table>
<thead>
<tr>
<th>Bypass</th>
<th>2%</th>
</tr>
</thead>
</table>

Outcomes 2012 volume and mortality.
Executive Health Screening Program

2011 - 2012

The Executive Health Screening Program is designed to identify any potential peripheral vascular disorders that can affect a patient’s health and well-being. The exam can identify problems such as carotid artery stenosis, which is a risk factor for stroke; peripheral arterial disease, which can indicate an increased risk of heart attack and stroke and can impair function and quality of life; and abdominal aortic aneurysm (AAA). Ruptured AAAs are almost entirely preventable if an AAA is identified and monitored; however, about 15,000 people die each year in the United States due to ruptured AAAs.

Noninvasive Vascular Lab Ultrasound Study Distribution (N = 37,397)

2012

The Noninvasive Vascular Laboratory provides service seven days a week to diagnose arterial and venous disorders throughout the vascular tree and for follow-up after revascularization procedures, such as bypass grafts and stents. In 2012, 37,397 vascular lab studies were performed.

- **44%** Venous Duplex (N = 16,372)
- **38%** Arterial Duplex (N = 14,442)
- **18%** Physiologic Testing (N = 6,583)

All Cleveland Clinic vascular lab technologists are certified registered vascular technologists, which exemplifies Cleveland Clinic’s commitment to quality patient care. Each year, they perform a high volume of ultrasounds.
**Fibromuscular Dysplasia**

Fibromuscular dysplasia (FMD) is a vascular condition in which there is abnormal cell growth in the walls of medium and large arteries. This can cause the arteries to become narrowed (stenosis) and can also lead to aneurysm and dissection. Cleveland Clinic’s FMD program is dedicated to caring for and educating patients with FMD. It conducts research to better understand the condition and treatment options. In 2012, a total of 169 patients seen in the program had a primary diagnosis of FMD, and 148 patients had a secondary diagnosis of FMD.

**Fibromuscular Dysplasia — Patient Volume**

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>400</td>
</tr>
<tr>
<td>2009</td>
<td>300</td>
</tr>
<tr>
<td>2010</td>
<td>300</td>
</tr>
<tr>
<td>2011</td>
<td>400</td>
</tr>
<tr>
<td>2012</td>
<td>400</td>
</tr>
</tbody>
</table>

**Lower Extremity Wound Clinic Volume**

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>2,000</td>
</tr>
<tr>
<td>2009</td>
<td>1,500</td>
</tr>
<tr>
<td>2010</td>
<td>1,000</td>
</tr>
<tr>
<td>2011</td>
<td>1,000</td>
</tr>
<tr>
<td>2012</td>
<td>1,000</td>
</tr>
</tbody>
</table>

In 2012, a total of 1,397 patients were treated in the Lower Extremity Wound Clinic.

**Thrombosis Center**

Cleveland Clinic's Thrombosis Center was established in 2009. It includes a multidisciplinary group of specialists in vascular medicine, vascular surgery, adult and pediatric care, hematology, interventional radiology, cardiology, cardiac surgery, and laboratory medicine. The group works together to provide the best possible treatment to patients with deep vein thrombosis, pulmonary embolism, and hypercoagulable states. In 2012, a total of 1,840 patients with a primary thrombosis diagnosis were seen at Cleveland Clinic's main campus.
**Iliac Stenting**

*2010 – 2012*

![Graph showing volume of stent procedures from 2010 to 2012.](image)

In 2012, Cleveland Clinic performed 128 stent procedures for the treatment of iliac occlusive disease. Stent use has been increasing steadily over the past few years. This method of treatment is highly successful in re-establishing blood flow with minimal complications. The images above show before and after a stent procedure.

---

**Hybrid Procedures Trends (Endarterectomy With Stent)**

*2010 – 2012*

![Graph showing volume of hybrid procedures from 2011 to 2012.](image)

Iliac endarterectomy with stent has replaced aortic femoral bypass Cleveland Clinic's treatment of choice for complex aorto-iliac artery occlusive disease.
Visceral Stenting Trends

2010 – 2012

Chronic mesenteric ischemia is a condition caused by blockages to the intestinal (visceral) blood vessels. Cleveland Clinic has led the change in clinical practice from primarily surgical bypass to endovascular stenting. It has seen steady growth year over year in its procedure volumes.

Visceral Stenting Trends

2010 – 2012

Cleveland Clinic has shown improved outcomes using brachial artery access over the traditional femoral approach to treat critically ill patients who have acute mesenteric ischemia. Minimally invasive stenting continues to lower mortality.
Angioplasty Trends

2011 – 2012

Tibial angioplasty intervention is the primary choice in the treatment of rest pain, ulcers, and gangrene. In addition to tibial angioplasty, femoral-popliteal angioplasty is used in the treatment of claudication.

Tibial Bypass Trends

2011 – 2012

Cleveland Clinic can use autologous (a patient’s own vein) conduits in 75% of its bypasses. Vein bypass has better results than prosthetic conduits. Vein bypasses have a 70% five-year patency and greater than 90% limb salvage rates. Prosthetic conduits are used in patients without alternatives and have a 20% patency at two years. Practitioners strive to find and use all venous conduit sources (saphenous vein, arm vein, and femoral vein).
Venous Disease Treated at Cleveland Clinic

The physicians in the departments of Vascular Medicine and Vascular Surgery offer a full range of therapies for patients with venous diseases. The total number of venous procedures increases annually.

Varicose Veins

Varicose veins are the most common venous disorder. Treatment starts with conservative therapy, including properly fitting support stockings, skin care, and a regular walking program. If this is not sufficient to alleviate symptoms, a comprehensive evaluation is performed to identify any underlying venous abnormalities. Appropriate treatment, ranging from sclerotherapy to endovenous ablation, can then be planned.

Endovenous Ablation

Endovenous ablation is the preferred treatment for patients with valvular incompetency of the great saphenous vein. The procedure is minimally invasive and can be performed under local anesthesia in an outpatient setting. Endovenous ablation is associated with better outcomes than vein stripping, and the use of newer, longer-wavelength lasers allows patients to experience less post-procedure pain.

Deep Venous Thrombosis (DVT)

Patients with DVT are usually treated with long-term anticoagulation, but the use of early thrombolysis can decrease long-term complications of DVT. Consequently, the use of lytic therapy in treatment has increased. In addition, evaluation and treatment of the underlying cause of the DVT, such as a blood clotting disorder, are essential to minimize recurrence.

Other Venous Procedures

Venous balloon angioplasties may be required to relieve venous obstruction that causes swelling or poor flow for dialysis access. In 2012, 104 venous angioplasties were performed and 32 iliac vein stents were placed. All patients who had iliac stents placed for May-Thurner syndrome (compression of the left iliac wall) had patent stents at follow-up.
Carotid artery stenosis is the cause of more than half of all temporary and permanent strokes. Patients with hypertension, coronary artery disease, and peripheral artery disease are at increased risk of developing carotid artery stenosis. This risk can be reduced through early diagnosis with vascular ultrasound and through disease management with medications such as antiplatelet and antihypertensive agents. Cleveland Clinic incorporates the most current technology and methods to care for patients with cerebrovascular disease. These include specialized ultrasound laboratories and advanced medical treatments, such as open carotid surgery and minimally invasive carotid artery stenting procedures.

### Procedural Complications*

<table>
<thead>
<tr>
<th>Procedure</th>
<th>N</th>
<th>MI (%)</th>
<th>Stroke (%)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid Stenting</td>
<td>437</td>
<td>0.5</td>
<td>1.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Diagnostic Angiograms</td>
<td>638</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Carotid Endarterectomy</td>
<td>684</td>
<td>1.8</td>
<td>2.5</td>
<td>0.9</td>
</tr>
</tbody>
</table>

*For all procedures performed at Cleveland Clinic's main campus.

### Cerebrovascular Disease Treatment Mortality

<table>
<thead>
<tr>
<th>Percent</th>
<th>MI (%)</th>
<th>Stroke (%)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid Stenting</td>
<td>Observed</td>
<td>0.5</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endarterectomy</td>
<td>Observed</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: University HealthSystem Consortium (UHC) Comparative Database, 2012 discharges.*

The Heart & Vascular Institute is currently enrolling patients in medical, surgical and endovascular trials involving cerebrovascular disease. These national trials represent the most up-to-date therapies available to patients with atherosclerotic carotid diseases. Ongoing registries are also available for patients who are eligible. In addition, both minimally invasive and open surgeries are performed for cerebrovascular debranching to expand the application of thoracic stent grafting technology in patients with thoracic aneurysms.
Cleveland Clinic thoracic surgeons treat patients with a wide variety of diseases of the lung and esophagus. The staff is composed of specialists in lung and esophageal cancer, lung failure, airway disease, swallowing disorders, and other diseases. Diagnosis and treatment approaches include the most advanced techniques, such as minimally invasive surgery.

General Thoracic Surgery Volume and Mortality
2008 – 2012

Cleveland Clinic surgeons performed 1,541 thoracic surgery procedures in 2012. The mortality rate was 1.5%.
The majority of major thoracic surgical procedures at Cleveland Clinic in 2012 were pulmonary procedures.

Cleveland Clinic performed 318 pulmonary resections in 2012 and had a low 0% mortality.
Lobectomies accounted for the majority of pulmonary resections at Cleveland Clinic in 2012. In addition to open procedures, surgeons perform video-assisted surgeries (VATS) and minimally invasive techniques.

### Distribution of Pulmonary Resections by Type (N = 318)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Lobectomy</td>
<td>29%</td>
<td>93</td>
</tr>
<tr>
<td>Video-Assisted Lobectomy</td>
<td>22%</td>
<td>69</td>
</tr>
<tr>
<td>Video-Assisted Wedge</td>
<td>18%</td>
<td>59</td>
</tr>
<tr>
<td>Other Open</td>
<td>9%</td>
<td>30</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>7%</td>
<td>21</td>
</tr>
<tr>
<td>Open Wedge</td>
<td>6%</td>
<td>19</td>
</tr>
<tr>
<td>Segmentectomy</td>
<td>5%</td>
<td>15</td>
</tr>
<tr>
<td>Other VATS</td>
<td>4%</td>
<td>12</td>
</tr>
</tbody>
</table>

### Pulmonary Resection Postoperative Length of Stay (N = 318)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wedge Resection</td>
<td>4</td>
</tr>
<tr>
<td>Segmentectomy</td>
<td>4</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>2</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>3</td>
</tr>
</tbody>
</table>

Video-assisted procedures allow for shorter length of stay for patients undergoing pulmonary resection.
Lobectomy for Stage I Lung Cancers
2010 – 2012

Volume

<table>
<thead>
<tr>
<th>Year</th>
<th>VATS/Robotic</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>2011</td>
<td>48%</td>
<td>52%</td>
</tr>
<tr>
<td>2012</td>
<td>61%</td>
<td>39%</td>
</tr>
</tbody>
</table>

Cleveland Clinic surgeons are steadily increasing the use of video-assisted/robotic techniques to perform lobectomies for patients with Stage I lung cancer. These techniques are less invasive than open procedures and can help improve outcomes.

Major Pulmonary Resections
Operative Mortality
2008 – 2012

The mortality rate for patients who had major pulmonary resections in 2012 was 0%. Cleveland Clinic consistently achieves mortality rates below the expected rate.

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0%</td>
</tr>
<tr>
<td>2011</td>
<td>0%</td>
</tr>
<tr>
<td>2012</td>
<td>0%</td>
</tr>
</tbody>
</table>

Combined Morbidity and Mortality for Pulmonary Resections for Lung Cancer, July 2009 – June 2012

<table>
<thead>
<tr>
<th>Eligible Procedures</th>
<th>Unadjusted Rate</th>
<th>Risk-Adjusted Rate (95% CI)</th>
<th>Standardized Incidence Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>458</td>
<td>7.2%</td>
<td>7.1% (5.2%, 9.2%)</td>
<td>0.85 (0.62, 1.11)</td>
</tr>
</tbody>
</table>

Cleveland Clinic surgeons performed 318 major pulmonary resections in 2012 without a single death. The risk-adjusted rate of morbidity or mortality following a pulmonary resection for lung cancer is in the lowest quartile in the country.
In 2012, Cleveland Clinic thoracic surgeons performed 189 esophageal operations. One-year mortality was 1.6%. Procedures included resections for cancer and reoperative surgery for motility and reflux disorders.

Cleveland Clinic surgeons use video-assisted techniques for lobectomy whenever possible. This type of procedure allows for a shorter length of stay and quicker return to a patient’s normal activities.

In 2012, Cleveland Clinic thoracic surgeons performed 189 esophageal operations. One-year mortality was 1.6%. Procedures included resections for cancer and reoperative surgery for motility and reflux disorders.

The expected one-year mortality rate following esophagectomy was 3.3%. Cleveland Clinic surgeons achieved a 1.5% mortality rate in 2012.

Source: University HealthSystem Consortium (UHC) Comparative Database, 2012 discharges.
The majority of esophageal surgeries done in 2012 were paraesophageal hernia repairs. Cleveland Clinic surgeons treat patients who have a variety of high volumes benign and malignant esophageal conditions.

### Combined Morbidity/Mortality for Esophagectomy for Esophageal Cancer, July 2009 – June 2012

<table>
<thead>
<tr>
<th>Eligible Procedures</th>
<th>Unadjusted Rate</th>
<th>Risk-Adjusted Rate (95% CI)</th>
<th>Standardized Incidence Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>141</td>
<td>28.4%</td>
<td>27.6% (21.4%, 34.3%)</td>
<td>0.97 (0.76, 1.21)</td>
</tr>
</tbody>
</table>

Cleveland Clinic

- **Min**: 0.59
- **25th**: 0.96
- **Median**: 1.05
- **75th**: 1.17
- **Max**: 1.58

- **Min** = STS standardized incidence ratio


### Distribution of Esophageal Surgeries by Indication (N = 189)

**2012**

- **36%** Paraesophageal Hernia Repair (N = 68)
- **29%** Cancer (N = 54)
- **11%** Other (N = 20)
- **10%** Reflux (N = 19)
- **9%** Achalasia (N = 18)
- **5%** Esophageal Reconstruction (N = 10)

The majority of esophageal surgeries done in 2012 were paraesophageal hernia repairs. Cleveland Clinic surgeons treat patients who have a variety of high volumes benign and malignant esophageal conditions.
The Section of Preventive Cardiology and Rehabilitation at Cleveland Clinic provides patients with a comprehensive assessment to identify traditional and emerging nontraditional cardiovascular risk factors. It collaborates with referring physicians to create individualized treatment plans. Patients typically have a limited number of visits and return to their primary care or referring physician for care.

### LDL Levels Among Statin-Tolerant Adults

Patients taking statins for both primary and secondary prevention experienced reductions in low-density lipoprotein (LDL) cholesterol levels. Patients were seen at baseline and had at least two follow-up visits within one year. The time between visits varied from patient to patient.

#### Primary Prevention, Statin-Tolerant Adults (N = 658 in 2012) 2007 – 2012

**LDL Value**

<table>
<thead>
<tr>
<th>Year</th>
<th>LDL Value</th>
<th>2nd Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>121 mg/dL</td>
<td>82 mg/dL</td>
</tr>
<tr>
<td>2008</td>
<td>115 mg/dL</td>
<td>79 mg/dL</td>
</tr>
<tr>
<td>2009</td>
<td>112 mg/dL</td>
<td>75 mg/dL</td>
</tr>
<tr>
<td>2010</td>
<td>110 mg/dL</td>
<td>72 mg/dL</td>
</tr>
<tr>
<td>2011</td>
<td>108 mg/dL</td>
<td>70 mg/dL</td>
</tr>
<tr>
<td>2012</td>
<td>106 mg/dL</td>
<td>68 mg/dL</td>
</tr>
</tbody>
</table>

#### Secondary Prevention, Statin-Tolerant Adults (N = 324 in 2012) 2007 – 2012

**LDL Value**

<table>
<thead>
<tr>
<th>Year</th>
<th>LDL Value</th>
<th>2nd Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>121 mg/dL</td>
<td>82 mg/dL</td>
</tr>
<tr>
<td>2008</td>
<td>115 mg/dL</td>
<td>79 mg/dL</td>
</tr>
<tr>
<td>2009</td>
<td>112 mg/dL</td>
<td>75 mg/dL</td>
</tr>
<tr>
<td>2010</td>
<td>110 mg/dL</td>
<td>72 mg/dL</td>
</tr>
<tr>
<td>2011</td>
<td>108 mg/dL</td>
<td>70 mg/dL</td>
</tr>
<tr>
<td>2012</td>
<td>106 mg/dL</td>
<td>68 mg/dL</td>
</tr>
</tbody>
</table>
**LDL Levels Among Statin-Intolerant Adults**

Patients referred to the prevention clinic who could not tolerate statins still experienced reductions in LDL levels. Patients had at least two follow-up visits within a year.

**Primary Prevention, Statin-Intolerant Adults (N = 152 in 2012)**

2007 – 2012

**LDL Value**

- Baseline: 131 mg/dL
- 2nd Follow-up: 97 mg/dL

**Secondary Prevention, Statin-Intolerant Adults (N = 135 in 2012)**

2007 – 2012

**LDL Value**

- Baseline: 132 mg/dL
- 2nd Follow-up: 81 mg/dL
Blood Pressure Among Primary and Secondary Prevention Patients (N = 947)

2012

Patients who were seen in the prevention clinic for both primary and secondary prevention experienced reductions in blood pressure. All patients had at least two follow-up visits within a year.

Value (mmHg)

Pediatric Preventive Cardiology and Metabolic Clinic Lipid Levels (N = 95)

2012

Value (mg/dL)

The Pediatric Preventive Cardiology and Metabolic Clinic offers expert assessment, lifestyle management advice, medication, and monitoring for patients aged < 21 years with cardiometabolic dyslipidemia as well as genetic dyslipidemia. Data are for patients with genetic dyslipidemia who had at least one follow-up visit in 2012.
HbA$_{1c}$ Levels Among Patients With Diabetes (N = 298)

2012
Patients seen in the prevention clinic who had diabetes reduced HbA$_{1c}$ levels during the course of their treatment. All patients were seen at baseline and had at least two follow-up visits within a year.

Exercise Prescriptions
2009 – 2012
Cleveland Clinic’s exercise prescriptions are designed to help patients start an exercise program. The prescription is written after the patient’s fitness level is determined. It provides the information about the recommended frequency, intensity, type, and length of exercise sessions.
Cardiac Rehabilitation

Outcomes measured in the Cardiac Rehabilitation Program include those related to functional capacity, quality of life, blood pressure, and weight.

**Improvement in Exercise Capacity by Exercise Stress Test (N = 246)**

2012

The metabolic equivalent of task (MET) is the ratio of the working metabolic rate to the resting metabolic rate. Each 1-MET increase in functional capacity reduces the risk of mortality by 8% to 12%. The average predicted reduction in mortality for patients in the program based on improvement in functional capacity (METs) was approximately 16%.

Data represent all cardiac rehab patients with both entry and exit visits in 2012.

Cardiac Rehabilitation

**Improvement in Systolic Blood Pressure (N = 246)**

2012

Among patients who completed the Cardiac Rehabilitation Program, 86% achieved normal blood pressure (< 140/90 mmHg). The average improvement was 10 mmHg.

Data represent all cardiac rehab patients with both entry and exit visits in 2012.
**Cardiac Rehabilitation**

**Improvement in Weight (N = 278)**

2012

Patients who completed the Cardiac Rehabilitation Program lost an average of 4.5 pounds.

Data represent all cardiac rehab patients with both entry and exit visits in 2012.

---

**Cardiac Rehab Volume**

2008 - 2012

---
Quality of life is measured using the SF-36® Health Survey. This is a validated measure that tracks overall wellness of patients in cardiac rehabilitation. Patients who completed the program experienced improved physical and emotional quality of life.

The Weigh to a Healthy Heart

2011 – 2012
The Weigh to a Healthy Heart is a comprehensive 11-week weight loss program designed to help prevent cardiovascular disease. The program is guided by a team of dietitians, physicians, exercise physiologists, and behavioral counselors. Patients receive an exercise prescription and participate in private nutrition sessions, group exercise classes, lipid and fasting sugar testing, and weekly group support sessions. They also get help creating a grocery list.

In 2012, patients who attended more than 75% of the classes lost an average of 8 pounds. Those who attended fewer than 75% of the classes lost an average of 5 pounds.

Mean Weight Loss Over 11 Weeks

<table>
<thead>
<tr>
<th>Year</th>
<th>Weight Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>5 pounds</td>
</tr>
<tr>
<td>2012</td>
<td>8 pounds</td>
</tr>
</tbody>
</table>
The Critical Response and Resuscitation team has three primary goals:

- Reduce nursing unit cardiopulmonary arrests (CPA)
- Improve post-CPA survival to discharge
- Maintain regulatory compliance

The team works together with the Miller Family Heart & Vascular Institute staff to improve outcomes.

### Cardiopulmonary Arrests

**2009 – 2012**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cleveland Clinic</th>
<th>Heart &amp; Vascular Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>180</td>
<td>100</td>
</tr>
<tr>
<td>2010</td>
<td>150</td>
<td>120</td>
</tr>
<tr>
<td>2011</td>
<td>160</td>
<td>130</td>
</tr>
<tr>
<td>2012</td>
<td>140</td>
<td>110</td>
</tr>
</tbody>
</table>

Includes: MET→CPA, ARC→CPA

### Survival-to-Discharge Rate

**2009 – 2012**

<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>35</td>
</tr>
<tr>
<td>2011</td>
<td>40</td>
</tr>
<tr>
<td>2012</td>
<td>45</td>
</tr>
</tbody>
</table>

Cleveland Clinic

500 bed comparison hospital

Includes: MET→CPA, ARC→CPA
Surgical Quality Improvement

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. These outcomes data reflect Cleveland Clinic’s NSQIP performance benchmarked against more than 350 participating hospitals.

Cleveland Clinic
Overall Multispecialty 30-Day Mortality (N = 4,988)
July 2011 – June 2012

<table>
<thead>
<tr>
<th>Percent</th>
<th>Observed</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall mortality was significantly lower than expected, and overall morbidity was significantly higher than expected.

Vascular Surgery 30-Day Mortality and Morbidity (N = 438)
July 2011 – June 2012

In addition to overall surgical performance, NSQIP data specific to vascular surgery are provided.

<table>
<thead>
<tr>
<th>Percent</th>
<th>Cleveland Clinic</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30-Day Mortality</td>
<td>30-Day Morbidity</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

There was no significant difference between vascular surgery observed and expected mortality or morbidity rates.
**Vascular Surgery Complications**

**July 2011 – June 2012**

There was no significant difference between vascular surgery observed and expected complication rates.

---

**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 & Medicaid Services, shows the percentage of patients who received all the recommended care for which they were eligible.

**Cleveland Clinic Surgical Appropriateness of Care**

**2011 – 2012**

Cleveland Clinic has set a target of UHC’s 90th percentile, and results are trending positively.
Cleveland Clinic is dedicated to delivering excellent clinical outcomes and the best possible experience for 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 Cleveland Clinic’s care.

**Outpatient — Heart & Vascular Institute**

**2011 – 2012**

### Percent Best Response*

<table>
<thead>
<tr>
<th>Category</th>
<th>2011 (N = 4,626)</th>
<th>2012 (N = 4,597)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appt Access/Check-in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic Wait Times and Comfort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse and Assistant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concern for Needs and Privacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Assessment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Response options: Very Good, Good, Fair, Poor, Very Poor
*Each bar represents a composite score based on responses to multiple survey questions.

Source: Press Ganey, a national hospital survey vendor.
HCAHPS Overall Assessment
2011 – 2012

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 medicare.gov/hospitalcompare/search.html.

The guiding principle of Cleveland Clinic is “Patients First,” and improving the patient experience is a major strategic organizational 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.

HCAHPS Domains of Care
2011 – 2012

*Except for “Room Clean” and “Quiet at Night,” each bar represents a composite score based on responses to multiple survey questions.

Source: Press Ganey, a national hospital survey vendor
Overview

Cleveland Clinic health system uses a scorecard approach to measure and monitor quality, safety, and patient experience. Real-time dashboard data are leveraged in each location to drive performance improvement. Although not an exact match to publicly reported data, more timely internal data create transparency at all organizational levels and support improved care in all clinical locations. The following measures are examples of health system 2012 quality and safety focus areas. Throughout this section, “Cleveland Clinic” refers to the academic medical center or “main campus,” and those results are shown.

Cleveland Clinic Core Measures

Appropriateness of Care

2011 – 2012

All-Cause 30-Day Readmission Rate

to Any Cleveland Clinic Hospital

2011 – 2012

Cleveland Clinic’s goal is for all patients to receive all the recommended care for their condition. An aggregated “all or nothing” measurement approach to monitoring multiple publicly reported process-of-care measures for heart failure, acute myocardial infarction, pneumonia, and surgery patients yields results consistently above 94%.

Cleveland Clinic monitors 30-day readmission rates for any reason to any of its system hospitals. Unplanned readmissions are actively reviewed for improvement opportunities. Strategies associated with communication, education, and follow-up have been implemented for several high-risk conditions, including heart failure and pneumonia. These practices are being expanded and enhanced to reduce overall avoidable readmissions.
Cleveland Clinic Overall In-Hospital Mortality Observed/Expected Ratio
2011 – 2012

Cleveland Clinic’s observed/expected (O/E) mortality ratio outperformed the University HealthSystem Consortium (UHC) academic medical center 50th percentile throughout 2012 based on the UHC 2012 risk model. Ratios less than 1.0 indicate mortality performance “better than” expected in UHC’s risk adjustment model.

*These data are prepared using the University HealthSystem Consortium (UHC) Clinical Database. uhc.edu

Cleveland Clinic Deaths Among Surgical Patients With Serious Treatable Complications (PSI 4) Rate per 1,000 Eligible Patients
2011 – 2012

The Agency for Healthcare Research and Quality’s Patient Safety Indicator 4 (AHRQ PSI 4) reports deaths among patients with serious treatable complications. Cleveland Clinic performs in the top third of UHC’s academic medical centers for this measure.
Cleveland Clinic continues to improve its performance with respect to postoperative blood clots (AHRQ Patient Safety Indicator 12). Improved screening and prevention strategies have led to a 45% reduction in these events over the past two years.

Cleveland Clinic has implemented several strategies to reduce central line-associated bloodstream infections (CLABSI), including a central-line bundle of insertion, maintenance, and removal best practices. In 2012, Cleveland Clinic initiated focused reviews of every CLABSI occurrence and is introducing equipment and technology to support reductions in CLABSI rates in its high-risk critical care population.

*These data are prepared using the University HealthSystem Consortium (UHC) Clinical Database. uhc.edu
A pressure ulcer is an injury to the skin that can be caused by pressure, moisture, or friction. These sometimes occur when patients have difficulty changing positions on their own. Cleveland Clinic caregivers have been trained to provide appropriate skin care and regular repositioning help while taking advantage of special devices and mattresses to reduce pressure for high-risk patients. In addition, they actively look for hospital-acquired pressure ulcers and treat them quickly if they occur.

Nationally, falls are a leading cause of hospital patient injury. Cleveland Clinic fall prevention efforts include identifying patients who are at risk for falls, checking on them frequently, assisting them to the bathroom, and providing nonskid footwear. Caregivers make sure patients have all necessary items, including a call light, within easy reach.

*The National Database of Nursing Quality Indicators® (NDNQI®) is owned by the American Nurses Association. The database collects and evaluates unit-specific nurse-sensitive data from hospitals domestically and globally, with > 1900 hospitals participating. The comparison data represented here are based on a third of all hospitals in the U.S. participating. © 2012, American Nurses Association, All Rights Reserved. www.nursingquality.org
Patient Experience

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey is a standardized national tool used to measure patients’ perspectives of hospital care. Results collected for public reporting are available at medicare.gov/hospitalcompare.

Cleveland Clinic HCAHPS Overall Assessment
2011 – 2012

Percent Best Response*

<table>
<thead>
<tr>
<th></th>
<th>2011 (N = 10,378)</th>
<th>2012 (N = 11,190)</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommend Hospital (% Definitely Yes)*</td>
<td>84.0</td>
<td>84.9</td>
<td></td>
</tr>
<tr>
<td>Hospital Rating (% 9 or 10) 0–10 Scale</td>
<td>80.0</td>
<td>80.8</td>
<td></td>
</tr>
</tbody>
</table>

*Response options: Definitely Yes, Probably Yes, Probably No, Definitely No

Source: Centers for Medicare & Medicaid Services and Press Ganey, a national hospital survey vendor
The guiding principle of Cleveland Clinic is “Patients First,” and improving the patient experience is a major strategic organizational 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.
Global Cardiovascular Innovation Center

The Global Cardiovascular Innovation Center (GCIC) has awarded a total of more than $18 million to more than 54 companies and projects. The organization has helped create more than 525 jobs in Ohio.

The GCIC is part of the Cleveland Clinic Innovation Center (CCIC), which is Cleveland Clinic’s technology commercialization arm. Its mission is to “benefit the sick through the broad and rapid deployment of Cleveland Clinic technology.” The center facilitates innovation, creates spin-off companies, licenses technology, secures resources, and establishes strategic collaborations with corporate partners.
Centerline Analysis Software

Endovascular repair of aortic aneurysms and dissections is critically dependent on a proper understanding of the geometry of a patient's arteries. Cleveland Clinic researchers have developed an automated system that extracts the centerlines of the aorta and branch vessels from a patient's CT scan and then builds a complete mathematical model of the relevant vasculature. Unlike the data stored in a CT scan, this model represents the anatomy in a way that can be easily manipulated and understood by computer software. Software developed by Cleveland Clinic utilizes these models to help design and implant endovascular devices. This technology will make minimally invasive vascular repairs safer, more effective, and more widely available.

Kapsus Device

In recent years, there has been increased interest in developing new ways to treat structural heart pathology. These include procedures such as transcatheter aortic valve replacement, mitral valve treatment in patients with congestive heart failure, and closure of the left atrial appendage to reduce the risk of stroke. To help facilitate transseptal access to the left atrium, Cleveland Clinic researchers developed the Kapsus device. The technology represents the first major change in 50 years for transseptal access to the left atrium. The design allows for improved repeatability, safety, and speed in these procedures.
Link Between Carnitine and Atherosclerosis

Researchers at Cleveland Clinic have shown that carnitine, a compound abundant in red meat and added as a supplement to popular energy drinks, is linked to the development of atherosclerosis. Bacteria living in the human digestive tract metabolize carnitine, turning it into trimethylamine-N-oxide (TMAO). In 2011, the researchers linked TMAO to the promotion of atherosclerosis. The study also shows that a diet high in carnitine promotes the growth of the bacteria that metabolize carnitine, thus compounding the problem by producing even more TMAO. In addition, TMAO alters the metabolism of cholesterol on different levels, as shown in the accompanying illustration. This research is expected to lead to development of new diagnostic tests for cardiac risks and new potential therapies for patients with cardiovascular disease.
Absorb™ Stent

The Absorb stent (Abbott Laboratories; Abbott Park, Ill.) is a polymer-based stent/vascular scaffold that is completely bioresorbable. Researchers at Cleveland Clinic are comparing the early and long-term results of Absorb with those of the most advanced permanent metallic and polymer drug-eluting stents. The device is used to treat patients with coronary artery disease. Permanent polymer stents can lead to arterial inflammation and stent thrombosis. The Absorb stent dissolves once the artery can stay open. This allows the artery to function naturally, expanding and contracting to meet the heart’s need for blood. Absorb may also reduce the need for long-term anticoagulant therapy.

XVIVO Lung Perfusion System

The majority of lungs donated for transplant (about 80%) cannot be used because they are infected or damaged or because they contain too much fluid. However, Cleveland Clinic researchers are testing a way to make many of these lungs usable. The XVIVO system involves infusing the lungs with a solution while they are attached to a ventilator. The lungs can then be transplanted. Approximately 1,600 people are waiting for lung transplant. FDA approval of this system would expand the availability of lungs for transplant and improve survival among those on the donor wait list.

Subcutaneous Defibrillation

Sudden cardiac death is the leading cause of death in the United States. Cleveland Clinic is among a select group of U.S. hospitals using a new device to treat and prevent sudden cardiac death. The subcutaneous implantable defibrillator allows the leads to be tunneled under the skin. Traditional implantable devices require either open heart surgery or lead placement in veins. Such placement can result in malfunction and other complications. In addition to reducing these risks, the technology provides an additional treatment option for patients who are unable to have transvenous lead placement.
SIMPLICITY-HTN III
Renal Denervation for Resistant Hypertension

Cleveland Clinic is involved in the SIMPLICITY-HTN III trial. This multicenter trial is designed to study the efficacy of renal denervation — a novel therapy for patients with resistant hypertension. Up to 20% of patients with hypertension cannot achieve normal blood pressure with traditional therapy. Renal denervation is a one-time interventional treatment similar to a cardiac catheterization. A small catheter is inserted through the groin and guided to the renal arteries. A low-energy radiofrequency is transmitted to the arteries, which burns the nerves inside the arteries. Once the nerves are burned, the brain receives feedback that translates into a significant reduction in blood pressure. The reduction can be as great as 30 to 40 mm Hg. The treatment has the potential to become the standard of care for patients with resistant hypertension and may benefit patients with other conditions, such as heart failure, metabolic syndrome and insulin resistance. In addition to the therapeutic benefit of renal denervation, the treatment offers significant cost savings to patients.
Vagus Nerve Stimulator

An imbalance between the parasympathetic and sympathetic nervous systems contributes to the progression of chronic heart failure. Contemporary treatment options only partially address this factor. Cleveland Clinic researchers are participating in an international multicenter trial to test the efficacy and safety of the vagus nerve stimulator. The device is similar to a pacemaker in shape and size and has two leads. It is implanted in the upper right side of the chest, and the leads are attached to the vagus nerve on the right side of the neck and the right ventricle. Patients who receive the device are already receiving optimal medical therapy. The device helps correct autonomic imbalance through intermittent stimulation of the vagus nerve. The stimulation is timed to QRS complexes sensed by the right ventricular lead. Cleveland Clinic was the first in Ohio to implant this device.
Staff Listing

**Institute Leadership**
Bruce W. Lytle, MD<sup>A</sup>, Chairman, Sydell and Arnold Miller Family Heart & Vascular Institute
Daniel Clair, MD<sup>A</sup>, Chairman, Vascular Surgery
Steven E. Nissen, MD<sup>A</sup>, Chairman, Robert and Suzanne Tomsich Department of Cardiovascular Medicine
Joseph F. Sabik III, MD<sup>A</sup>, Chairman, Thoracic and Cardiovascular Surgery

**Quality Review Officers**
Nicholas G. Smedira, MD<sup>A</sup>, Sydell and Arnold Miller Family Heart & Vascular Institute
Sunita Srivastava, MD, Vascular Surgery
Lars G. Svensson, MD, PhD, Thoracic and Cardiovascular Surgery

**Institute Patient Experience Officer**
A. Marc Gillinov, MD<sup>A</sup>

**Thoracic Surgery**
Thomas W. Rice, MD<sup>A</sup>, Section Head
David P. Mason, MD
Sudish C. Murthy, MD, PhD
Siva Raja, MD, PhD
Daniel Raymond, MD

**Thoracic and Cardiovascular Surgery**
Joseph F. Sabik III, MD<sup>A</sup>, Chairman
Gösta B. Pettersson, MD, PhD<sup>A</sup>, Vice Chairman

**Cardiovascular Surgery**
A. Marc Gillinov, MD<sup>A</sup>
Douglas R. Johnston, MD
Bruce W. Lytle, MD<sup>A</sup>
Kenneth R. McCurry, MD
Stephanie Mick, MD
Tomislav Mihaljevic, MD<sup>A</sup>
Nader Moazami, MD
José L. Navia, MD
Gösta B. Pettersson, MD, PhD<sup>A</sup>
Eric E. Roselli, MD
Joseph F. Sabik III, MD<sup>A</sup>
Nicholas G. Smedira, MD<sup>A</sup>
Edward G. Soltesz, MD
Lars G. Svensson, MD, PhD

**Pediatric and Adult Congenital Heart Surgery**
Gösta B. Pettersson, MD, PhD<sup>A</sup>, Section Head
Robert D. Stewart, MD, Surgical Director of Congenital Heart Transplantation

**Vascular Surgery**
Daniel Clair, MD<sup>A</sup>, Chairman
Linda Graham, MD, Vice Chair
Timur Sarac, MD, Vice Chair
Matthew Eagleton, MD
Roy K. Greenberg, MD
Jeanwan Kang, MD
Rebecca Kelso, MD
Levester Kirksey, MD
Sean Lyden, MD

<sup>A</sup>Chair Holders
Staff Listing

Ellen Mayer-Sabik, MD
Paul Schoenhagen, MD
William James Stewart, MD
Balaji Tamarappoo, MD
Maran Thamilarasan, MD
James Thomas, MD
Abdul Wattar, MD

Clinical Cardiology
Ben Barzilai, MD, Section Head
Ajay Bhargava, MD
Caroline Casserly, MD
Michael Faulx, MD
Adam Grasso, MD, PhD
Donald F. Hammer, MD
Joel B. Holland, MD
Julie Huang, MD
Carlos Hubbard, MD, PhD

Heart Failure and Cardiac Transplant Medicine
Randall C. Starling, MD, Section Head
Corinne Bott-Silverman, MD
Eiran Gorodeski, MD
Mazen A. Hanna, MD
Robert E. Hobbs, MD
Eileen Hsich, MD
Carlos Hubbard, MD, PhD
Karen B. James, MD
Sangjin Lee, MD
Christine Moravec, PhD
Maria Mountis, DO
W.H. Wilson Tang, MD
David O. Taylor, MD
James B. Young, MD^A

Invasive Cardiology
Stephen Ellis, MD, Section Head
Christopher Bajzer, MD
Corinne Bott-Silverman, MD
Joseph G. Cacchione, MD
Leslie Cho, MD
Khosrow Dorosti, MD
Michael Faulx, MD
Perry L. Fleisher, MD
Irving Franco, MD
Frederick A. Heupler Jr., MD
Robert E. Hobbs, MD
Martin Joseph, MD

^Chair Holders
Samir Kapadia, MD
Richard Krasuski, MD
Amar Krishnaswamy, MD
A. Michael Lincoff, MD
Ravi N. Nair, MD
Russell E. Raymond, DO
Jonathan Scharfstein, MD
Mehdi Shishehbor, DO
Conrad C. Simpfendorfer, MD
John Stephens, MD
E. Murat Tuzcu, MD
Vladimir Vekstein, MD
Patrick L. Whitlow, MD

Preventive Cardiology and Rehabilitation
Leslie Cho, MD, Section Head
Stanley L. Hazen, MD, PhD, Section Head
Michael B. Rocco, MD, Medical Director, Cardiac Rehabilitation
Gordon Blackburn, PhD, Program Director, Cardiac Rehabilitation
David J. Frid, MD
Department of Cardiovascular Medicine
Betul Hatipoglu, MD
Department of Endocrinology
Julie Huang, MD
Department of Cardiovascular Medicine
Leopoldo Pozuelo, MD
Program Director, Cardiovascular Behavioral Health Clinic
Paul Schoenhagen, MD
Department of Diagnostic Radiology

Pediatric Preventive Cardiology and Metabolic Clinic
Naim Alkhouri, MD
Department of Pediatric Gastroenterology
Richard Lorber, MD
Department of Pediatric Cardiology
Douglas Rogers, MD
Section Head, Pediatric Endocrinology

Vascular Medicine
John R. Bartholomew, MD, Section Head
Christopher Bajzer, MD
Robert Bauman, MD
Natalie Evans, MD
Carmen Fonseca, MD
Leslie Gilbert, MD
Marcelo Gomes, MD
Heather L. Gornik, MD
Douglas Joseph, DO
Samir Kapadia, MD
Soo Hyun (Esther) Kim, MD
Natalia Fendrikova Mahlay, MD
Michael Maier, DPM
William Ruschhaupt, MD
Mehdi Shishehbor, DO
Patrick L. Whitlow, MD

Women's Cardiovascular Center
Leslie Cho, MD, Director
Julie Huang, MD
Soo Hyun (Esther) Kim, MD
Ellen Mayer-Sabik, MD

Chair Holders
Staff Listing

Research

Clinical Investigations
Eugene H. Blackstone, MD\textsuperscript{a}, Director

Vascular Surgery Research
Roy K. Greenberg, MD, Director of Endovascular Research

Cardiovascular Research and C5Research
(Cleveland Clinic Coordinating Center for Clinical Research)
A. Michael Lincoff, MD\textsuperscript{a}, Director
Stephen J. Nicholls, MD, PhD, Cardiovascular Director

Associate Directors of C5Research
Heather L. Gornik, MD
Roy K. Greenberg, MD
Wael A. Jaber, MD
David O. Martin, MD
Stephen J. Nicholls, MD, PhD
W.H. Wilson Tang, MD
Patrick L. Whitlow, MD

C5Research Core Laboratory Directors
Roy K. Greenberg, MD
Stanley L. Hazen, MD, PhD
Wael A. Jaber, MD
Soo Hyun (Esther) Kim, MD
Venugopal Menon, MD
Mehdi H. Shishehbor, DO

\textsuperscript{a}Chair Holders

Pediatric and Adult Congenital Heart Surgery Research
Marshall Jacobs, MD, Director Clinical Research

Cardiothoracic Anesthesiology
Michael S. O'Connor, DO, Chairman
Colleen Koch, MD, Vice Chair
Michael Licina, MD, Vice Chair
John Apostolakis, MD, Quality Review Officer
Ahmad Adi, MD
Andrej Alfirevic, MD
C. Allen Bashour, MD
M. Gregory Bourdakos, MD
Sergio Bustamante, MD
Michelle Capdeville, MD
Gohar Dar, MD
Pierre DeVilliers, MD
Andra Duncan, MD
Brian Fitzsimons, MD
Marius Gota, MD
Michael Hauser, MD
Steven Insler, DO
Brian Johnson, MD
Erik Kraenzler, MD
Tory McGrath, MD
Anand Mehta, MD
Michael S. O'Connor, DO
Grzegorz Pitas, MD
Dominique Prud’Homme, MD
Shiva Sale, MD
Robert M. Savage, MD
Joyce Shin, MD
Norman J. Starr, MD
Carlos Trombetta, MD
Lee Wallace, MD
Jean-Pierre Yared, MD

Cardiovascular Intensive Care Units Anesthesiology
Jean-Pierre Yared, MD, Medical Director, Cardiovascular ICU
Director, Center for Critical Care Medicine
David Anthony, MD
C. Allen Bashour, MD
Gregory Bourdakos, MD
Gohar Dar, MD
Andra Duncan, MD
Marius Gota, MD
Steven Insler, DO
Eric Kaiser, MD
Donn Marciniak, MD
Michael S. O’Connor, DO
Robert Savage, MD

Vascular Surgery Anesthesiology
Theodore Marks, MD, Section Head
Maged Argalious, MD
Harendra Arora, MD
Jacek Cywinski, MD
Tracy Dovich, MD
Brian Fitzsimons, MD
Alexandru Gottlieb, MD
Robert Helfand, MD
Samuel Irefin, MD
Jia Lin, MD
Brian Parker, MD
Mangalakaraipudur Ramachandran, MD

Regional Medical Practice

Avon (Richard E. Jacobs) Health Center
Mark Angel, MD, Cardiovascular Medicine
James Bekeny, MD, Vascular Surgery
Thomas Callahan IV, MD, Cardiovascular Medicine
Lon W. Castle, MD, Cardiovascular Medicine
Albert Chan, MD, Cardiovascular Medicine
Basem Droubi, MD, Vascular Surgery
Lawrence Jacobs, MD, Cardiovascular Medicine
Jeanwan Kang, MD, Vascular Surgery
Soo Hyun (Esther) Kim, MD, Vascular Medicine
Chiara Liguori, MD, Cardiovascular Medicine
Robert D. Mosteller, MD, Cardiovascular Medicine
Ashoka Nautiyal, MD, Cardiovascular Medicine
Christopher Smolock, MD, Vascular Surgery
Christine Tanaka-Esposito, MD, Cardiovascular Medicine

Beachwood Family Health and Surgery Center
Joseph Cacchione, MD, Cardiovascular Medicine
Leslie Gilbert, MD, Vascular Medicine
Joel B. Holland, MD, Cardiovascular Medicine
Carlos Hubbard, MD, Cardiovascular Medicine
David Naar, MD, Vascular Surgery
Michael B. Rocco, MD, Cardiovascular Medicine
Sunita Srivastava, MD, Vascular Surgery
Patrick Tchou, MD, Cardiovascular Medicine

Brunswick Family Health Center
Joel Godard, MD, Cardiovascular Medicine

Chagrin Falls Family Health Center
Jason Confino, MD, Cardiovascular Medicine
Leslie Gilbert, MD, Vascular Medicine
Joseph Martin, MD, Cardiovascular Medicine
Anthony Rizzo, MD, Vascular Surgery

Elyria Family Health Center
David Joyce, MD, Cardiovascular Medicine

Cleveland Clinic Florida
Richard Adamick, MD, Cardiovascular Medicine
Marianela Areces, MD, Cardiovascular Medicine
Craig Asher, MD, Cardiovascular Medicine
Jose Baez-Escudero, MD, Cardiovascular Medicine
Andrew Boyle, MD, Cardiovascular Medicine
Nicolas Brozzi, MD, Cardiothoracic Surgery
Howard S. Bush, MD, Cardiovascular Medicine
Carmel Celestin, MD, Vascular Medicine
Mehrdad Farid, MD, Vascular Medicine
Bernardo Fernandez, MD, Vascular Medicine
Kenneth Fromkin, MD, Cardiovascular Medicine
Mark Grove, MD, Vascular Surgery
Marcelo Eduardo Helguera, MD, Cardiovascular Medicine

Terry King, MD, Vascular Surgery
Darryl Miller, MD, Vascular Surgery
Viviana Navas, MD, Cardiovascular Medicine
Gian Novaro, MD, Cardiovascular Medicine
Sergio Pinski, MD, Cardiovascular Medicine
Edward Savage, MD, Cardiothoracic Surgery
Michael Shen, MD, Cardiovascular Medicine
David Wolinsky, MD, Cardiovascular Medicine

Independence Family Health Center
Caroline Casserly, MD, MBA, Cardiovascular Medicine
Joel Godard, MD, Cardiovascular Medicine
Lawrence Jacobs, MD, Cardiovascular Medicine
Rebecca Kelso, MD, Vascular Surgery
Michael Maier, DPM, Vascular Medicine
Sudish Murthy, MD, Thoracic Surgery
Michael B. Rollins, MD, Cardiovascular Medicine

Lorain Family Health and Surgery Center
David Joyce, MD, Cardiovascular Medicine
Michael Langer, DO, Cardiovascular Medicine
Theodore Pacheco, MD, Cardiovascular Medicine
Richard Sterba, MD, Pediatric Cardiology

Mentor Medical Office Building
Abdul Wattar, MD, Cardiovascular Medicine

Strongsville Family Health and Surgery Center
John R. Bartholomew, MD, Vascular Medicine
Joel Godard, MD, Cardiovascular Medicine
Matthew Kaminski, MD, Cardiovascular Medicine
Natalia Fendrikova Mahlay, MD, Vascular Medicine
Tara Mastracci, MD, Vascular Surgery
Robert Mosteller, MD, Cardiovascular Medicine
Daniel Raymond, MD, Thoracic Surgery
Terrence G. Tulisiak, MD, Cardiovascular Medicine

Twinsburg Family Health Center
George Anton, MD, Vascular Surgery
Daniel Cantillon, MD, Cardiovascular Medicine
Jason Confino, MD, Cardiovascular Medicine
Joseph Martin, MD, Cardiovascular Medicine
Mark Pace, DO, Cardiovascular Medicine

Willoughby Hills Family Health Center
Mohamed A. Atassi, MD, Cardiovascular Medicine
Leslie Gilbert, MD, Vascular Medicine
Kamal Riad, MD, Cardiovascular Medicine
Lincoln Roland, MD, Vascular Surgery
Abdul Wattar, MD, Cardiovascular Medicine
Niraj Varma, MD, PhD, Cardiovascular Medicine

Wooster Family Health Center
Kenneth E. Shafer, MD, Cardiovascular Medicine
Richard Sterba, MD, Pediatric Cardiology
Bennett Werner, MD, Cardiovascular Medicine

Cleveland Clinic Hospitals

Ashtabula Medical Center
Perry L. Fleisher, MD, Cardiovascular Medicine
John Stephens, MD, Cardiovascular Medicine

Euclid Hospital
J. Michael Koch, MD, Cardiovascular Medicine

Fairview Hospital
Albert Chan, MD, Cardiovascular Medicine
Basem Droubi, MD, Vascular Surgery
Inderjit S. Gill, MD, Thoracic and Cardiovascular Surgery
Joseph A. Lahorra, MD, Thoracic and Cardiovascular Surgery
R. Thomas Temes, MD, Thoracic and Cardiovascular Surgery

Hillcrest Hospital
Rami Akhrass, MD, Thoracic and Cardiovascular Surgery
George Anton, MD, Vascular Surgery
Mark J. Botham, MD, Thoracic and Cardiovascular Surgery
Avrum Jacobs, MD, Cardiovascular Medicine
David Naar, MD, Vascular Surgery
Anthony Rizzo, MD, Vascular Surgery
Lincoln Roland, MD, Vascular Surgery
Thomas G. Santoscoy, MD, Thoracic and Cardiovascular Surgery
T. Mark Sequeira, MD, Cardiovascular Medicine
Staff Listing

Jonathan Scharfstein, MD, Cardiovascular Medicine
Vladimir Vekstein, MD, Cardiovascular Medicine
Donna J. Waite, MD, Thoracic and Cardiovascular Surgery
Martin Wiseman, MD, Cardiovascular Medicine

Lakewood Hospital
Rami Akhrass, MD, Thoracic and Cardiovascular Surgery
Mark Angel, MD, Cardiovascular Medicine
James Bekeny, MD, Vascular Surgery
Albert Chan, MD, Cardiovascular Medicine
Basem Droubi, MD, Vascular Surgery
Khodanpur Guruprasad, MD, Cardiovascular Medicine
A. George Hawwa, MD, Cardiovascular Medicine
Wael Khoury, MD, Cardiovascular Medicine
Douglas Joseph, DO, Cardiovascular Medicine
Thomas Santoscoy, MD, Thoracic and Cardiovascular Surgery
Amir Taraben, MD, Cardiovascular Medicine
R. Thomas Temes, MD, Thoracic and Cardiovascular Surgery

Medina Hospital
Michael Amalfitano, DO, Cardiovascular Medicine
Kathleen Boyle, MD, Vascular Surgery
Natalia Fendrikova Mahlay, MD, Cardiovascular Medicine
Siva Raja, MD, Thoracic Surgery
Matthew Kaminski, MD, Cardiovascular Medicine

South Pointe Hospital
Monica Khot, MD, Cardiovascular Medicine
Michael Koch, MD, Cardiovascular Medicine
Abdul Wattar, MD, Cardiovascular Medicine

Some physicians may practice in multiple locations.
For a complete list including staff photos, please visit clevelandclinic.org/staff
Sydell and Arnold Miller Family Heart & Vascular Institute

General Information and Appointments
800.659.7822

Thoracic and Cardiovascular Surgery Evaluation
Nurse practice managers will expedite patient record review with a Cleveland Clinic surgeon and address questions. 216.444.3500 or 877.8HEART1 (877.843.2781)

Cardiovascular Medicine Appointments/Referrals
216.444.6697 or 800.223.2273, ext. 46697

Vascular Medicine Appointments/Referrals
216.444.4420 or 800.223.2273, ext. 44420

Vascular Surgery Appointments/Referrals
216.444.4508 or 800.223.2273, ext. 44508

Sydell and Arnold Miller Family Heart & Vascular Institute Resource Center
Nurses are available Monday through Friday, 8:30 a.m. to 4:00 p.m., Eastern time, to answer patient questions and concerns about heart and blood vessel disease or to schedule a second opinion. 216.445.9288 or 866.289.6911 or email heartcenter@ccf.org

On the Web at clevelandclinic.org/heart

Additional Contact Information

General Information
216.444.2200

Hospital Transfers
24/7 hospital transfers or physician consults
800.553.5056

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 Hotline for information on our clinical specialties and services, to schedule and confirm patient appointments, for assistance in resolving service-related issues, and to connect with Cleveland Clinic specialists.

Medical Concierge for Out-of-State Patients
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

For address corrections or changes, please call
800.890.2467
The Sydell and Arnold Miller Family Heart & Vascular Institute physicians see patients at the locations below. Please inquire about the availability of specific services at each location when calling.

**Cleveland Clinic Main Campus**  
9500 Euclid Ave.  
Cleveland, OH 44195  
216.444.2200 or 800.223.2273

**Cleveland Clinic Florida**  
2950 Cleveland Clinic Blvd.  
Weston, FL 33331  
954.659.5320  
clevelandclinic.org/florida  
Cardiovascular medicine, vascular medicine, cardiothoracic surgery, thoracic surgery

**Ashtabula County Medical Center**  
2420 Lake Road  
Ashtabula, OH 44004  
440.994.7622  
acmchealth.org  
Cardiovascular medicine

**Beachwood Family Health and Surgery Center**  
26900 Cedar Road  
Beachwood, OH 44122  
216.839.3000 or toll-free 866.318.2491  
Cardiovascular medicine, vascular surgery

**Brunswick Family Health Center**  
3574 Center Road  
Brunswick, OH 44212  
330.225.8886  
Cardiovascular medicine

**Elyria Family Health and Surgery Center**  
303 Chestnut Commons Drive  
Elyria, OH 44035  
440.366.9444 or 440.204.7900  
Vascular surgery

**Euclid Hospital**  
18901 Lakeshore Blvd.  
Euclid, OH 44119  
216.531.9000  
euclidhospital.org  
Cardiovascular medicine

**Fairview Hospital**  
Fairview Physicians’ Center  
18101 Lorain Ave.  
Cleveland, OH 44111  
216.476.7310  
fairviewhospital.org  
Cardiovascular medicine, cardiothoracic surgery, vascular surgery

**Hillcrest Hospital**  
6780 Mayfield Road  
Mayfield Heights, OH 44124  
440.449.9300  
hillcresthospital.org  
Cardiovascular medicine, cardiothoracic surgery, vascular surgery

**Independence Family Health Center**  
Crown Centre II  
5001 Rockside Road  
Independence, OH 44131  
216.986.4000  
Cardiovascular medicine, vascular surgery, thoracic surgery
Lorain Family Health and Surgery Center
5700 Cooper Foster Park Road
Lorain, OH 44053
440.204.7400 or 800.272.2676
Pediatric cardiovascular medicine, vascular surgery

Marymount Hospital
12300 McCracken Road
Garfield Heights, OH 44125
216.587.4280
marymount.org
Vascular surgery, thoracic surgery

Medina Hospital
1000 E. Washington St.
Medina, OH 44256
330.725.1000
Cardiovascular medicine, vascular surgery, thoracic surgery

South Pointe Hospital
20000 Harvard Road
Warrensville Heights, OH 44122
216.491.6000
southpointehospital.org
Cardiovascular medicine, thoracic surgery

Strongsville Family Health and Surgery Center
16761 SouthPark Center
Strongsville, OH 44136
440.878.2500 or 800.239.1098
Cardiovascular medicine, vascular medicine, vascular surgery, thoracic surgery

Twinsburg Medical Office
8701 Darrow Road
Twinsburg, OH 44087
330.888.4000
Cardiovascular medicine, vascular surgery

Westlake Family Health Center
30033 Clemens Road
Westlake, OH 44145
440.899.5555 or 800.599.7771
Cardiovascular medicine, thoracic and cardiovascular surgery

Willoughby Hills Family Health Center
2570 SOM Center Road
Willoughby Hills, OH 44094
440.943.2500 or 800.807.2888
Cardiovascular medicine, vascular medicine

Wooster Family Health and Surgery Center
1740 Cleveland Road
Wooster, OH 44691
330.287.4500 or 800.451.9870
Cardiovascular medicine
Alliances and Affiliations

Clinical and Research Alliance

MedStar Heart Institute
5565 Sterrett Place
Columbia, MD 21044
877.772.6505

Heart & Vascular Institute Affiliates

The Bellevue Hospital
1400 W. Main St.
Bellevue, OH 44811
419.483.4040
bellevuehospital.com

Cadence Health
25 N. Winfield Road
Winfield, IL 60190
cdh.org

Cleveland Clinic Florida
2950 Cleveland Clinic Blvd.
Weston, FL 33331
954.659.5320

Fisher-Titus Medical Center
272 Benedict Ave.
Norwalk, OH 44857
419.668.8101
fisher-titus.org

Forsyth Medical Center
3333 Silas Creek Parkway
Winston-Salem, NC 27103
336.718.5000
forsythmedicalcenter.org

Presbyterian Hospital
200 Hawthorne Lane
Charlotte, NC 28204
704.384.4000
presbyterian.org

Saint Vincent
232 W. 25th St.
Erie, PA 16544
814.452.5000
saintvincenthealth.com

Heart Surgery Affiliates

Cape Fear Valley Health System
1638 Owen Drive
Fayetteville, NC 28304
910.609.4000
www.capefearvalley.com
Cardiothoracic surgery

Chester County Hospital
701 E. Marshall St.
West Chester, PA 19380
610.738.2690
www.cchosp.com
Cardiothoracic surgery

EMH Regional Medical Center
Gates Medical Building, Suite 101
630 E. River St.
Elyria, OH 44035
440.284.1504
emh-healthcare.org
Cardiothoracic surgery
Fairview Hospital
18101 Lorain Ave.
Cleveland, OH 44111
216.476.7310
fairviewhospital.org
Cardiothoracic surgery, vascular surgery, cardiovascular medicine

Hillcrest Hospital
6780 Mayfield Rd.
Mayfield Heights, OH 44124
440.449.9300
Cardiothoracic surgery, vascular surgery, cardiovascular medicine

Lake Health West
Lake West Medical Building, Suite 280
36000 Euclid Ave.
Willoughby, OH 44094
440.918.4640
lakehealth.org
Cardiothoracic surgery

MetroHealth Medical Center
2500 MetroHealth Drive
Cleveland, OH 44109
216.778.4304
metrohealth.org
Cardiothoracic surgery

Rochester General Hospital
1425 Portland Ave.
Rochester, NY 14621
585.544.6550
rochestergeneralhospital.org
Cardiothoracic surgery
Overview

Cleveland Clinic is an academic medical center offering patient care services supported by research and education in a nonprofit group practice setting. More than 3,000 Cleveland Clinic staff physicians and scientists in 120 medical specialties care for more than 5 million patients across the system, performing more than 200,000 surgeries and conducting 450,000 Emergency Department visits. Patients come to Cleveland Clinic from all 50 states and more than 132 nations around the world.

Cleveland Clinic is an integrated healthcare delivery system with local, national, and international reach. The main campus in midtown Cleveland, Ohio, has a 1,450-bed hospital, outpatient clinic, specialty institutes, labs, classrooms, and research facilities in 46 buildings on 167 acres. Cleveland Clinic patients represent the highest CMS case-mix index in the nation. Cleveland Clinic encompasses 75 northern Ohio outpatient locations, including 16 full-service family health centers, eight community hospitals, an affiliate hospital, and a rehabilitation hospital for children. Cleveland Clinic also includes Cleveland Clinic Florida, Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Cleveland Clinic Canada, and Sheikh Khalifa Medical City (management contract). Cleveland Clinic Abu Dhabi is a full-service hospital and outpatient center in the United Arab Emirates scheduled to begin offering services in 2014. Cleveland Clinic is the second-largest employer in Ohio with nearly 44,000 employees. It generates $10.5 billion of economic activity a 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.

The Cleveland Clinic system began to grow in 1987 with the founding of Cleveland Clinic Florida and expanded in the 1990s with the development of 16 family health centers across Northeast Ohio. Fairview Hospital, Hillcrest Hospital, and six other community hospitals joined Cleveland Clinic over the past decade and a half, offering Cleveland Clinic institute services in heart and neurological care, physical rehabilitation, and more. Clinical and support services were reorganized into 27 patient-centered institutes beginning in 2007. Institutes combine medical and surgical specialists around specific diseases or body systems under single leadership and in a shared location to provide optimal team care for every patient. Institutes work with the Office of Patient Experience to give every patient the best outcome and experience.
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 $265 million in 2012. Research programs include cardiovascular, oncology, neurology, musculoskeletal, allergy and immunology, ophthalmology, metabolism, and infectious diseases.

Cleveland Clinic Lerner College of Medicine

Lerner College of Medicine of Case Western Reserve University, which celebrated its 10th anniversary in 2012, is known for its small class size, unique curriculum, and full-tuition scholarships for all students. The program is open to 32 students who are preparing to be physician investigators.

Graduate Medical Education

In 2012, nearly 1,800 residents and fellows trained at Cleveland Clinic and Cleveland Clinic Florida, which is 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 in the nation since 1995. In 2012, Cleveland Clinic’s urology and nephrology programs were both ranked No. 1 in the nation.

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

24/7 hotline to streamline access to our array of medical services and schedule patient appointments, call 855.REFER.123 (855.733.3712), email refdr@ccf.org, or visit clevelandclinic.org/refer123.

**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 1,200 life-threatening and life-altering diagnoses. For more information, visit clevelandclinic.org/myconsult, email eclevelandclinic@ccf.org, or call 800.223.2273, ext. 43223.

**Request Medical Records**

216.444.2640 or 800.223.2273, ext. 42640

**Track Your Patients’ Care Online**

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 more 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 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 (ccfcme.org) is an educational resource for healthcare providers and the public. Available 24/7, it houses programs that cover topics in 30 areas. 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 underway.
Clinical Trials
Since its establishment in 1921, Cleveland Clinic has been an innovator in medical breakthroughs, with a mission of unlocking basic science and pursuing clinical research. Today, Cleveland Clinic is running more than 2,000 clinical trials of various types. Our researchers are focusing on an array of conditions, including breast and liver cancer, coronary artery disease, heart failure, epilepsy, Parkinson disease, chronic obstructive pulmonary disease, asthma, high blood pressure, diabetes, depression, and eating disorders. To learn more, go to clevelandclinic.org/research.

Healthcare Executive Education
Cleveland Clinic’s dynamic executive education program provides real-world insights into the highly competitive business of healthcare. The Executive Visitors’ Program is an intensive three-day program that provides a behind-the-scenes view of our organization for the busy executive. The Samson Global Leadership Academy is a two-week immersion into the challenges of leadership, management, and innovation. The curriculum includes coaching and a personalized three-year leadership development plan. Learn more at clevelandclinic.org/execed.
Treating the Whole Patient

The Heart & Vascular Institute works together with the Office of Patient Experience, Spiritual Care Department, Healing Services, and the Arts & Medicine Institute to provide a full range of complimentary services to patients and their families.

Services include light massage therapy, reiki and Healing Touch™ therapies, art and music therapy, and a guided imagery program to help patients relax and prepare for surgery or other procedures.

The chapel and Muslim prayer room are available to everyone throughout their time at Cleveland Clinic.

Art programs include art therapy, guided tours, and the Cleveland Museum of Art Distance Learning Program — an interactive experience that allows participants to take a virtual tour through some of the world's best galleries via high-definition videoconferencing.

Each day, there are scheduled activities on the rooftop plaza. The space provides a spectacular view of the city. Guests can enjoy yoga, chair massages, labyrinth walk meditation, reiki, live cooking demonstrations, concerts, and tea.

In addition, the Sydell and Arnold Miller Family Pavilion hosts many musical and other performances and events throughout the year.

Patient and Family Health and Education Center

800.223.2273, ext. 43771
healthl@ccf.org

The Patient and Family Health and Education Center has provided resources to patients and visitors since October 2008. The center serves as a library of health and education materials. In addition, patients and guests have access to complimentary computers with Internet access, audio and video education programs, and health education classes and screenings. There were 11,436 visitors to the center in 2012.

Heart & Vascular Institute Resource Nurses

866.289.6911
heartcenter@ccf.org

A team of dedicated, experienced nurses staffs the Resource Center. They answer thoracic- and cardiovascular-related questions by phone, email and online chat. This service is open to everyone and is especially helpful to those who do not have immediate access to a Cleveland Clinic cardiologist or surgeon. In 2012, there were 24,009 total contacts. This includes 11,226 phone calls; 5,636 online chats; 5,065 webmails; and 2,082 email, mail, in-person and other contacts.

The nurses also staff a 24/7 toll-free inbound call line for all patients discharged from the institute who have questions or concerns after they leave the hospital. In 2012, they answered 19,013 calls. The effort to improve the patient experience also includes a follow-up phone call from a registered nurse to every patient. Patients are asked about symptoms, complications, or concerns they may have once they are home.

Staying in Touch

The Heart & Vascular Institute has a variety of ways for patients and others to contact the institute and learn more about topics related to heart and vascular health. The institute’s Twitter account (twitter.com/ClevClinicHeart) has more than 1,500 followers and was recently named one of Good Housekeeping’s 14 Most Trusted Health Sites. In 2012, the institute hosted 41 live webchats with experts who answered questions about specific thoracic and cardiovascular topics. Transcripts are posted at clevelandclinic.org/heart/webchat. In 2012, the institute’s website (clevelandclinic.org/heart) and blog (health.clevelandclinic.org/heart) received more than 7 million visits combined. The YouTube channel (youtube.com/clevelandclinic) receives more than 2 million views a year.
This project would not have been possible without the commitment and expertise of a team led by Dr. Umesh Khot, Pam Goepfarth, Sandra Hays, and Vi Huynh. Graphic design and photography were provided by Brian Kohlbacher, Robin Bova, and Cleveland Clinic’s Center for Medical Art and Photography.