Recent years have seen remarkable advances in heart and vascular care. Breakthroughs in the understanding of cardiovascular disease—ranging widely from the identification of molecular mechanisms to the impact of lifestyle choices—have led to the development of powerful new diagnostics and therapies.

Never before have so many people with cardiovascular disease had so much opportunity to live longer, healthier lives.

Beth Israel Deaconess Medical Center, a teaching hospital of Harvard Medical School, has a proud legacy of leadership in cardiovascular medicine, cardiac surgery and vascular surgery. In 2007, these three disciplines formed the CardioVascular Institute (CVI) at Beth Israel Deaconess Medical Center (BIDMC). This confluence transformed a tradition of informal collaboration into a tightly integrated, intentional family of expert healthcare providers and researchers.

Over the past decade, the CVI has pioneered exciting innovations in cardiovascular care, clinical research, medical education and scientific discovery. We maintain a steadfast commitment to analyzing clinical outcomes to ensure patients get the best care.

The CardioVascular Institute’s first decade has led to important advances in innovation, integration and outcomes. Please turn these pages to learn more.

Our patients are our inspiration.
Celebrating 10 Years: 2007-2017
CardioVascular Institute Fast Facts

10 YEARS

A decade of collaboration at BIDMC
Cardiovascular Medicine
Cardiac Surgery
Vascular and Endovascular Surgery

6 community hospital affiliations
Anna Jaques Hospital
Beth Israel Deaconess Hospital–Milton*
Beth Israel Deaconess Hospital–Needham*
Beth Israel Deaconess Hospital–Plymouth*
Lawrence General Hospital
Signature Healthcare

*BIDMC member hospitals

76 physicians, surgeons and researchers
404 nurses and advanced practice providers
98 dedicated cardiovascular care beds and 23 intensive care beds

In 2016

1,128 cardiac surgery cases
4,793 Cath Lab cases
2,299 Electrophysiology Lab cases
2,060 Vascular Surgery cases
35,403 CVI clinic encounters (3 divisions)
In 2016

65 active clinical trials following 699 PATIENTS

U.S. News & World Report
Top “High Performing” recognition
- Heart Failure
- Heart Bypass Surgery
- Aortic Valve Surgery

“Hospitals that earned a high performing rating were significantly better than the national average.”

U.S. Centers for Medicare & Medicaid Services
Patient Experiences Survey
Overall rating of
Hospital Experience
and
Willingness to Recommend the Hospital
superior to state and U.S. averages

74 investigators with
$20,762,681 in total research funding
CardioVascular Institute Highlights

- The CVI is a national leader in transcatheter aortic valve replacement (TAVR) and transcatheter mitral valve replacement therapies.

- The Division of Cardiac Surgery has attained the Society of Thoracic Surgeons’ top 3-Star rating for isolated coronary bypass grafting procedures. Just 12%-15% of hospitals receive this rating, denoting the highest category of quality (see page 22).

- Clinical researchers in the Division of Vascular and Endovascular Surgery are developing new technologies and evaluating minimally invasive repair of aortic aneurysms and lower extremity bypass.

- The Richard A. and Susan F. Smith Center for Outcomes Research in Cardiology evaluates the effectiveness of clinical practice, therapies and policies to advance cardiovascular healthcare delivery in the United States.

- Genomics and metabolomics research supported by the National Institutes of Health is identifying molecular changes underlying exercise and physical activity, a first step in personalized cardiovascular medicine.

- Electrophysiologists are developing new approaches for arrhythmia therapies, including ultraprecise ablation techniques and modulation of the autonomic nervous system.

- Patient care services are continuously improved through the use of LEAN principles and Daily Management System.

- The Advanced Heart Failure program is Boston’s first non-transplant center to receive advanced certification from The Joint Commission as a Ventricular Assist Device Destination Therapy Center.

- The Cardiac Direct Access Unit is pioneering a new care delivery model for urgent cardiovascular care.

- BIDMC’s clinical cardiovascular medicine fellowship program is the largest affiliated with Harvard Medical School.

- The Division of Vascular Surgery and the Division of Cardiovascular Medicine are long-standing recipients of National Institutes of Health T32 research grants to train the physician-scientists of tomorrow.

BIDMC’s Cardiovascular Legacy

1925
Hermann Blumgart, MD, who served as chair of the Beth Israel Hospital Department of Medicine from 1927 to 1962, is the first physician-scientist to use radioisotopes to diagnose cardiac disease.

1928
New England Deaconess Hospital opens the nation’s first clinic to prevent and treat vascular complications of diabetes.

1930
Louis Wolff, MD, of Beth Israel Hospital is one of three physician-scientists to describe a cardiac arrhythmia now known as Wolff-Parkinson-White syndrome.

1942
Howard Frank, MD, and Jacob Fine, MD, of Beth Israel Hospital highlight the value of venography for the diagnosis of deep vein thrombosis.

1944
New England Deaconess Hospital surgeon Leland S. McKittrick, MD, introduces new surgical techniques for limb preservation in diabetic patients with severe vascular disease.

1952
Cardiologist Paul Zoll, MD, surgeon Howard A. Frank, MD, and their Beth Israel Hospital team are the first to use electrical stimulation to the chest to restore cardiac rhythm, leading to the development of the pacemaker and external defibrillator.

1972
Beth Israel Hospital Chief of Vascular Surgery Edward W. Salzman, MD, publishes a study on the mechanisms of platelet aggregation that paves the way for the development of drugs that prevent blood clot formation after heart attack and stroke.

1984
Dr. Salzman serves as editor of the first edition of the classic textbook, *Thrombosis and Hemostasis*.

1984
New England Deaconess Hospital vascular surgeon Frank LoGerfo, MD, advances surgical techniques for arterial revascularization of distal lesions due to peripheral arterial disease (PAD).

1992
Mark Josephson, MD, a pioneer in modern cardiac electrophysiology, establishes the Harvard-Thorndike Electrophysiology Institute and Arrhythmia Service at BIDMC.

1992-1993
Richard E. Kuntz, MD, and a Beth Israel Hospital team publish studies that revolutionize the understanding of restenosis (narrowing) of coronary arteries after stenting.

1995
Cardiac surgeons perform New England’s first minimally invasive coronary bypass surgery without a heart-lung machine.

Cardiovascular medicine faculty lead pioneering STAND I and STAND II studies on devices for suture-mediated closure of the femoral artery after cardiac catheterization.
BIDMC’s Cardiovascular Legacy

1996
BIDMC opens one of the nation’s first atrial fibrillation clinics.

1997
Faculty publish research on the effectiveness of active aspiration catheterization for removing blood clots in coronary vessels.

Faculty publish research evaluating coronary brachytherapy to prevent in-stent restenosis.

1998
Beth Israel Hospital team mentored by Donald Baim, MD, publishes OARS and BOAT studies evaluating stents and other devices for reducing coronary atherosclerosis.

2000
Faculty lead research in the safety and effectiveness of carotid stents.

2002
Faculty publish research into devices that capture clots and other debris to improve the safety of stenting coronary vessels and saphenous veins.

2007
BIDMC launches the CardioVascular Institute.

2010
Faculty provides national leadership of the CoreValve Pivotal Trial for transcatheter aortic valve replacement.

2012
CVI vascular surgery team publishes a pivotal study demonstrating the safety of treating most aortic aneurysms with ultrasound-guided endovascular techniques.

2013
Vascular surgeons perform emergency surgeries on critically injured Boston Marathon bombing victims.

Vascular surgeons are among the first worldwide to perform a complex endovascular intervention using the novel VesselNavigator intraoperative 3-D CT-fluoroscopy fusion imaging system developed in collaboration with Philips.

2014
Structural Heart Center cardiologists and surgeons are the first in the nation to implant an FDA-approved CoreValve aortic valve in a patient.

2016
Faculty leads PIONEER trial, evaluating major bleeding risk reduction in atrial fibrillation patients undergoing stenting for coronary artery disease.
Working Together

Ten years of structured collaboration and a long tradition of close relationships among colleagues in the CVI’s three divisions yields the benefits of broad expertise.

Meet Our Patient

Marie McIntyre, 81
Retired fashion model

Advanced aortic valve disease patient received a transcatheter aortic valve replacement (TAVR)

“I breezed through this procedure. My energy is off the charts!”

Photo: James Derek Dwyer
Structural Heart Center/Valve Program

Our interventional cardiologists, cardiac surgeons and cardiac anesthesiologists collaborate to provide the state-of-the-art non-surgical procedures, multidisciplinary approaches and new medical devices that are rapidly transforming care for structural abnormalities of the heart and great arteries.

**Leadership.** Faculty from the Structural Heart Center have provided—and continue to provide—national leadership in clinical research leading to transformative, non-surgical therapies for severe aortic valve disease and mitral valve disease.

**Therapies.** The CVI offers patients a wide range of treatment options—both surgical and non-surgical therapies for cardiac valve conditions.

**Clinical trials.** Trials currently underway at the CVI are evaluating transcatheter mitral valve replacement (TMVR) systems and transcatheter aortic valve replacement (TAVR) systems for select populations.
Advanced Heart Failure Program

Our Advanced Heart Failure Program is a strong collaboration between cardiologists and cardiac surgeons who deliver the full range of care for patients with all stages of heart failure. Our inpatient volume is among the highest in New England.

Advanced certification. In 2013, the CVI became the first non-transplant center in Massachusetts to offer Ventricular Assist Device (VAD) therapy. Advanced certification for Destination Therapy VAD implantation was granted by The Joint Commission in 2017.

Transplant care. Our program maintains a partnership with a high-volume transplant center and is distinguished by highly personalized follow-up care in our Advanced Heart Failure Clinic.

Outcomes measures. Our 30-day post-discharge mortality exceeds both national averages and those of other Boston tertiary referral centers. We have consistently maintained a 30% reduction in our 30-day readmission rate since 2012.

Shock team. Our multidisciplinary team provides rapid, 24/7 group decision-making for patients with cardiogenic shock and refractory respiratory failure.
Aortic Center

In the CVI’s Aortic Center, highly skilled teams of vascular surgeons and cardiac surgeons provide collaborative care and innovative treatments for emergent and elective repair of aortic disease, including open surgeries, hybrid surgeries and minimally invasive procedures for complex aneurysms, dissections and transections.

**Advanced interventions.** Our faculty are leaders in advanced interventions for the treatment of aortic disease, including the development of custom-built fenestrated stent grafts for complex anatomy. Our surgeons are also expert in technically challenging valve-sparing procedures to repair aneurysms at the aortic root, where the aorta meets the heart.

**Sophisticated imaging.** VesselNavigator, a 3D imaging system used to guide the minimally invasive repair of aortic aneurysms, was developed through the work of surgeons at BIDMC, one of the first institutions to use this state-of-the-art navigation technology.

**Influential papers.** Studies published by Aortic Center faculty in 2008, 2015 and 2016 in *The New England Journal of Medicine* have been integral in shaping clinical decisions in the field of endovascular aortic repair.

**Prolific outcomes research.** Faculty research includes notable publications examining gender differences in the treatment of aortic disease.

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**COMPREHENSIVE AORTIC CARE**
- Abdominal aortic aneurysms
- Ascending and descending thoracic aneurysms
- Aortic arch disease
- Thoracoabdominal aortic aneurysms
- Acute and chronic Type A and Type B aortic dissections
- Ruptured abdominal and thoracic aneurysms

**CONTINUOUS QUALITY IMPROVEMENT**
- Participant in the Vascular Quality Initiative
- National leader in outcomes research for aortic conditions

**SPECIALIZED TREATMENT PROTOCOLS**
- Ruptured abdominal aortic aneurysm
- Ruptured thoracic aortic aneurysm
- Aortic dissection
- Spinal drain management

**VESSELNAVIGATOR**
- Enhances the accuracy of stent and graft placement
- Reduces need for contrast agent
- Results in improved patient outcomes
- Leads to enhanced efficiency and cost effectiveness

**97% PERCUTANEOUS REPAIR**
Between 2013 and 2017, 446 EVAR, TEVAR and FEVAR procedures were performed percutaneously, one of the largest series in the world.
The CardioVascular Institute’s patient care professionals collaborate across roles and divisions to ensure every patient receives exceptional care. Highly skilled, knowledgeable and compassionate, the team includes hundreds of advanced practice providers, nurses, perfusionists, case managers and technicians.

Continuous quality improvement. A Daily Management System empowers front-line nursing staff to identify opportunities to improve patient care and workflow. Through the system’s daily huddles, improvement is the work of everyone, every day.

MyICU. The CVI’s two critical care units participate in MyICU, an innovative program that has led to improved patient care and satisfaction. CVI nurses helped develop the tablet-based application, which provides families with timely information and a tool for asking questions and requesting meetings.

Shock team. This multidisciplinary team provides expert group decision-making in critical situations when advanced mechanical support technology has the potential to save lives.

Patient-Centered Care

Many individual improvements add up to exceptional care.

- Improving and standardizing communication among providers to ensure patient safety
- Increasing availability of equipment to allow staff to use time more efficiently
- Reduced time-to-procedure starts

Nurse practitioners and physician assistants provide evidence-based care, problem-solving and communication skills to achieve the best patient outcomes.

A 2015 CVI study published in the Journal of Cardiovascular Nursing showed that myocardial infarction and heart failure patients whose care team included a nurse practitioner were 50% less likely to be readmitted within 30 days.

Our nurses are early adopters of and provide other hospitals with training for Cardiac Surgery Unit Advanced Life Support. These resuscitation protocols are designed to save critical minutes when post-surgery patients experience life-threatening emergencies.
Novel Approaches to Cardiovascular Health

Helping people attain the best possible health is our quest. Finding better ways to do this is our passion. Our patients inspire a spirit of inquiry that infuses everything we do, from researching cardiovascular mechanisms at the molecular level to developing new evidence-based clinical models.

Meet Our Patient
Barak Nir, 59
Attorney, financial consultant

Received emergency mitral valve replacement surgery while visiting Boston from Israel

“I owe my life to the amazing skill and swift actions of BIDMC’s cardiac surgery team.”
Cardiac Surgery

The Division of Cardiac Surgery offers comprehensive, personalized care and excellent outcomes for conditions of the heart muscle, valves and arteries. Surgical team members work closely with colleagues in Cardiovascular Medicine, Vascular Surgery, Anesthesiology and other disciplines.

**Quality.** We are the recipient of the Society of Thoracic Surgeons’ top 3-Star rating for 2016. Only 12% to 15% of hospitals receive the 3-Star rating, which denotes the highest category of quality (see detail on page 22).

**Mitral valve therapies.** We are the Boston-area leader in mitral valve repair and aortic valve replacement.

**Valve research.** The Division is the co-founder, with Cardiac Anesthesiology, of BIDMC’s Valve Research Group, exploring the use of 3D technology to fully capture the complex and dynamic behavior of the heart’s four valves (see detail at right).

**Joint programs.** Multidisciplinary collaborations among divisions are formalized in the Aortic Center, the Heart Failure Program and the Structural Heart Center.

**INNOVATION**

**VALVE RESEARCH GROUP**

We are investigating the use of 3D printing to enhance surgical precision.

- Precise replicas of a patient’s valve can be printed in three dimensions 30 minutes after echocardiography
- Models help distinguish need for valve replacement vs. valve repair
- Surgeons visualize heart valves before entering operating room

**FARR 8: A PLACE TO HEAL**

Patient-friendly features of this post-surgical cardiac unit include:

- Nearby nursing stations
- Pull-out beds for family members
- Dimmable lighting
- Spacious bathrooms and showers

**PAPERS IN LEADING PUBLICATIONS**

- Annals of Thoracic Surgery
- Journal of Thoracic and Cardiovascular Surgery
- Journal of the American College of Cardiology
Cardiac Direct Access Unit

In November 2016, the CardioVascular Institute reinvented the delivery of urgent cardiac care in New England when it opened the Cardiac Direct Access Unit (CDAc). During its first six months of operation, from November 2016 to May 2017, the CDAc treated 766 patients, 94% of whom avoided the emergency room for at least 30 days.

**Bypassing the ED.** Patients with non-life-threatening symptoms like chest pain, shortness of breath, swelling, palpitations and syncope immediately see an attending physician, bypassing emergency room wait times and expense.

**In-unit facilities.** The outpatient unit includes a clinic, six observation beds, an outpatient diuresis room, echocardiography, stress testing and labs.

**Important.** Physician referral is required. Colleagues, please call our attending physician at 617-632-7777.
Harvard-Thorndike Electrophysiology Institute and Arrhythmia Service

Electrophysiology at BIDMC has long been recognized for its pioneering and innovative role in the treatment of heart rhythm disorders. Faculty members are internationally known for leadership across the entire spectrum of electrophysiology.

**Ventricular tachycardia.** This high-volume program has an exceptional track record in complex procedures such as epicardial mapping and ablation, use of leading-edge technologies and modulation of the autonomic nervous system.

**Atrial fibrillation.** Our personalized approach to atrial fibrillation management is noted for safety, success and management of complex cases. We focus on the modulation of risk factors like sleep apnea and ablation of non-pulmonary vein triggers. Our group has extensive experience with the study and use of new oral anticoagulant medications and device-based therapy for reduction of stroke risk.

**Device management.** This highly developed program is one of New England’s busiest centers for expert management of cardiac arrhythmia devices. Services include implantation of standard and novel leadless pacemakers, transvenous and subcutaneous implantable cardioverter defibrillators (ICDs) and a comprehensive multidisciplinary approach to device lead extraction.

**RESEARCH**
Our innovative program includes pre-clinical development of new technologies, with the goal of finding new methods for arrhythmia prevention and improved patient care.

**ADVANCED TECHNOLOGY**
Our electrophysiologists helped to develop new methods of mapping the heart’s electrical system leading to improved procedural outcomes.

**INFLUENTIAL ARTICLES**
Interventional Cardiology

Interventional cardiologists at BIDMC pioneered many of the catheter-based therapies that have saved and improved the lives of millions of patients everywhere. Faculty continue to play a major role in the pre-clinical and clinical development and evaluation of leading-edge technologies for the treatment of complex cardiovascular disorders.

Wide range of services. Cath Lab faculty perform a full range of interventional procedures and are nationally noted for transcatheter aortic and mitral valve replacement, percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) and important medical strategies that reduce the risk of major post-procedure bleeding.

High volume. The laboratory is a high-volume center, performing more than 4,000 procedures per year for the growing BIDMC network and patients from across the region and the nation.

Clinical research. Many of our interventional cardiology patients are enrolled in clinical trials, providing them with access to investigational treatments including drug-eluting stents, temporary heart pumps and anti-coagulant and anti-platelet medications.
Endovascular Surgery

Over the past decade, the CVI's Division of Vascular and Endovascular Surgery has pushed forward the frontiers of the discipline, developing minimally invasive techniques for aortic aneurysm, carotid disease and lower extremity arterial disease. Guided by this work, our skilled surgeons are uniquely equipped to determine the best treatment for each patient, whether open surgery or endovascular surgery.

**Preventing amputation.** The Division has significantly expanded the use of primary endovascular therapy for critical limb ischemia, leading to low mortality and exceptional amputation-free survival. We have one of the world's largest experiences with tibial angioplasty, performing 945 procedures between 2004 and 2017.

**Percutaneous AAA repair.** Our program has pioneered the use of ultrasound-guided femoral access for totally percutaneous endovascular AAA repair, helping to eliminate the need for incisions and associated complications.

**Influential research.** Our active research program includes extensive clinical research focused on patient outcomes and new technologies. In addition, five investigators oversee National Institutes of Health-funded basic science research.

**ENDOVASCULAR AND OPEN VASCULAR SURGERY AT BIDMC**

**HYBRID OPERATING ROOMS**
- Versatile operating rooms are used for open, minimally invasive, percutaneous and hybrid procedures.
- Advanced imaging system allows simultaneous multiple images.

**600+ PUBLICATIONS**
Over the past decade, our faculty have routinely published in influential journals including *The New England Journal of Medicine*, *Journal of Vascular Surgery* and *JAMA Surgery*.

**38 CLINICAL TRIALS**
Over 300 subjects enrolled in clinical trials, including those focused on:
- Aortic aneurysms
- Carotid artery disease
- Limb preservation
Richard A. and Susan F. Smith Center for Outcomes Research in Cardiology

The Smith Center was launched in 2015 to understand and improve patient outcomes and advance healthcare delivery. It is the first center of its kind in Boston and one of only a few in the country.

**Unique approach.** The Smith Center’s multidisciplinary team brings together clinical specialists in coronary artery disease, cardiac electrophysiology, valvular heart disease and heart failure, with scientists skilled in clinical trial design, observational studies and biostatistics. The center also provides interdisciplinary educational and mentorship opportunities, drawing on rich intellectual and clinical resources at BIDMC and within the Harvard system.

**High-profile research.** Our studies, funded in part by the National Institutes of Health, focus on key issues impacting cardiovascular medicine.

- **Healthcare reform.** A large-scale analysis showed that Centers for Medicare & Medicaid Services (CMS) penalties contributed to a decrease in hospital readmissions.
- **Public reporting.** A pivotal study showed that public reporting may disincentivize physicians from offering potentially life-saving treatments when patients are at risk of poor outcomes.

INNOVATION

**RESEARCH MOVES TOWARD PERSONALIZED MEDICINE**

The Smith Center’s analytic approaches are used to identify patients with the most to gain or lose from treatment.

**RICH DATA RESOURCES INCLUDE**

- Centers for Medicare & Medicaid Services (CMS) database of 40 million patients and 10,000 procedure codes
- Nationwide readmission data from approximately 15 million annual discharges, representing half of all U.S. hospitalizations

**KEY COLLABORATIONS**

Our academic and industry partners include the Harvard T.H. Chan School of Public Health, the Baim Institute for Clinical Research, Boston Scientific, Abiomed, Medtronic and Symphony Health.

**INFLUENTIAL STUDIES IN:**

- *The New England Journal of Medicine*
- *Journal of the American Medical Association (JAMA)*
- *Circulation*
- *Annals of Internal Medicine*
Personal Genomics and Cardiometabolic Disease

The CVI’s research program in Personal Genomics and Cardiometabolic Disease is a national leader in metabolomics, the biochemical analysis of metabolites, small molecules that determine how the body burns fuel. The influential program is paving the way for the development of personalized therapies for cardiovascular disease through the following key lines of research.

**Exercise.** By understanding and identifying the molecular pathways by which exercise confers its beneficial effects, CVI scientists are building a biochemical roadmap for the creation of precision cardiovascular exercise programs.

**Early disease diagnosis.** CVI investigators have discovered novel biomarkers that indicate which individuals are destined to develop diabetes and heart disease—more than a decade before disease onset.

**Sophisticated technologies.** The program is at the forefront in testing and developing highly sensitive proteomics technologies that can help clinicians more precisely diagnose, monitor and screen for cardiovascular risk.

**BLOOD TEST OF THE FUTURE**

The program’s comprehensive analysis of tens of thousands of blood samples from individuals of different races, genders, ages, ethnic groups and fitness levels is the first step in the development of a new generation of blood tests to one day guide precision diagnoses and treatments for cardiovascular disease.

**PRESTIGIOUS SUPPORT INCLUDES**

- **$11 million Molecular Transducers of Physical Activity Consortium (MoTrPAC) grant from the National Institutes of Health (NIH) to investigate and map molecular changes in the body during and after exercise.**
- **Partnership with NIH’s Trans-Omics for Precision Medicine (TOPMed) Initiative to collect vast amounts of genomic data and omics analyses to guide precision medicine.**

**ACADEMIC COLLABORATIONS**

- Broad Institute
- Framingham Heart Study
- Jackson Heart Study
- Diabetes Prevention Program
- TIMI Study Group
Continuous Improvement

The CVI’s relentless focus on healthcare quality is assured by the three divisions’ memberships in organizations that allow them to benchmark their surgical and procedural outcomes against national standards.

Meet Our Patient

Richard “Sonny” Lepore, 84
Barbershop owner

Peripheral artery disease patient underwent bypass surgery for critical limb ischemia

“Both of my legs were saved by BIDMC’s Vascular Surgery team, so I can continue to run my business and enjoy life.”
CardioVascular Institute

Volume

Volume at the CardioVascular Institute is growing.

<table>
<thead>
<tr>
<th>Cases*</th>
<th>CY 2014</th>
<th>CY 2015</th>
<th>CY 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cath Lab</td>
<td>4,342</td>
<td>4,360</td>
<td>4,794</td>
</tr>
<tr>
<td>Transcatheter aortic valve replacement</td>
<td>85</td>
<td>107</td>
<td>170</td>
</tr>
<tr>
<td>Electrophysiology Lab</td>
<td>2,022</td>
<td>2,167</td>
<td>2,299</td>
</tr>
<tr>
<td>Cardiac Surgery</td>
<td>905</td>
<td>1,020</td>
<td>1,128</td>
</tr>
<tr>
<td>Vascular Surgery</td>
<td>2,131</td>
<td>2,041</td>
<td>2,060</td>
</tr>
<tr>
<td>CVI total cases</td>
<td></td>
<td>9,485</td>
<td>9,695</td>
</tr>
<tr>
<td>10,451</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinic Encounters</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular Medicine</td>
<td>32,488</td>
<td>34,375</td>
<td>37,351</td>
</tr>
<tr>
<td>Cardiac Surgery</td>
<td>1,742</td>
<td>1,997</td>
<td>2,091</td>
</tr>
<tr>
<td>Vascular Surgery</td>
<td>7,919</td>
<td>7,758</td>
<td>8,544</td>
</tr>
<tr>
<td>CVI total clinic encounters</td>
<td>42,149</td>
<td>44,130</td>
<td>47,986</td>
</tr>
</tbody>
</table>

*These numbers include all procedures performed by the respective services.
Cardiac Surgery

Volume and Quality Measures

Society of Thoracic Surgeons
3-Star Quality Rating for Isolated Coronary Bypass Grafting
Calendar Year 2016

The Society of Thoracic Surgeons has developed a comprehensive rating system that allows for comparisons regarding the quality of cardiac surgery among hospitals across the country. Only 12% to 15% of hospitals receive the 3-Star rating, which denotes the highest category of quality. In the current analysis of national data covering the period from January 1, 2016, through December 31, 2016, BIDMC’s cardiac surgery program was found to lie in the highest quality tier, thereby receiving the society’s 3-Star rating.

Volume by Case Type
Cardiac Surgery

Volume by Case Type

Isolated Aortic Valve Replacement (AVR) Volume and Mortality

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
<th>30 Day Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2014</td>
<td>111</td>
<td>0.9%</td>
</tr>
<tr>
<td>CY 2015</td>
<td>145</td>
<td>1.0%</td>
</tr>
<tr>
<td>CY 2016</td>
<td>138</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Median Post-operative Length of Stay

<table>
<thead>
<tr>
<th>Year</th>
<th>Length of Stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2014</td>
<td>5</td>
</tr>
<tr>
<td>CY 2015</td>
<td>5</td>
</tr>
<tr>
<td>CY 2016</td>
<td>5</td>
</tr>
</tbody>
</table>

AVR + CABG Volume and Mortality

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
<th>30 Day Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2014</td>
<td>8</td>
<td>1.3%</td>
</tr>
<tr>
<td>CY 2015</td>
<td>67</td>
<td>0.9%</td>
</tr>
<tr>
<td>CY 2016</td>
<td>34</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Median Post-operative Length of Stay

<table>
<thead>
<tr>
<th>Year</th>
<th>Length of Stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2014</td>
<td>8</td>
</tr>
<tr>
<td>CY 2015</td>
<td>5</td>
</tr>
<tr>
<td>CY 2016</td>
<td>5</td>
</tr>
</tbody>
</table>

All Aortic Valve Replacements Volume and Mortality

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
<th>30 Day Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2014</td>
<td>271</td>
<td>1.4%</td>
</tr>
<tr>
<td>CY 2015</td>
<td>266</td>
<td>1.3%</td>
</tr>
<tr>
<td>CY 2016</td>
<td>365</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

Median Post-operative Length of Stay

<table>
<thead>
<tr>
<th>Year</th>
<th>Length of Stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2014</td>
<td>8</td>
</tr>
<tr>
<td>CY 2015</td>
<td>5</td>
</tr>
<tr>
<td>CY 2016</td>
<td>5</td>
</tr>
</tbody>
</table>
Cardiac Surgery

Volume by Case Type

**All Aorta Procedures Volume and Mortality**

**Median Post-operative Length of Stay**

**All Mitral Valve Repairs Volume and Mortality**

**Median Post-operative Length of Stay**

**Isolated Mitral Valve Repairs Volume and Mortality**

**Median Post-operative Length of Stay**
## Cardiac Surgery

### Coronary Bypass Graft Quality Measures

Society of Thoracic Surgeons (STS) data provide a national comparison. Lower scores are better.

<table>
<thead>
<tr>
<th>Measure</th>
<th>CY 2014</th>
<th>CY 2015</th>
<th>CY 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIDMC prolonged ventilation (intubated for 24 hours after surgery)</td>
<td>8.4%</td>
<td>6.5%</td>
<td>5.8%</td>
</tr>
<tr>
<td>STS prolonged ventilation</td>
<td>8.2%</td>
<td>8.2%</td>
<td>7.9%</td>
</tr>
<tr>
<td>BIDMC renal failure</td>
<td>1.7%</td>
<td>0.9%</td>
<td>1.4%</td>
</tr>
<tr>
<td>STS renal failure</td>
<td>2.0%</td>
<td>2.1%</td>
<td>2.1%</td>
</tr>
<tr>
<td>BIDMC deep sternal wound infection</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>STS deep sternal wound infection</td>
<td>0.3%</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>BIDMC cerebral vascular accident (stroke)</td>
<td>1.1%</td>
<td>0.7%</td>
<td>0.4%</td>
</tr>
<tr>
<td>STS cerebral vascular accident (stroke)</td>
<td>1.3%</td>
<td>1.3%</td>
<td>1.3%</td>
</tr>
<tr>
<td>BIDMC any reoperation after initial surgery</td>
<td>2.5%</td>
<td>3.7%</td>
<td>2.9%</td>
</tr>
<tr>
<td>STS any reoperation after initial surgery</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.6%</td>
</tr>
<tr>
<td>BIDMC post-procedure length of stay (LOS) (mean)</td>
<td>5.8 days</td>
<td>5.7 days</td>
<td>5.9 days</td>
</tr>
<tr>
<td>STS post-procedure LOS (mean)</td>
<td>5.8 days</td>
<td>6.9 days</td>
<td>6.9 days</td>
</tr>
<tr>
<td>BIDMC post-procedure LOS (median)</td>
<td>5 days</td>
<td>5 days</td>
<td>5 days</td>
</tr>
<tr>
<td>STS post-procedure LOS (median)</td>
<td>6 days</td>
<td>6 days</td>
<td>6 days</td>
</tr>
<tr>
<td>BIDMC isolated CABG operative mortality (within 30 days or same hospital stay)</td>
<td>2.0%</td>
<td>1.2%</td>
<td>0.7%</td>
</tr>
<tr>
<td>STS isolated CABG mortality (within 30 days or same hospital stay)</td>
<td>2.1%</td>
<td>2.2%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>
Vascular and Endovascular Surgery

Procedure Volumes

Vascular Surgery Overall Volume

Carotid Endarterectomy Volume
Perioperative stroke or mortality rate = 0%
Median post-operative length of stay = 1 day

Carotid Artery Stent Volume
Perioperative stroke or mortality rate = 0%
Aortic Procedures

Endovascular Abdominal Aortic Aneurysm Repair (EVAR) Volume

The endovascular approach provides patients with a shorter length of stay, less post-procedure pain and increased mobility—all resulting in fewer complications.

Perioperative mortality rate 0.4%
Length of stay > 2 days 18% (vs. expected 32%)

Fenestrated Endovascular Abdominal Aortic Aneurysm Repair (FEVAR) Volume

FEVAR offers patients a customized endovascular approach to aneurysm repair.
Vascular and Endovascular Surgery

Lower Extremities

**Lower Extremity Endovascular Procedures Volume**

Perioperative mortality rate = 0.7%

**Lower Extremity Infrainguinal Bypass Volume**

Perioperative mortality rate = 1.3%
### Vascular and Endovascular Surgery

**Lower Extremity Cases**

Perioperative mortality rate = 0.7%

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<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Coronary revascularization (PCI)</td>
<td>1,341</td>
<td>1,078</td>
<td>1,159</td>
</tr>
<tr>
<td>Endomyocardial biopsy</td>
<td>32</td>
<td>45</td>
<td>53</td>
</tr>
<tr>
<td>Other intervention</td>
<td>13</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Peripheral interventions (all types)</td>
<td>1,082</td>
<td>922</td>
<td>937</td>
</tr>
<tr>
<td>Patient foramen ovalectal septal defect (PFO/ASD) closure</td>
<td>37</td>
<td>49</td>
<td>44</td>
</tr>
<tr>
<td>Pure diagnostic or intra-aortic balloon pump</td>
<td>8</td>
<td>24</td>
<td>14</td>
</tr>
<tr>
<td>Valvuloplasty</td>
<td>1,964</td>
<td>2,052</td>
<td>2,327</td>
</tr>
<tr>
<td>Electrophysiology studies</td>
<td>97</td>
<td>133</td>
<td>206</td>
</tr>
<tr>
<td>Cardioversions</td>
<td>569</td>
<td>583</td>
<td>643</td>
</tr>
<tr>
<td>Cardiac ablations</td>
<td>576</td>
<td>581</td>
<td>573</td>
</tr>
<tr>
<td>Percutaneous (generators, leads or systems)</td>
<td>337</td>
<td>460</td>
<td>399</td>
</tr>
<tr>
<td>Implantable cardiotomy defibrillator implants (generators, leads or systems)</td>
<td>202</td>
<td>231</td>
<td>250</td>
</tr>
<tr>
<td>Vascular encounters</td>
<td>468</td>
<td>295</td>
<td>255</td>
</tr>
<tr>
<td>Cardiac magnetic resonance imaging</td>
<td>680</td>
<td>731</td>
<td>723</td>
</tr>
<tr>
<td>Echocardiography (includes stress echo)</td>
<td>15,233</td>
<td>15,794</td>
<td>16,649</td>
</tr>
<tr>
<td>Electrocadiography</td>
<td>64,980</td>
<td>64,980</td>
<td>64,980</td>
</tr>
<tr>
<td>Holter and King of Hearts monitors</td>
<td>3,019</td>
<td>4,601</td>
<td>5,698</td>
</tr>
<tr>
<td>Device monitoring</td>
<td>3,369</td>
<td>4,601</td>
<td>5,698</td>
</tr>
<tr>
<td>Other (includes left atrial appendage closure, implantable loop recorder and lead removals)</td>
<td>209</td>
<td>248</td>
<td>336</td>
</tr>
</tbody>
</table>

### Cardiovascular Medicine

**Procedures Volume**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Lower Extremity Endovascular Procedures Volume Perioperative mortality rate = 1.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Extremity Infragenual Bypass Volume Perioperative mortality rate = 1.3%</td>
<td></td>
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</tr>
</tbody>
</table>
Cardiovascular Medicine

Radial Access Use for Cardiac Catheterization
Gaining access to the heart through the radial artery in the wrist decreases complications, improves patient comfort and reduces costs without affecting procedural success rates.

Diagnostic Procedures
- Radial access: 71%
- Femoral access: 29%

Percutaneous Coronary Intervention
- Radial access: 62%
- Femoral access: 38%

Transcatheter Aortic Valve Replacement Volume
The CVI offers Boston’s widest array of surgical and non-surgical therapies for cardiac valve conditions.

Percutaneous Coronary Intervention (PCI) Same-Day Procedures
Studies have proved that for properly selected patients, same-day PCIs are safe, cost effective and more convenient for patients.

Heart Failure 30-Day Post-Discharge Mortality Rate (Adjusted)
BIDMC’s Advanced Heart Failure Program has the lowest mortality rate of any major Boston referral center.

Source: Hospital Compare
Cardiovascular Medicine

Percutaneous Coronary Intervention (PCI) Quality Measures

Post-PCI Composite Discharge Medications in Eligible Patients

A higher number is better.

PCI In-Hospital Risk-Adjusted Mortality

A lower number is better.
The Highest Standards

Our board-certified specialists combine clinical expertise, academic rigor and a spirit of inquiry to provide patients with extraordinary care for the heart and vascular system.

Meet Our Patient

Julie Ross, 40
Certified public accountant and mother of two
Cardiac arrest patient
Treated with advanced mechanical life support and implantable cardioverter defibrillator

“When my heart stopped, my husband saved my life with CPR and the CVI experts took it from there.”
In addition, most of our clinical physicians participate in basic, translational and/or clinical research.
**CardioVascular Institute at Beth Israel Deaconess Medical Center**

**Affiliate Locations:** See bidmc.org/cvinetwork

### Appointments

<table>
<thead>
<tr>
<th>Cardiovascular Medicine</th>
<th>Vascular and Endovascular Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>617-632-9959 (all sites)</td>
</tr>
<tr>
<td>Chelsea</td>
<td>Boston (BIDMC, HVMA Kenmore, Joslin Clinic)</td>
</tr>
<tr>
<td>Chestnut Hill</td>
<td>Cambridge</td>
</tr>
<tr>
<td>Lexington</td>
<td>Framingham</td>
</tr>
<tr>
<td>Milton</td>
<td>Chelsea</td>
</tr>
<tr>
<td>Needham</td>
<td>Lexington</td>
</tr>
<tr>
<td>Plymouth</td>
<td>Chestnut Hill</td>
</tr>
<tr>
<td>Sharon</td>
<td>Needham</td>
</tr>
<tr>
<td></td>
<td>Everett</td>
</tr>
</tbody>
</table>

**Cardiac Surgery**

617-632-8383

**Aortic Center**

617-632-7070

**Cardiovascular Medicine Referrals and Transfers**

- Cardiac Direct Access Unit
  617-632-7777 (attending cardiologist)

- Transfer to BIDMC Emergency Department from outside
  617-754-2494 (attending emergency physician)

- Cardiac interventions: admissions, transfers and elective procedures
  617-CAR-DIAC (617-227-3422)

- Electrophysiology procedures: elective and outpatient
  617-632-7459