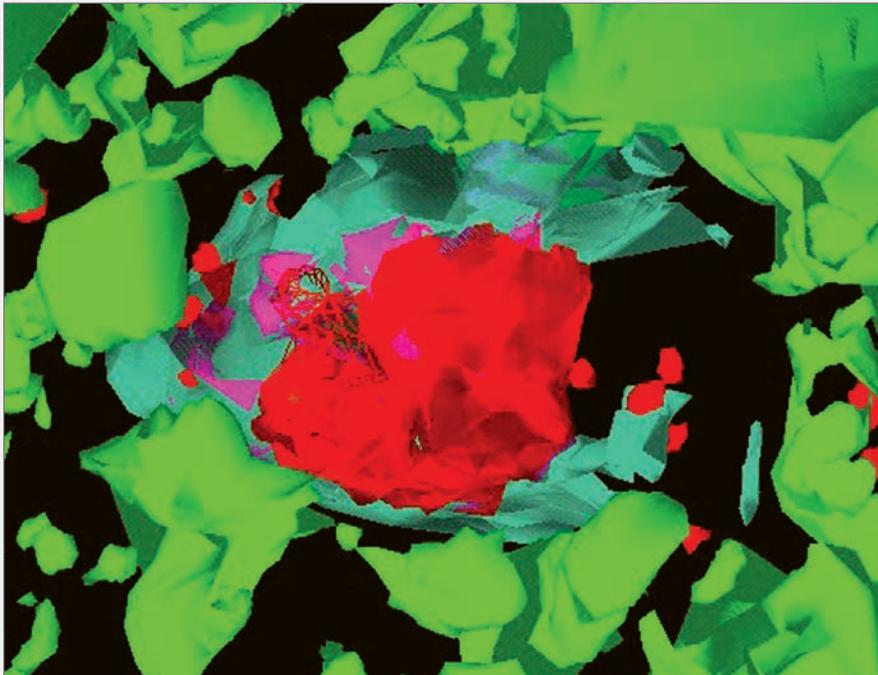


# NewYork-Presbyterian Cardiovascular Services 2017 Outcomes and Quality Report





NewYork-Presbyterian Cardiology and Heart Surgery  
ranks #3 in the nation.



*3D fluorescence deconvolution micrograph of stacked images showing adrenergic receptors (red) clustered around the nucleus of a myofibril in the heart tissue of a heart failure patient*

## **NewYork-Presbyterian Cardiovascular Services** 2017 Outcomes and Quality Report

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**For More Information**  
[nyp.org/amazingadvances](http://nyp.org/amazingadvances)

# Welcome

Dear Colleague:

We are pleased to bring you our *2017 Outcomes and Quality Report in Cardiovascular Services*. The strength of our cardiology, interventional cardiology, and cardiac surgery programs is derived from the exceptional clinical, scientific, and educational resources made possible by the partnership of NewYork-Presbyterian, Columbia University Medical Center, and Weill Cornell Medicine. These programs are among the largest and most comprehensive in the nation, bringing together faculty that have made transformative contributions to their specialties – from adult congenital heart disease to advanced heart failure and complex valve disease.

Our patients benefit from exceptional heart teams, whose multispecialty members provide collaborative and integrated care that optimizes their outcomes. Our physicians treat the most challenging cases, applying expertise that crosses and often combines the skills of cardiologists, interventionalists, and surgeons to meet the unique needs of each patient. This collegiality is a hallmark of our cardiology and heart surgery programs and a key factor in being ranked #1 in New York State for the past 17 years and #3 in the nation since 2013 by *U.S. News & World Report*.

Our distinguished team of cardiac clinicians and scientists is at the forefront of research in new devices and surgical and interventional techniques, cardiovascular imaging, electrophysiology procedures, and computational modeling, as well as molecular and genetic studies. Their work is routinely published in highly ranked journals and cited by investigators around the world.

We are extremely proud of the outstanding care that our heart teams consistently provide to patients and their commitment to moving the field forward so that patients of all ages can achieve maximum outcomes through the most minimally invasive approaches.

Sincerely,



**Steven J. Corwin, MD**  
*President and  
Chief Executive Officer  
NewYork-Presbyterian*



**Lee Goldman, MD**  
*Executive Vice President, Dean of  
the Faculties of Health Sciences  
and Medicine, and Chief Executive  
Columbia University Medical Center*



**Augustine M.K. Choi, MD**  
*Stephen and Suzanne Weiss Dean  
Weill Cornell Medicine*



Dr. Steven J. Corwin



Dr. Lee Goldman



Dr. Augustine M.K. Choi

# Measures of Distinction

## CLINICAL CARE

Clinicians and Research Scientists

**197**

---

Adult Patient Discharges

**15,148**

---

Dedicated Cardiac and Vascular Beds

**205**

Inpatient Beds

**99**

ICU Beds

---

Multidisciplinary Services

**54**

---

Specialty Centers and Clinics

**7**

Source: NewYork-Presbyterian 2016

## RECOGNITION

- *U.S. News & World Report* ranks our Cardiac and Heart Surgery program **#3** in the nation
  - NewYork-Presbyterian is rated as **Excellent** in **30 Day Survival, Advanced Technology, and Patient Services** by *U.S. News & World Report*
  - The Hospital is recognized as **High Performing** in heart failure, heart bypass surgery, aortic valve surgery, and abdominal aortic aneurysm repair
  - NewYork-Presbyterian's **Adult ECMO Program** is a designated **Platinum Center of Excellence in Life Support** by the Extracorporeal Life Support Organization
  - The Hospital has **2 State-Designated Trauma Centers** and is verified as a **Level 1 Adult Advanced Trauma Center**
- 

## RESEARCH

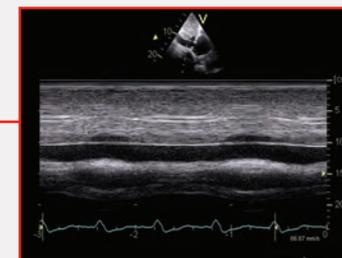
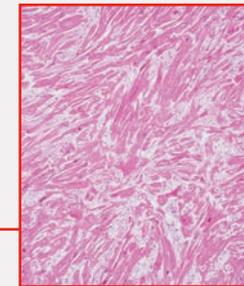
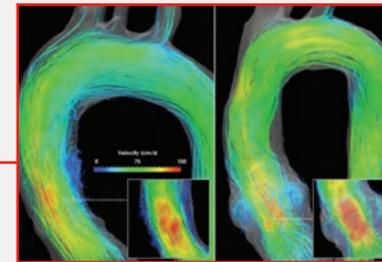
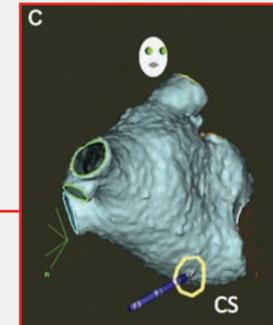
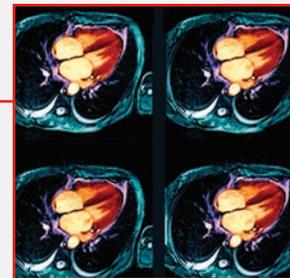
- Received over **\$14 million** in 2016 from the **National Institutes of Health** and other organizations to support cutting edge research in basic, translational, and applied research
  - Researchers conducted **over 200** studies encompassing all areas of heart disease, enrolling **more than 3,000** participants in these studies
- 

## GRADUATE MEDICAL EDUCATION

- **252 residents** participated in our cardiology, vascular, and cardiothoracic surgery residency programs
- **88 fellows** participated in our fellowship programs in:
  - Advanced Cardiovascular Imaging
  - Advanced Heart Failure and Transplant Cardiology
  - Cardiovascular Disease
  - Cardiothoracic Surgery
  - Electrophysiology
  - Heart Valve
  - Interventional Cardiology

# Innovations at a Glance

- Leading clinical trials evaluating several forms of transcatheter mitral valve replacement (TMVR) under study in feasibility clinical trials as a potential therapy for patients with symptomatic, severe mitral regurgitation
- Utilizing ventricular assist devices for adult congenital heart disease patients who progress to end-stage heart failure using advanced cardiac MRI and CT with 3-D printing technology to help plan surgery and optimize outcomes
- Among leaders in the country to perfect the ability to map and ablate arrhythmias with 3-D intracardiac echocardiography without ionizing radiation
- Collaborating with the National Basketball Association establishing a new standard in the detection of cardiac risk among professional athletes
- One of the first hospitals to offer a dedicated robotic cardiothoracic surgical suite for minimally invasive heart, lung, and esophageal procedures – more than 100 robotic cardiac procedures performed to date
- Utilizing 4-D flow MRI with computational fluid dynamics to spare the native valve in patients with ascending aortic aneurysms
- Leading investigators for the ARCADIA trial studying the role of abnormalities in the structure and function of the heart's left atrium in stroke patients
- Among the country's foremost experts in extended septal myectomy to relieve obstruction of the left ventricular outflow tract in patients with hypertrophic cardiomyopathy
- One of four centers participating in a clinical trial to assess a potentially groundbreaking procedure that uses a new device to treat faulty/leaky heart valves, specifically tricuspid regurgitation, and the first in the country to successfully perform the procedure
- Participating in and leading a large multicenter randomized trial examining the use of a combined surgical and interventional approach (hybrid surgery) to coronary revascularization procedures



NewYork-Presbyterian's dedicated adult congenital heart disease programs assure that this population receives comprehensive management and the highly specialized clinical services mandated by the complexity of their medical and surgical histories. A multidisciplinary approach – including specialists in pulmonary hypertension, heart failure, electrophysiology, and cardiac imaging – is used to manage atypical presentations of heart disease that will frequently require surgical or interventional procedures.

Our cardiologists, interventionalists, and cardiac surgeons offer advanced expertise and experience in all the major procedures for PFO, PDA, or VSD closure, transcatheter valve replacement for both pulmonary and tricuspid valves, and stenting of pulmonary arteries and coarctation of the aorta.

In 2016, our adult congenital heart disease team performed nearly 400 surgical, catheter-based, and electrophysiology implant procedures in patients with adult congenital heart disease.

## Advancing Catheter-Based and Surgical Approaches

- Traditional surgical techniques are still the standard of care for patients in basically good health, but who often need valve surgery. Our surgeons are now leveraging the advantages of the less-invasive, catheter-based approaches for adult congenital heart disease patients, such as Fontan patients, who present with more complicated comorbidities associated with their heart condition and therefore may not be candidates for open heart surgery. These include transcatheter aortic valve and percutaneous mitral and tricuspid valve procedures.
- Our surgeons are using ventricular assist devices for adult congenital heart disease patients who progress to end-stage heart failure. Complex anatomy of these patients makes it particularly challenging for placement of these

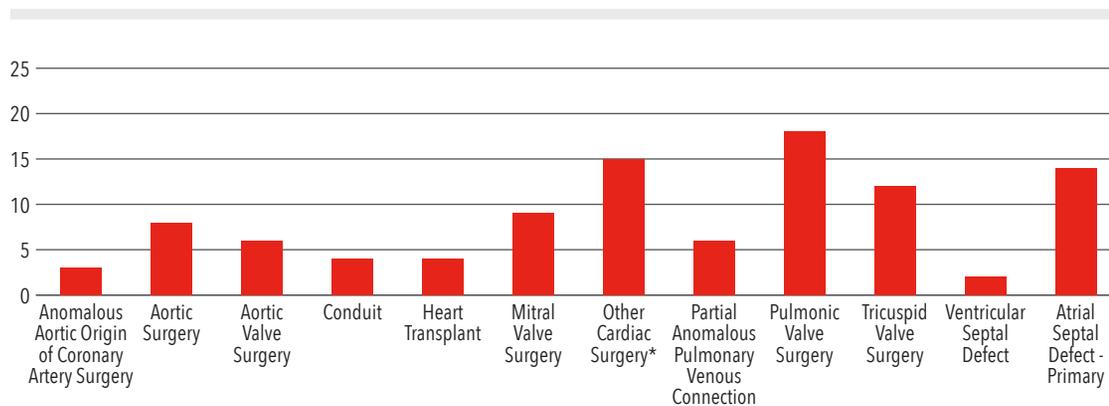
devices. Our surgeons are applying advanced cardiac MRI and CT for 3-D printing technology to help plan surgery and optimize outcomes with the goal of using ventricular assist devices as a destination therapy.

- Researchers at Weill Cornell are participating in the AMPLATZER™ PFO Occluder Post-Approval Study for patients with PFO closure in cryptogenic strokes.
- Our physicians are also beginning to evaluate 4-D flow, a new technique in cardiac MRI, to help predict the timing of surgery for tricuspid regurgitation in Ebstein's anomaly and to determine if it is a more accurate method than echocardiography for assessing aortic valve regurgitation in preparation for patients undergoing heart surgery. The approach may prove useful when echo images are insufficient or when a discrepancy exists between the echocardiogram and the clinical presentation.

## Managing Noncardiac Complications

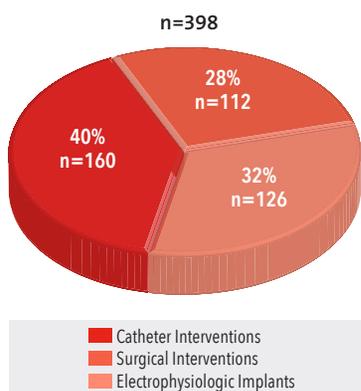
- Our physicians are establishing and refining care pathways for patients with Fontan single ventricle anatomy who are prone to liver complications, working closely with hepatology colleagues.
- In collaboration with colleagues in pulmonary hypertension, congenital heart disease specialists are participating in an NIH study on patients with Eisenmenger's syndrome, specifically looking at patients with atrial septal defects and pulmonary hypertension.
- Development of a formal program for women with congenital heart disease who are undergoing high-risk pregnancies is underway, bringing together specialists in maternal-fetal medicine, cardiology, and anesthesia to manage a detailed plan for delivery and postpartum care.

### Adult Congenital Heart Surgery 2016



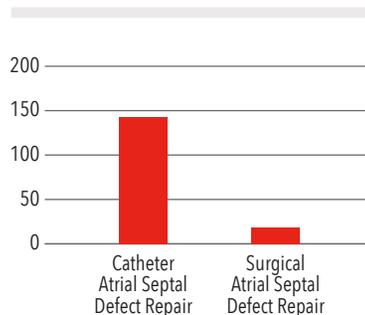
\*Other cardiac surgery: Fontan, Right Ventricular Outflow Tract Procedure, Maze, Cone Procedure, PMI, Pulmonary Arterial Reconstruction, Cor Triatriatum Repair, Mediastinal Procedure, Sternal Wire Removal  
Source: Society of Thoracic Surgeons (STS) National Database 2016

### Interventions by Type 2016



Source: NewYork-Presbyterian

### Atrial Septal Defect Repair 2016



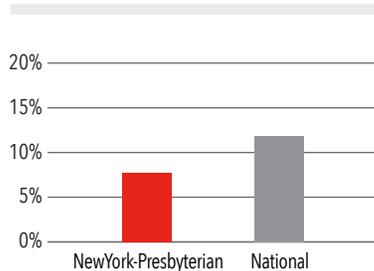
Source: NewYork-Presbyterian

### CASE STUDY

A 40-year-old woman was born with double outlet right ventricle and pulmonary stenosis and underwent a Rastelli operation at five years of age. At 18 years old, she required a replacement RV-PA conduit, however, this procedure was abandoned because of the severe complexity of the surgery. She was left with severe pulmonary regurgitation. She was seen at two major medical centers in New Jersey and Pennsylvania but was unable to be offered definitive treatment due to the complexity of her case. She saw the ACHD team at NewYork-Presbyterian for a third opinion and underwent placement of a Melody transcatheter pulmonary valve replacement. She improved a little, however, she continued to have congestive heart failure and hypoxemia due to severe tricuspid stenosis and severe subaortic stenosis. Due to her unusual anatomy and very high surgical risk, our ACHD team, along with the cardiac imaging team, created a 3-D printed reconstruction of her heart. We used this to plan a complex repair, rarely used in adults, by making a homograft right atrial to right ventricular connection, bioprosthetic pulmonary valve replacement, and resection of the subaortic stenosis. This surgery was long and complex, however, the patient had an excellent result with no complications.



Advanced Heart Failure  
Mortality Rate  
July 1, 2013 - June 30, 2016



Source: Centers for Medicaid and Medicare Services / medicare.gov/hospitalcompare



NewYork-Presbyterian is one of only five programs in the world to be designated as a Platinum Center of Excellence in Life Support by the Extracorporeal Life Support Organization.

NewYork-Presbyterian's advanced heart failure programs offer a continuum of care for patients in all stages of heart failure – from medical management to mechanical circulatory support and heart transplantation. At the core of these programs are multidisciplinary teams with highly specialized expertise in assessment and management of patients with challenging comorbidities.

Most recently, new programs have been established dedicated to the care of patients with diastolic heart failure and a second program focused on the elderly population with heart failure. With an emphasis on preventing hospital admissions and reducing emergency room visits, our physicians have been utilizing the CardioMEMS™ device for continuous monitoring of pulmonary pressure. The FDA-approved heart failure monitoring system facilitates early recognition of fluid accumulation by enabling patients to transmit daily pressure trend information and pulmonary artery pressure waveforms for immediate physician review.

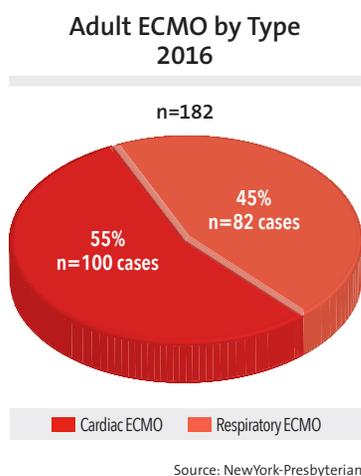
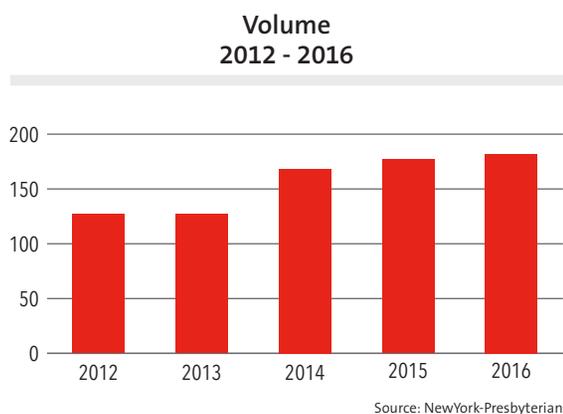
## Preeminence in ECMO

NewYork-Presbyterian's Extracorporeal Membrane Oxygenation (ECMO) program is one of the largest in the world, managing more than 150 cases per year over the past three years. Our ECMO teams – available 24/7 for patient referrals and transfers – are also among the most experienced in medical ECMO transport.

**Transferring Patients Needing ECMO** As the Hospital's ECMO program has grown, our ECMO teams have continually refined protocols for safely transporting extremely ill patients from other hospitals who need this highly specialized care. A recent issue of *The Annals of Thoracic Surgery* highlighted our ECMO program, which conducted a review of 222 patients transported to NewYork-Presbyterian while supported with ECMO to evaluate survival during a surge period. A surge is defined as at least eight transports during a one-month period or patients transported within 24 hours of another patient in nonsurge months. The key message for achieving optimal outcomes for ECMO transport patients is to have well-defined interhospital communication processes, patient selection criteria, and management protocols that include consideration of staff fatigue and burnout for handling transient increases in volume.

**ECMO and Pregnancy** ECMO is being used with increasing frequency to support pregnant and postpartum patients with severe cardiac or pulmonary failure. A recent study undertaken by Columbia clinicians in cardiothoracic surgery, pulmonary and critical care, maternal-fetal medicine, and pediatric cardiology described the largest case series of patients treated with ECMO during pregnancy and postpartum. Published in *The Annals of Thoracic Surgery*, the study results supported the use of ECMO during and following pregnancy, with favorable maternal and fetal outcomes that outweigh the risk of bleeding or thrombotic complications when managed by an experienced, multidisciplinary team.

## ADULT ECMO



## New Developments in Ventricular Assist Devices

NewYork-Presbyterian's cardiovascular teams are highly experienced in the field of ventricular assist devices. Clinical investigations by faculty at Columbia and Weill Cornell encompass virtually every aspect of these devices, from their design to implantation techniques to the multiple factors that can affect outcomes.

**Momentum 3 Trial** Columbia faculty were major participants in the Momentum 3 trial, the largest left ventricular assist device (LVAD) trial to date, and are now involved in the continuous access protocol component. The trial evaluated HeartMate 3, which is smaller and more easily implantable than previous devices, but also features a centrifugal-flow system that utilizes fully magnetically levitated technology engineered to lower adverse event rates, especially thrombosis. The results, which were published in the February 2, 2017 issue of *The New England Journal of Medicine*, showed that this pump design was associated with better outcomes at six months when compared to the earlier axial-flow pump device, primarily because of the lower rate of reoperation for pump malfunction. In August 2017, the FDA approved the HeartMate 3 Left Ventricular Assist System as a bridge-to-transplant and this latest device is now being widely used by our cardiac surgeons.

**Short-Term Mechanical Circulatory Support** Predicting survival of patients with cardiogenic shock following a heart attack and weaning them from short-term mechanical circulatory support devices remains largely unknown. Columbia physicians recently completed a study on 124 patients who received ECMO or VAD therapy at NewYork-Presbyterian finding that age and cardiac index were predictors for survival to discharge and recovery without durable VAD or transplant. While angiographic result and cardiac index predict ventricular recovery, 50 percent of patients optimally revascularized still required heart replacement therapy.

## Highlights in Heart Transplantation

**Transplant Outcomes After Device Implantation** Recent research undertaken by Columbia faculty focused on outcomes of heart transplantation in patients who had a mechanical circulatory device implanted as a bridge-to-transplant. Comparing short- and long-term outcomes in more than 400 patients, the researchers concluded that using various mechanical circulatory support devices can provide comparable clinical outcomes to primary heart transplant.

**National Donor Heart Selection Conference** NewYork-Presbyterian was one of 12 heart transplant centers participating in authoring the report of the American Society of Transplantation Conference on Donor Heart Selection in Adult Cardiac Transplantation in the United States published in the October 2017 issue of the *American Journal of Transplantation*. The conference resulted in established agreement on the most important donor and recipient risk factors for donor selection and identified the components necessary for a future donor risk score.

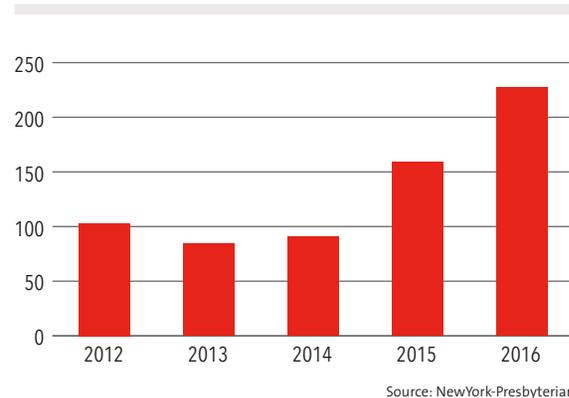
≈ 800

VAD IMPLANTS

Since 2010, NewYork-Presbyterian cardiac surgeons have implanted nearly 800 ventricular assist devices, experiencing an increase of nearly 45% in just the last two years.

## VENTRICULAR ASSIST DEVICES

Volume  
2012 - 2016

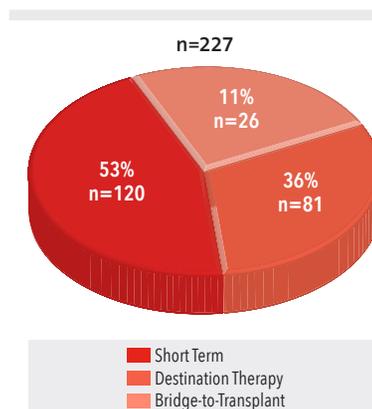


Patient Profiles INTERMACS\*  
June 23, 2006 - December 31, 2016

	NewYork-Presbyterian	INTERMACS
Level 1 Critical Cardiogenic Shock	12.6%	17.1%
Level 2 Progressive Decline	57.8%	36.6%
Level 3 Stable but Inotrope Dependent	23.9%	30.1%
Levels 4-7	5.7%	16.2%

\*INTERMACS is the United States National Registry for patients receiving durable mechanical circulatory support device therapy to treat advanced heart failure.  
Source: INTERMACS Quality Assurance Quarterly Report (Q4 2016)

Ventricular Assist Device Implants  
Volume Distribution  
2016



Source: NewYork-Presbyterian

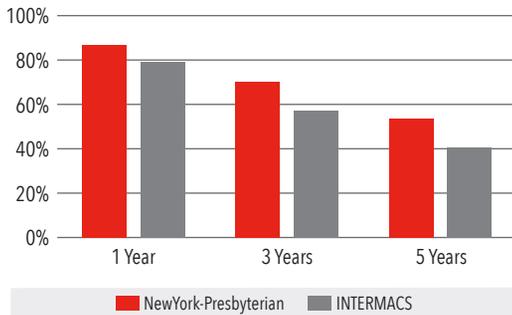
Adverse Events\*  
June 23, 2006 - December 31, 2016

	NewYork-Presbyterian	INTERMACS
Neurological Dysfunction	2.90%	4.10%
Renal Dysfunction	1.80%	2.30%
Respiratory Failure	3.10%	3.70%
Pump/Related-Drive Line Infections (after the first 3 months)	0.83%	1.38%
Pump/Related-Drive Line Infections (during the first 3 months)	1.50%	1.50%
Bleeding	12.70%	13.20%
Rehospitalization	26.70%	39.40%

\*Table includes overall counts and percentages for each type of adverse event reported at Hospital site and INTERMACS overall.  
Source: INTERMACS Quality Assurance Quarterly Report (Q4 2016)

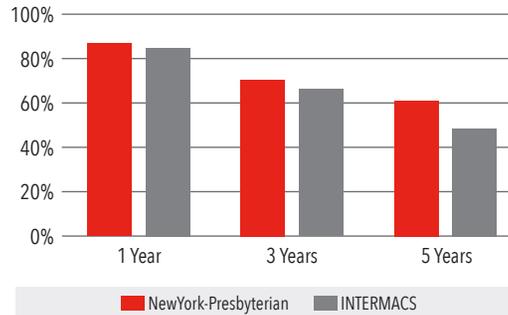
## VENTRICULAR ASSIST DEVICES

All Long-Term Implants Post-Implant Survival  
June 23, 2006 - December 31, 2016



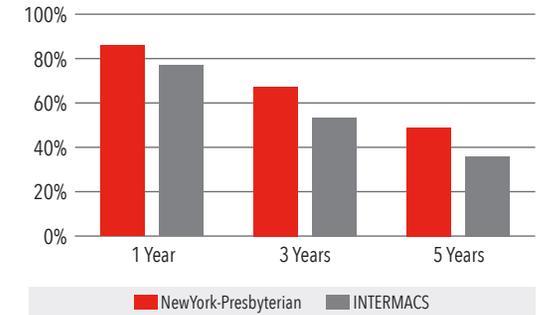
Source: INTERMACS Quality Assurance Quarterly Report (Q4 2016)

Bridge-to-Transplant Survival  
June 23, 2006 - December 31, 2016



Source: INTERMACS Quality Assurance Quarterly Report (Q4 2016)

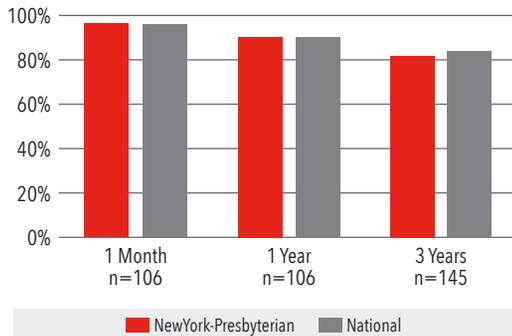
Destination Therapy Survival  
June 23, 2006 - December 31, 2016



Source: INTERMACS Quality Assurance Quarterly Report (Q4 2016)

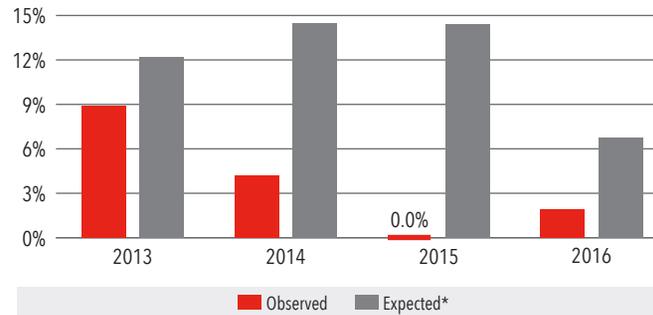
## ADULT HEART TRANSPLANT

Patient Survival



1 month (adjusted) January 1, 2014 - June 30, 2016  
 1 year (adjusted) January 1, 2014 - June 30, 2016  
 3 years (adjusted) July 1, 2011 - December 31, 2013  
 Source: Scientific Registry of Transplant Recipients / srrt.org  
 Release Date: July 6, 2017

In-Hospital Mortality Rate

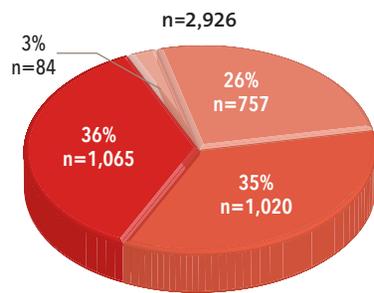


\*Expected mortality was determined using Vizient risk-adjustment methodology.  
 Source: Vizient Clinical Data Base/Resource Manager™  
 used by permission of Vizient. All rights reserved.

**2,500**  
HEART TRANSPLANTS

NewYork-Presbyterian has performed 2,500 heart transplants between January 1988 and September 2017 – the largest volume in New York State – and maintains the largest waiting list in the State.

## Electrophysiology Procedures 2016



■ Ablations ■ Pacemakers ■ Lead Extractions  
■ Implantable Cardioverter Defibrillators

Source: NewYork-Presbyterian

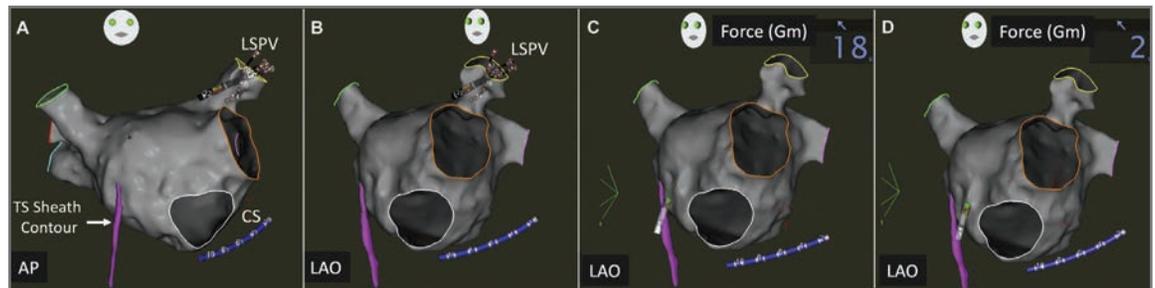
**≈ 70%**  
**FLUORESS ABLATION**

At Weill Cornell, fluoroless atrial fibrillation ablation is performed in approximately 70% of patients with less than 60 seconds of fluoroscopy in nearly 90% of cases.

## Fluoroless Catheter Ablation of Atrial Fibrillation

Traditionally, physicians have primarily used fluoroscopy to navigate catheter positioning for mapping and ablating atrial fibrillation. NewYork-Presbyterian is among the leading hospitals in the country to perfect the ability to map and ablate arrhythmias with three-dimensional intracardiac echocardiography. This minimally invasive imaging modality allows for real-time image guidance and visualization of anatomical structures without ionizing radiation, allowing our physicians to manipulate catheters to treat atrial fibrillation without exposing patients or the electrophysiologist to any appreciable amount of fluoroscopy. The vast majority of our patients with atrial fibrillation do not require fluoroscopy. However, there are challenges in patients with preexisting pacemaker and defibrillator leads, those with atrial septal defect closure devices, and those with anatomic anomalies or poor acoustic windows. In these circumstances, since safety is always the highest priority, short flashes of fluoroscopy may be appropriate.

## Tracking of the Transseptal Sheath



Acquisition of right atrial anatomy during insertion of the ablation catheter through the transseptal sheath allows for its position to be annotated on the FAM map or merged CT scan. This facilitates fluoroless reintroduction of the ablation catheter and sheath into the left atrium in cases where transseptal access is inadvertently lost.

## Advanced Left Ventricular Leadless System

NewYork-Presbyterian is among the first institutions in the United States to test a wireless, endocardial pacing system for stimulating the left ventricle in patients with heart failure who require cardiac resynchronization therapy. The system uses a proprietary wireless technology to deliver pacing stimulation directly to the inside of the left ventricle of the heart. This approach is designed to overcome limitations of existing cardiac resynchronization therapy systems that deliver pacing stimulation to the outside of the left ventricle. Pacing from the inside of the left ventricle is believed to be more physiologic.

## Research Highlights

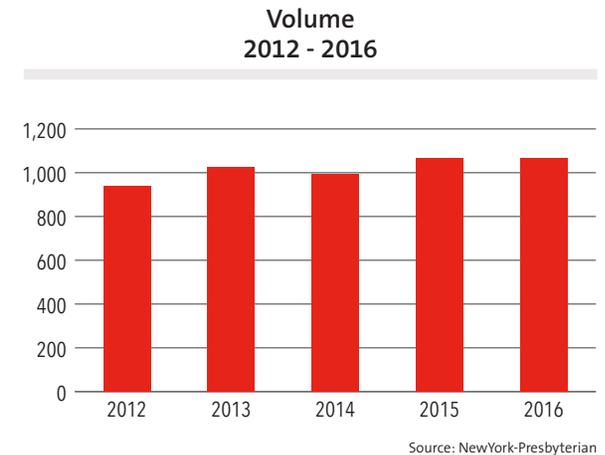
**Electrocardiographic Findings in NBA Athletes** Columbia researchers, in partnership with the National Basketball Association, served as lead authors on an observational study looking at ECG data for NBA athletes. The results, published in the December 6, 2017, issue (Epub) of *JAMA Cardiology*, showed that the prevalence of abnormal ECG findings in NBA players is higher than in other studied athlete groups. While athlete-specific international criteria improved ECG specificity over previous ECG interpretation criteria in these players, abnormal ECG classification remained high. Additionally, the development of left ventricular concentric remodeling appears to have a significant influence on the prevalence of abnormal ECG classification and repolarization abnormalities in this elite athlete population. Continued work is required to investigate the significance of these findings.

**Navigation-Guided versus Manual Catheter Ablation** Weill Cornell researchers conducted a study comparing the outcomes of robotic magnetic navigation-guided ablation with manual ablation of ventricular arrhythmias from the left ventricular and right ventricular papillary muscles. Catheter ablation was initially performed using robotic magnetic navigation guidance in 24 patients and manual guidance in 11 patients. The researchers concluded that the use of the robot magnetic navigation-guided approach to target papillary muscle ventricular arrhythmias results in comparable success rates seen with manual ablation, but with lower fluoroscopy times and decreased use of transaortic retrograde access.

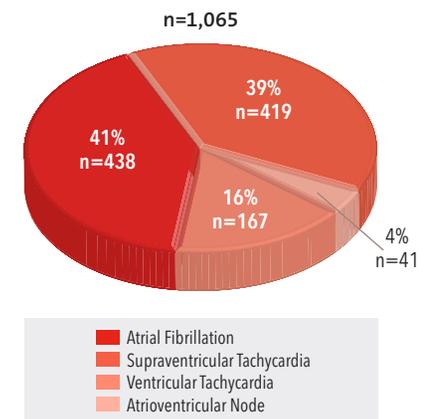
**Enhancing Assessment of Electromechanical Behavior** Columbia researchers looked at the value of electromechanical wave imaging (EWI) in the assessment of heart failure patients and cardiac resynchronization therapy (CRT). This noninvasive, ultrasound-based technique can map electromechanical activity at high spatial and temporal resolution and with real-time feedback. In their investigation, the results of which appeared in the January 2017 issue of *Pacing and Clinical Electrophysiology*, the researchers concluded that EWI was capable of characterizing local cardiac electromechanical behavior as it pertains to heart failure and CRT response. Activation sequences obtained with EWI allow for quantification of LV lateral wall electromechanical activation, thus providing a novel method for CRT assessment.

**Reconstructing Scar Areas** Researchers at Weill Cornell sought to compare areas of scar marked on 3-D integrated intracardiac echocardiogram (ICE) with abnormal electrogram sites in patients with cardiomyopathy and ventricular tachycardia (VT). They concluded ICE delineation of scar regions is feasible and shows excellent correlation with low voltage regions, as well as local abnormal ventricular activities in normal voltage regions. Image integration of scar areas into the anatomic mapping system can help focus attention to areas of interest for substrate mapping during VT ablation.

## CATHETER ABLATIONS



### By Type of Arrhythmia 2016



Source: NewYork-Presbyterian

# 23.5%

**LOWER MORTALITY RATE**

NewYork-Presbyterian's mortality rate for patients with heart attack is 23.5% lower than the national average.

### Acute Myocardial Infarction STEMI Performance Measures

	NewYork-Presbyterian	ACC-NCDR Hospitals
Overall AMI performance composite	97.8%	95.2%
Discharge AMI performance composite	97.1%	93.9%
Proportion of patients prescribed a beta-blocker at discharge	100.0%	97.5%
Proportion of patients prescribed a statin at discharge	100.0%	99.4%
Evaluation of LV systolic function	100.0%	97.0%
Proportion of patients prescribed an ACE-I or ARB for LVSD at discharge	93.9%	91.0%
Proportion of STEMI patients receiving primary PCI within 90 minutes	95.7%	95.9%

Source: American College of Cardiology National Cardiovascular Data Registry (ACTION Registry®-GWTG™) / Institutional Outcomes Report 2016  
Publish Date: April 12, 2016

The interventional cardiologists and cardiac surgeons at NewYork-Presbyterian offer the most advanced percutaneous coronary interventions and coronary bypass programs in the world. Utilizing a range of approaches, from minimally invasive catheter-based treatments to off-pump coronary artery bypass to multiple arterial revascularization, they continually expand the boundaries of care for patients with coronary artery disease.

### Lowering Bleeding Risk for Patients Undergoing Coronary Stent Procedures

While drug-eluting stents are the current standard for percutaneous coronary intervention, these stents necessitate longer durations of dual antiplatelet therapy (DAPT), potentially increasing bleeding in patients predisposed to these complications. Our physicians participated in the LEADERS FREE study to evaluate a polymer-free and carrier-free drug-coated stent that transfers umirolimus into the vessel wall over a period of one month. In a randomized, double-blind trial, they compared the drug-coated stent with a very similar bare-metal stent in patients with a high risk of bleeding. The results, published in *The New England Journal of Medicine*, demonstrated that the coated stent was superior to the bare-metal stent when used with a one-month course of DAPT.

NewYork-Presbyterian physicians are also leading the international ONYX ONE randomized controlled trial and the EVOLVE Short DAPT study, examining shorter durations of DAPT in conjunction with the use of the Onyx and Synergy drug-eluting stents. They are also about to begin enrollment in the XIENCE Short DAPT study, another trial examining a shorter duration of DAPT in patients at higher risk of bleeding.

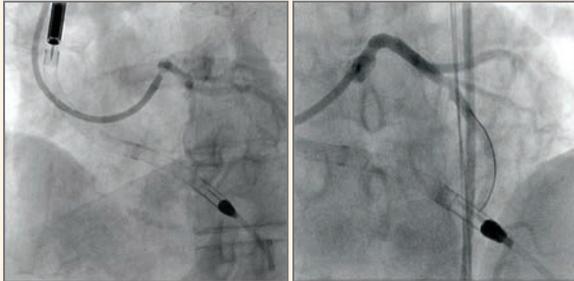
### Hybrid Coronary Revascularization

NewYork-Presbyterian has one of the finest programs in the nation for hybrid coronary revascularization that enables our surgeons to provide a combination of therapies for patients with extensive, multi-vessel disease. This approach combines minimally invasive robotic bypass off-pump, with the remaining arteries managed with stent placement. This technique brings the mammary artery to the left anterior descending artery without the need for cardiopulmonary bypass or sternotomy. NewYork-Presbyterian is a coordinating center for an actively enrolling NIH-sponsored, multicenter trial comparing hybrid coronary revascularization to conventional PCI.

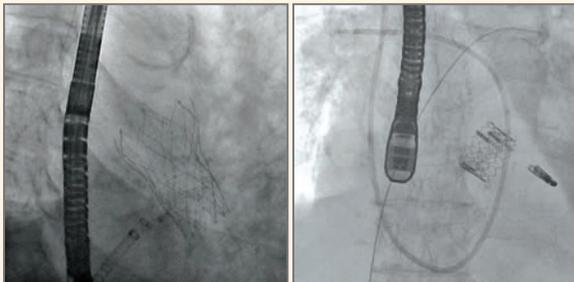
### CASE STUDY

A female patient in her 50s underwent mantle field radiation for lymphoma as a child. She subsequently developed aortic stenosis and left main coronary artery stenosis. The patient's left main lesion was addressed with a stent and an LVAD in the event she became hypotensive during the procedure, which could be fatal. Following recovery from this procedure, she then underwent TAVR with excellent results.

### Stent and LVAD placement

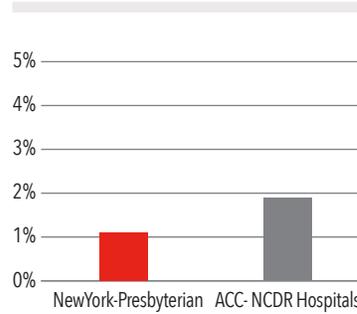


### TAVR



## PERCUTANEOUS CORONARY INTERVENTION

### Mortality Rate



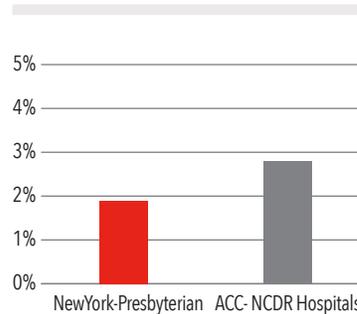
Source: American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR) CathPCI Registry Institutional Outcomes Report 2016  
Publish Date: April 12, 2016

### Risk Factors of Patients Undergoing PCI

Risk Factor	NewYork-Presbyterian	ACC-NCDR Hospitals
Age ≥75	27.4%	24.0%
Prior Myocardial Infarction >7 days	34.0%	30.4%
Prior Heart Failure	22.8%	15.5%
Diabetes Mellitus	41.1%	40.0%
Currently on Dialysis	5.8%	3.0%
Prior Coronary Artery Bypass Grafting	18.7%	17.2%

Source: American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR) CathPCI Registry Institutional Outcomes Report 2016  
Publish Date: April 12, 2016

### All Adverse Events\*



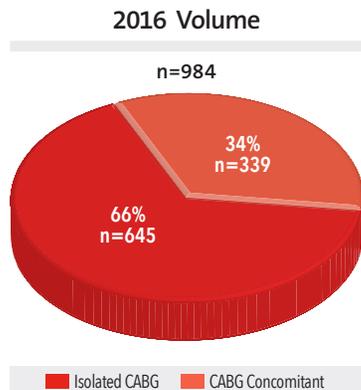
\* Composite of adverse events – death, emergency CABG, stroke, repeat target vessel revascularization  
Source: American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR) CathPCI Registry Institutional Outcomes Report 2016  
Publish Date: April 12, 2016

### PCI Complications — Incidents per Total Volume

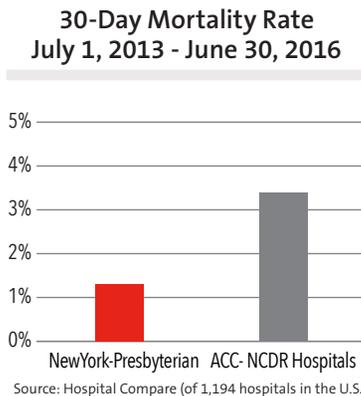
Complication	NewYork-Presbyterian	ACC-NCDR Hospitals
Hematoma >10 cm at Access Site within 72 hrs	0.7%	0.5%
Cardiogenic Shock	0.9%	1.6%
Cerebrovascular Accident/Stroke	0.2%	0.3%
Heart Failure	0.7%	1.5%
Myocardial Infarction	1.1%	1.6%
Renal Failure/Dialysis	0.4%	0.4%

Source: American College of Cardiology National Cardiovascular Data Registry (ACC-NCDR) CathPCI Registry Institutional Outcomes Report 2016  
Publish Date: April 12, 2016

## CORONARY ARTERY BYPASS GRAFTING



Source: NewYork-Presbyterian



**Isolated CABG Complications Rate**  
2014 - 2016

Postoperative Stroke	1.6%
Renal Failure - New Onset Dialysis	0.8%
30 Days Readmission - Unplanned	8.5%

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

## Current Perspectives on CABG

While the use of the left internal mammary artery is a standard expectation for coronary artery bypass grafting, our cardiothoracic surgeons are using multiple arterial grafts, as opposed to vein grafts, for their durability and the expectation of greater longevity, especially beneficial for younger patients. The graft conduits include the bilateral mammary artery, the radial artery, and the gastroepiploic artery. With our experience and expertise caring for high-risk patients, we are able to perform bypass surgery on patients with the most complex and challenging cardiac disease using ventricular assist devices, ECMO, and advanced pharmacology.

- In January 2018, Weill Cornell will serve as the principal investigating institution for the multicenter ROMA (Randomization of Single Multiple Arterial Grafts) trial that will compare the clinical outcome of single versus multiple arterial grafts in patients undergoing primary isolated non-emergent coronary artery bypass grafting. The ROMA trial – expected to be the second largest clinical trial conducted for coronary bypass – aims to enroll nearly 4,500 patients in six continents over the next three years.
- NewYork-Presbyterian uses bilateral internal mammary arteries for a much higher proportion of patients than almost any other institution in the country. In the most recent national surveys, only 5 to 10 percent of patients receive bilateral mammary grafts for coronary bypass in the United States; at NewYork-Presbyterian, more than 60 percent of our patients benefit from this approach.
- Our surgeons use other methods for multiple arterial grafting, such as sequential grafting that involves one arterial conduit to bypass multiple targets; less commonly, they employ branch grafting with the Y-graft or T-graft.
- When performing complex radial grafts, collateral blood flow to the hands and fingers following revascularization is carefully evaluated to minimize ischemia to the hand. Rigorous diagnostic assessment in the operating room includes the use of ultrasound and transit time flowmeters to confirm good flow and graft patency.
- To preserve sternal blood flow and minimize the risk of sternal infection, our surgeons skeletonize the mammary arteries. Instead of taking all of the tissues and veins around the artery, they take only the artery, preserving blood flow to the sternum as much as possible.

## HYPERTROPHIC CARDIOMYOPATHY

The complexity of hypertrophic cardiomyopathy (HCM) requires a multidisciplinary team that calls on the skills of cardiologists, cardiovascular imaging specialists, surgeons, electrophysiologists, and geneticists to offer patients essentially every treatment choice, including medication management, alcohol septal ablation via cardiac catheterization, and surgical options.

### Extended Septal Myectomy

NewYork-Presbyterian cardiac surgeons are among the country's leading experts in extended septal myectomy, a procedure in which a deeper, more extensive portion of the thickened ventricular wall is removed to relieve obstruction of the left ventricular outflow tract (LVOT). Prior to surgery, the team conducts a unique preoperative imaging plan. This includes a cardiac CT scan to create a 3-D model of the surgical anatomy and generate a virtual surgical myectomy. The detailed preoperative planning as to where to resect is enormously helpful for informed decision making as entering via the aortic valve is particularly challenging due to the extremely limited view of the enlarged tissue. Our surgeons have found that the extended septal myectomy approach produces longer lasting, more effective outcomes than standard myectomy.

### Total Endoscopic Robotic Surgery

Left ventricular outflow tract obstruction due to systolic anterior motion of the mitral valve is a frequent cause of disabling symptoms in HCM. Our cardiothoracic surgeons are among a select few in the country performing endoscopic robotic surgery for the treatment of HCM. In the traditional approach, the surgeon enters through a sternotomy and resects the muscle bundle through the aortic valve. With the robotic technique, the surgeon can perform a septal myectomy and repair the mitral valve at the same time. This approach permits excellent visualization of the thickened septum from the aortic valve to the apex and allows precise interventions on the mitral valve as it relates to the left ventricular outflow tract, the area that is narrowed in hypertrophic obstructive cardiomyopathy or hypertrophic cardiomyopathy. Patients with prior surgery via a sternotomy can be ideal candidates for the robotic approach as it avoids most or all of the scar tissue created by the previous operation.

>90%

REDUCED LVOT OBSTRUCTION

Through extended septal myectomy, LVOT obstruction is substantially reduced or eliminated in over 90% of patients. At NewYork-Presbyterian, the procedure has a less than 0.5% mortality rate, with outstanding outcomes that include minimizing mitral regurgitation, increasing exercise capacity, and improving patients' quality of life.



NewYork-Presbyterian's Pulmonary Hypertension Centers, which are accredited by the Pulmonary Hypertension Association as Pulmonary Hypertension Centers of Comprehensive Care, are among the largest programs in the world

for chronic thromboembolic pulmonary hypertension (CTEPH). Our physicians manage the most complex and sickest patients with idiopathic and heritable pulmonary hypertension and pulmonary hypertension related to diseases of the connective tissue, congenital heart and left heart disease, and lung, hematological, oncologic, and renal and hepatic diseases.

## PVDOMICS Study Group

NewYork-Presbyterian is one of six centers to participate in the PVDOMICS (Redefining Pulmonary Hypertension through Pulmonary Vascular Disease Phenomics) study group launched by the National Heart, Lung and Blood Institute, which seeks to improve understanding of pulmonary vascular disease through phenomics. The group's aim is to augment the current pulmonary hypertension classification based on shared biological features of the 1,500 participants with pulmonary hypertension and disease and those who are healthy comparators. The phenomic data generated is expected to be a rich resource to heart and lung disease investigators seeking to identify therapeutic targets.

## Advanced Therapeutic Options

Through multidisciplinary partnerships, our centers are able to offer medical, interventional, and surgical management of pulmonary hypertension and vascular disease, including catheter-directed fibrinolytic therapy, pulmonary embolectomy, and pulmonary thromboendarterectomy.

- In collaboration with the Pulmonary Embolism Response Team program, we continue to expand treatments for chronic thromboembolic pulmonary hypertension utilizing balloon pulmonary angioplasty.
- Working closely with medical and surgical ECMO teams, our physicians are pursuing mechanical solutions for patients with pulmonary hypertension as a bridge to high-risk surgery or transplant. This mechanical support has enabled

some of our patients to undergo such elective surgeries as hip replacement, as well as gall bladder and thyroid surgery. Most recently, they assisted in the management of a successful pregnancy of a patient with Eisenmenger's syndrome, from delivery through recovery.

- NewYork-Presbyterian is one of the few sites in the country providing the newer option of balloon pulmonary angioplasty for CTEPH, particularly for patients who are not candidates for pulmonary thromboendarterectomy (PTE). The procedure offers both hemodynamic and functional benefits.
- Our medical and surgical team was among the first to perform a palliative unidirectional valved Potts shunt in an adult with severe idiopathic pulmonary artery hypertension. (See case study, page 17.)

## Research Investigations

- Leaders in the field of genetic discovery in cardiovascular disease, Columbia researchers have reported the first mutation associated with inherited forms of pulmonary hypertension and have identified three novel genes for the disease.
- Columbia University Medical Center is one of three centers in the country that will evaluate pulmonary artery denervation, which is performed in the catheterization lab, as a treatment to improve functional capacity, hemodynamics, and overall effectiveness in patients with pulmonary artery hypertension. Recruitment is now open for the trial of the novel approach, which has never been performed before and is made possible by the close collaboration of cardiologists, interventionalists, surgeons, and critical care specialists.
- The presence of massive uterine leiomyomas has not been widely described as a risk factor for CTEPH, however, pelvic venous congestion may predispose these women to deep vein thrombosis and CTEPH. In a review of seven women with massive uterine leiomyomas and CTEPH, our clinicians in pediatrics, medicine, and obstetrics and gynecology found that women with these co-occurring conditions can safely undergo PTE with the appropriate multidisciplinary team and proper planning for operative placement of an inferior vena cava filter followed by hysterectomy shortly after PTE. The physicians recommend that women with massive fibroids and unexplained dyspnea consider a workup for CTEPH.

## CASE STUDY

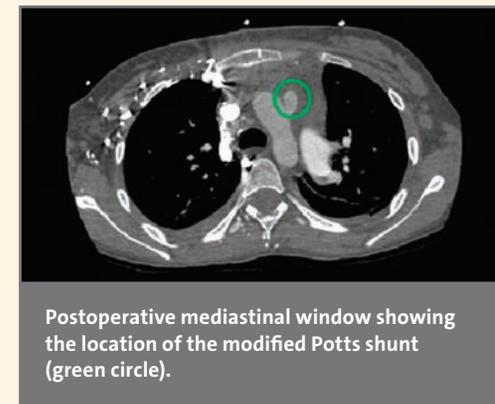
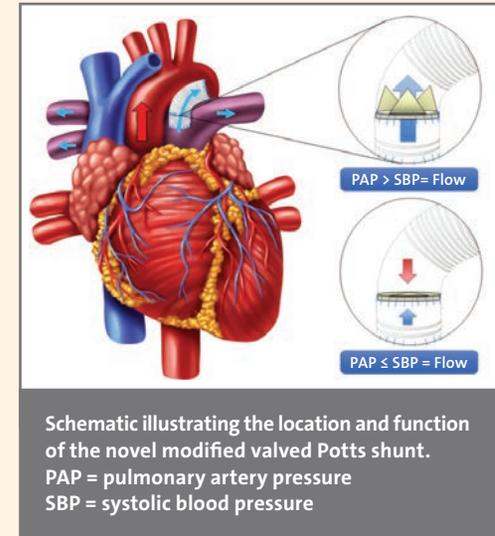
A 22-year-old woman with a 15-year history of idiopathic pulmonary arterial hypertension (IPAH) remained symptomatic despite balloon atrial septostomy to decrease her risk of resyncope and sudden cardiovascular collapse. Her persistent medication noncompliance and complex social circumstances disqualified her from lung transplantation. Our cardiac team opted to perform a palliative surgical procedure typically reserved for pediatric patients.

The patient presented to an outside hospital with progressive dyspnea of two weeks' duration after abruptly discontinuing her medications. She was afebrile with an oxygen saturation of 60% while she breathed room air. Her laboratory studies were notable for a brain natriuretic peptide exceeding 3,400 pg/ml and an electrocardiogram demonstrating a stable right bundle branch block. She was started on inhaled iloprost and inhaled nitric oxide and was urgently transferred to NewYork-Presbyterian.

On arrival, she was placed on high-flow nasal cannula and soon thereafter on intravenous epoprostenol, ambrisentan, and sildenafil. A transthoracic echocardiogram revealed a severely dilated right ventricle with poor systolic function, a left ventricular ejection fraction of 35%, and an estimated pulmonary artery systolic pressure of 130 mm Hg.

As the patient was not a candidate for lung transplantation, the decision was made to perform a palliative unidirectional valved Potts shunt – a connection between the main pulmonary artery and the descending aorta – with simultaneous closure of the atrial septostomy. This would effectively generate Eisenmenger's physiology with a “pop-off” valve from the pulmonary to the systemic circulation, providing right ventricular afterload reduction while maintaining cardiac output and preserving upper body oxygenation. A CT examination of the chest confirmed Potts shunt patency. She was discharged home on postoperative day 21 to take intravenous epoprostenol, ambrisentan, sildenafil, and furosemide. She was anticoagulated with warfarin and aspirin.

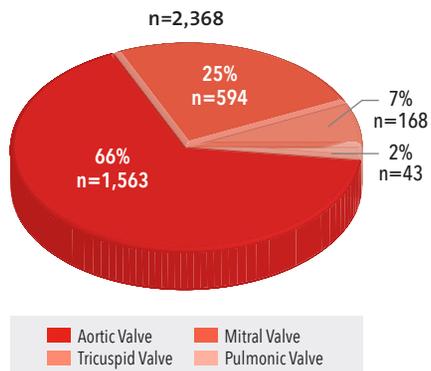
Unlike systemic desaturation from atrial-level shunting with a balloon atrial septostomy, the anastomotic sites of a Potts shunt ensure maintenance of fully oxygenated blood flow to the upper body, thereby improving exercise tolerance and reducing the risk of syncope and cardiovascular collapse. Our novel addition of a unidirectional pop-off valve has the benefit of allowing right-to-left shunting during suprasystemic pulmonary hypertensive crises, while preventing left-to-right shunting into the pulmonary artery when pulmonary artery pressure falls below systemic pressure.



# Valve Disease

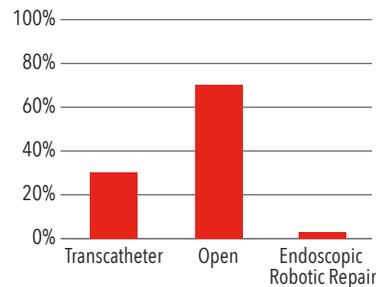
## VALVE PROCEDURES

Procedures by Valve Type  
2016



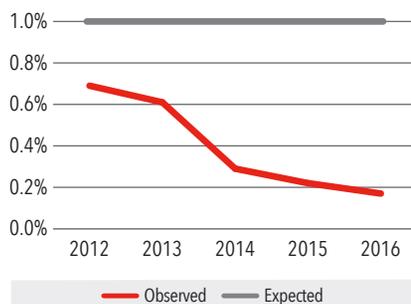
Source: NewYork-Presbyterian

Procedures by Approach  
2016



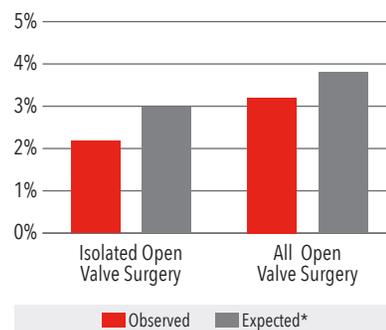
Source: NewYork-Presbyterian

Surgical Site Infection Rate  
2012 - 2016



Standardized Infection Ratio = Observed/Expected  
Source: National Healthcare Safety Network/  
Department of Infection Prevention and Control

In-Hospital Mortality Rate  
2016



\*Expected mortality was determined using  
Vizient risk-adjustment methodology.  
Source: Vizient Clinical Data Base/Resource Manager™  
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NewYork-Presbyterian offers pioneering programs in the treatment of valve disease, including interventional, surgical, and robotic options. Our clinicians across all cardiovascular specialties are at the vanguard of research and clinical trials in the development, evaluation, and refinement of innovative, less-invasive techniques for repairing and replacing aortic, mitral, and tricuspid valves.

### Aortic Valve

Transcatheter aortic valve replacement has progressed dramatically in terms of device technologies and patient selection due, in large part, to the transformative work of interventional cardiologists and cardiac surgeons at NewYork-Presbyterian. Our physicians have served and continue to serve as principal investigators in landmark trials related to transcatheter valve therapies, including multicenter studies for aortic and mitral valve disease, and now tricuspid valve disease.

At NewYork-Presbyterian, recovery has been made easier for patients with a transition from the use of general anesthesia to conscious sedation or monitored anesthesia control. In fact, 75 percent of TAVR patients do not go to the ICU from the Catheterization Lab, but rather directly to an observation unit for recovery.

**Partner 3** Having served as the principal investigators for the landmark trials that established TAVR as the standard of care for inoperable patients, as an alternative to surgery in high-risk patients, and most recently as another treatment option for patients at intermediate risk, Columbia and Weill Cornell faculty are now serving as principal investigators in a multicenter study in patients with symptomatic, severe aortic stenosis at low operative risk. The study is evaluating TAVR using the SAPIEN 3 balloon-expandable platform with surgical valve replacement in patients with low operative risk for symptomatic, severe aortic stenosis. This pivotal, groundbreaking trial, which has not been conducted anywhere else in the world, could potentially show that transcatheter valve replacement is no worse – or perhaps even better – than open surgical procedures.

**Valve-in-Valve TAVR** Columbia and Weill Cornell clinician-researchers are also exploring TAVR as an option for patients with failing surgically implanted bioprosthetic valves. Rather than having a high-risk open chest procedure, selected patients may be candidates for having a new valve placed inside the older valve via TAVR. The early experiences of using valve-in-valve TAVR for structural degeneration of bioprosthetic surgical aortic valves and data from the PARTNER 2 Valve-in-Valve Registry in patients with symptomatic aortic stenosis at high risk for complications during a reoperation demonstrated that valve-in-valve TAVR presents a viable option for selected patients.

**Early TAVR** NewYork-Presbyterian clinicians are also looking at two new categories of patients – those with moderate aortic stenosis in heart failure and those with severe asymptomatic aortic stenosis – with a goal to identify patients who may benefit from early TAVR before they present with atrial fibrillation, severe heart failure, or with pulmonary hypertension. To this end, researchers at Columbia and Weill Cornell are participating in major multicenter clinical trials with potentially significant implications for the aortic stenosis population.

- **Early TAVR Trial** Approved by the FDA in February 2017, this trial will compare the practice of active surveillance to early TAVR in patients diagnosed with severe aortic stenosis who have not yet developed symptoms.
- **TAVR UNLOAD Trial** Begun in May 2016, this international study is comparing TAVR performed via a transfemoral approach in combination with optimal heart failure therapy (OHFT) to OHFT alone in patients diagnosed with heart failure with reduced ejection fraction and moderate aortic stenosis. The investigators hypothesize that unloading the left ventricle by reducing the transaortic gradient with TAVR may improve the clinical outcomes of these patients.

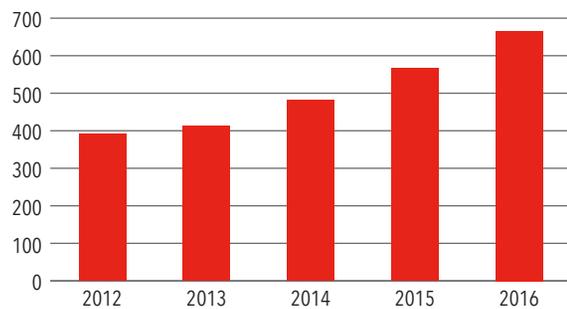
**>4,000**  
TAVR PROCEDURES

NewYork-Presbyterian's total case volume is over 4,000 procedures and our cardiac specialists are currently performing more than 500 TAVR cases per year. 70% of our patients are discharged in two days or less.

# Valve Disease

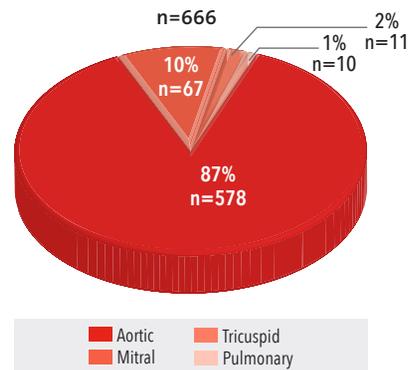
## TRANSCATHETER VALVE PROCEDURES

Volume  
2012 - 2016



Source: NewYork-Presbyterian

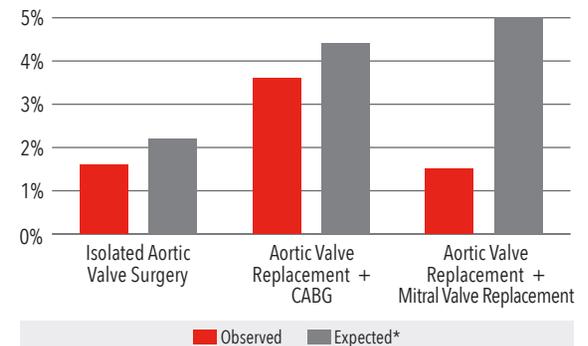
Procedures by Access  
2016



Source: NewYork-Presbyterian

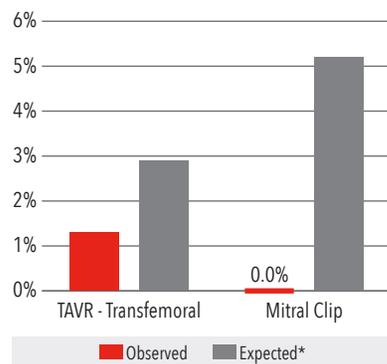
## AORTIC VALVE SURGERY

In-Hospital Mortality Rate  
2016



\*Expected mortality was determined using Vizient risk-adjustment methodology  
Source: Vizient Clinical Data Base/Resource Manager™ used by permission of Vizient. All rights reserved.

In-Hospital Mortality Rate  
2016



\*Expected mortality was determined using Vizient risk-adjustment methodology.  
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Transfemoral Complications Rate  
2016

Postoperative Stroke	0.4%
Renal Failure - New Onset Dialysis	0.0%
30 Days Readmission - Unplanned	5.4%

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

Isolated Aortic Valve Complications Rate  
2016

Postoperative Stroke	1.1%
Renal Failure - New Onset Dialysis	0.8%
30 Days Readmission - Unplanned	6.0%
Postoperative Infection	0.5%

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

## Mitral Valve

The majority of mitral valve surgery in the country is performed through full sternotomy; about 35 percent is done minimally invasively; and 5 percent is done robotically. At NewYork-Presbyterian, mitral valve replacement has been transitioning from full or partial sternotomy surgery to more minimally invasive keyhole, transcatheter, and robotic approaches.

Patients who come to NewYork-Presbyterian with mitral valve disease benefit from a comprehensive evaluation by a multidisciplinary heart team, which makes the determination of the appropriate therapeutic option based on several patient factors, including the severity of symptoms and comorbidities.

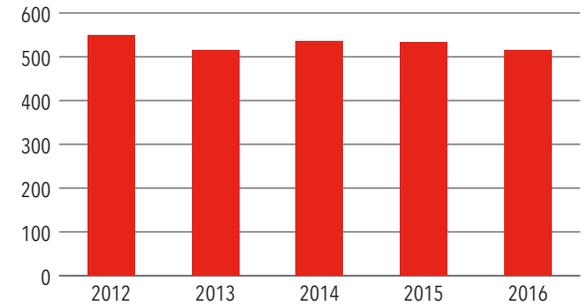
**MitraClip®** Patients with significant symptomatic degenerative mitral regurgitation who are not candidates for surgery are benefitting from the FDA-approved MitraClip, a low-risk, catheter-based procedure that creates a tissue bridge between the anterior and posterior leaflets using one or two clips that are deployed through a transseptal approach. The MitraClip, which is now available for high-risk patients with degenerative mitral valve disease, continues under evaluation in the Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients with Functional Mitral Regurgitation (COAPT) multicenter trial.



**Transcatheter Mitral Valve Replacement** For patients who are highly stenotic, MitraClip is not an option, and until recently, these patients would need to undergo an open surgical repair. Transcatheter mitral valve replacement (TMVR) is a new technology under study in feasibility clinical trials as a potential therapy for patients with symptomatic, severe mitral regurgitation. Performed through a small incision on the left side as in TAVR, TMVR involves a self-expanding, nitinol valve with bovine pericardial leaflets that is placed using a transapical delivery system. Columbia faculty were among the study's principal investigators in centers throughout the United States, Australia, and Europe. Early experience with 50 patients has shown that the device implant is feasible in patients at high- or extreme-risk for conventional mitral valve replacement. The results are now guiding the trial design of TMVR in lower-risk patients with severe mitral valve regurgitation.

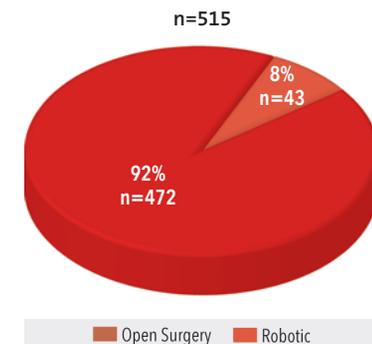
## MITRAL VALVE PROCEDURES

Open Surgery Volume  
2012 - 2016



Source: NewYork-Presbyterian

Volume by Type  
2016



Source: NewYork-Presbyterian

# Valve Disease

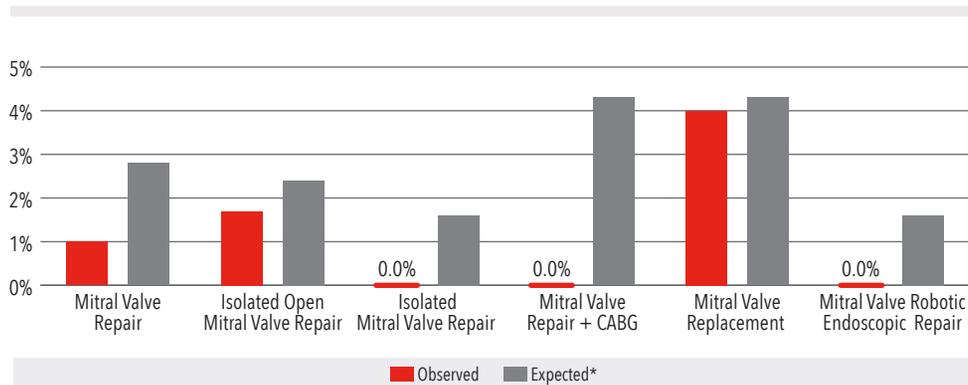
**Total Endoscopic Robotic Mitral Valve Repair** NewYork-Presbyterian’s cardiothoracic surgeons are now routinely performing endoscopic robotic surgery repair, particularly for patients with mitral valve regurgitation. The procedure is performed through four 8mm and one 12mm incisions – considered the smallest incisions used for this procedure in the nation. Advantages of this approach over traditional sternotomy, non-robotic, or robotic port access approaches is that rib spreading is not needed and approaching the valve robotically from the right side of the chest allows the valve and the heart to remain in their natural positions, rather than retracting the heart to expose the valve. A catheter-based system is used to place the patient on the heart-lung machine, which enables the surgery to be accomplished completely through the minute ports. The endoscopic approach also allows the surgeon to visualize the valve in its natural position, greatly facilitating the repair and resulting in a very high repair rate.

## Tricuspid Valve

Treatment alternatives for patients with severe, symptomatic tricuspid regurgitation are limited, with medical therapy often ineffective and surgery associated with high operative mortality. Columbia is one of five centers in the United States that participated in an early feasibility study of the Edwards FORMA Tricuspid Transcatheter Repair System of patients with tricuspid valve regurgitation. Clinical outcomes at 30 days showed that there was significant reduction of tricuspid regurgitation, especially in those patients with the worst baseline, and, at 30 days, there was significant improvement in NYHA functional class, six-minute walk tests, and KCCQ scores. Longer-term follow-up is necessary to assess recurrence, evidence of right ventricular remodeling, and late clinical outcomes.

## MITRAL VALVE PROCEDURES

**In-Hospital Mortality Rate 2016**



\*Expected mortality was determined using Vizient risk-adjustment methodology.  
 \*\*Isolated mitral valve includes both mitral valve repair and replacement.

**Isolated Mitral Valve Complications Rate 2016**

Postoperative Stroke	0.9%
Renal Failure - New Onset Dialysis	0.0%
30 Days Readmission - Unplanned	5.7%
Postoperative Infection	0.0%

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

# Aortic Disease

NewYork-Presbyterian’s open heart and endovascular surgery programs for aortic disease continue to grow as international and nationally recognized centers of excellence. These programs bring together the expertise of comprehensive care teams with advanced treatment algorithms that result in excellent outcomes for aortic disease. At the same time, we are expanding clinical and translational research efforts in all areas of adult cardiac and vascular surgery, with a major focus on aortic surgery. Drawing on an extensive aortic surgery database, our physicians are addressing aortic pathologies and procedures using complex statistical analyses with a goal toward durable outcomes.

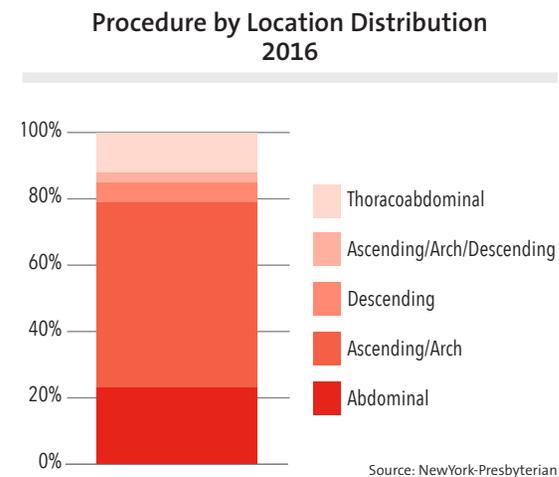
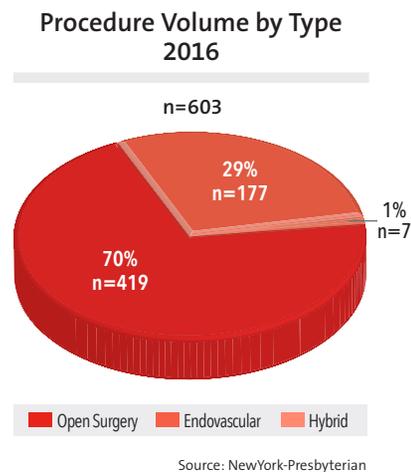
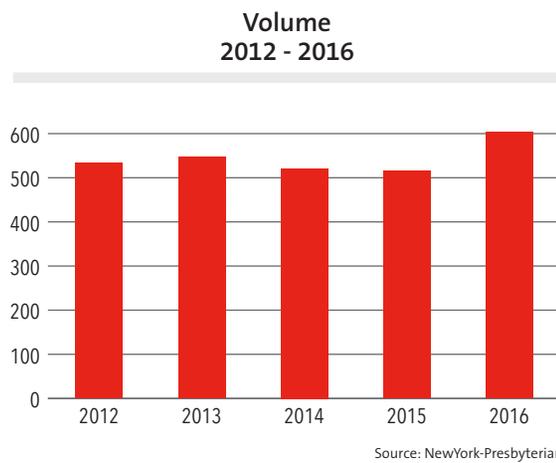
**Preserving the Native Aortic Valve** Through the collaboration of cardiothoracic surgeons, cardiologists, and cardiovascular radiologists, we are seeking to transform care for ascending aortic aneurysms that will enable preservation of a patient’s native valve. The use of a new imaging method – four-dimensional flow MRI and computational fluid dynamics – is being explored to visualize and analyze flow dynamics that will help guide surgery to alleviate stress on the repaired aortic valve. This, in turn, will reduce the incidence of late aortic events, including new aneurysms, tears, and dissections.

Two major research projects are underway at Weill Cornell investigating the flow dynamics in the aortic root after valve-sparing operations using 4-D MRI, computational dynamics, and sophisticated *in vitro* simulators. These investigations, in collaboration with colleagues in Rome, will help identify the optimal surgical technique for recreating normal physiology.

**Biological Solutions to Aortic Root Replacement** Weill Cornell surgeons recently published early and mid-term results of a study comparing valve-sparing surgery to root replacement with a biologic composite conduit in a series of 749 patients. They found that both approaches provide excellent outcomes. However, at mid-term follow-up the use of a biologic composite conduit is associated with a higher risk of reoperation.

**Endovascular Advances** At NewYork-Presbyterian, our endovascular specialists, who are experts in catheter and wire-based techniques, obtain the best possible outcomes for patients with aortic aneurysms, complicated Type B dissections, and aortic coarctation. Many endovascular aortic repairs are performed completely percutaneously with no incisions.

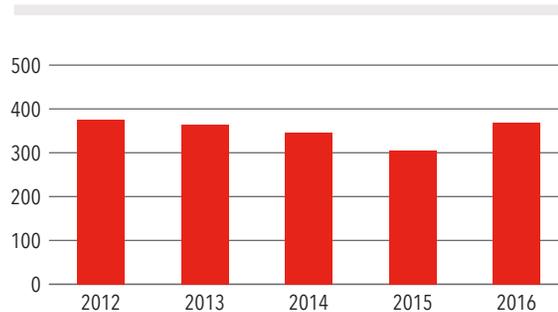
## AORTIC PROCEDURES



# Aortic Disease

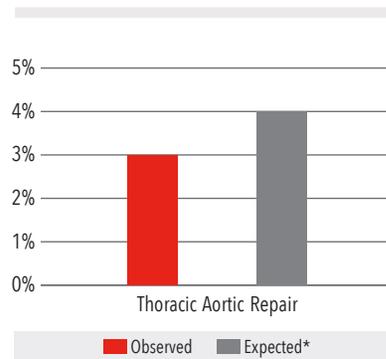
## OPEN THORACIC AORTIC REPAIR

Volume  
2012 - 2016



Source: NewYork-Presbyterian

In-Hospital Mortality Rate  
2016



\*Expected mortality was determined using Vizient risk-adjustment methodology.

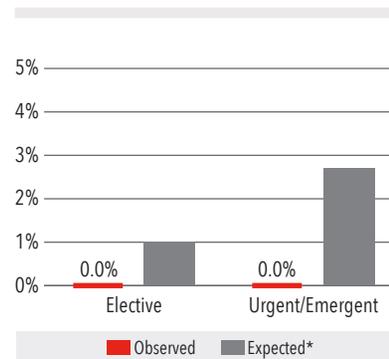
Source: Vizient Clinical Data Base/Resource Manager™ used by permission of Vizient. All rights reserved.

Ascending Aorta and Aortic Arch  
In-Hospital Complications Rate  
2016

Acute Renal Failure - Early Onset Dialysis	0.9%
Deep Sternal Wound Infection	0.0%
Postoperative Stroke	2.4%

Source: NewYork-Presbyterian

Valve-Sparing  
In-Hospital Mortality Rate  
2016



\*Expected mortality was determined using Vizient risk-adjustment methodology.

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

**Cornell International Consortium for Research in Aortic Surgery** This international network of high-volume aortic centers utilizes blinded external analysis of data by a dedicated group of experts for outcome analysis. Additional studies utilize a multidisciplinary approach to analyze and optimize aortic disease surgery in collaboration with cardiac surgeons, cardiologists, radiologists, bioengineers, and basic scientists.

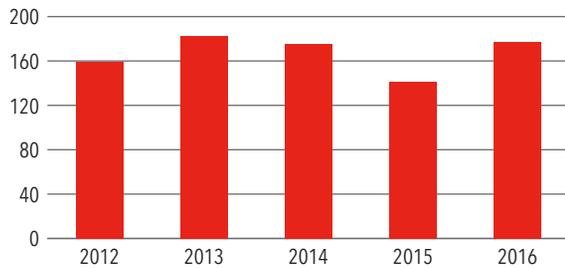
**Endovascular Thoracoabdominal Aneurysm Repair** Weill Cornell vascular surgeons are using fenestrated and branched endograft technology to offer less-invasive treatments for patients with thoracoabdominal aortic aneurysms that involve the visceral vessels of the aorta. Through this physician-sponsored IDE clinical trial, custom-designed endografts are used for an individualized approach tailored to each patient's anatomy.

**Frozen Elephant Trunk Technique** Weill Cornell faculty are participating in a multicenter clinical trial evaluating the frozen elephant trunk technique for complex aortic disease. This hybrid technique is a single-stage surgery combining endovascular treatment with conventional surgery using a hybrid prosthesis to treat disease of both the aortic arch and the descending thoracic aorta – traditionally a two-stage surgery.

**Genetics of Marfan's Syndrome** A recent grant from the National Marfan Foundation will help to establish a two-year fellowship to study the genetic predisposition of aneurysm formation in patients with Marfan's syndrome. The curriculum – to be conducted at Weill Cornell and with scientists in Milan, Italy – will incorporate the fields of cardiology, cardiac surgery, and mechanical engineering.

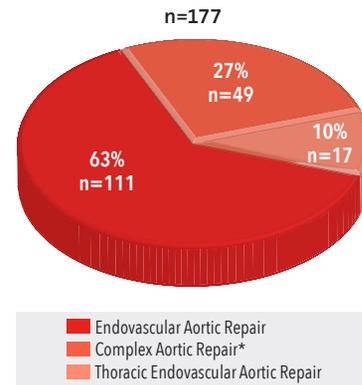
## ENDOVASCULAR PROCEDURES

Volume  
2012 - 2016



Source: NewYork-Presbyterian

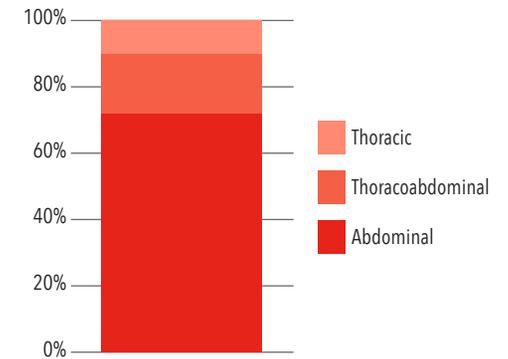
Procedure Volume by Type  
2016



\*Complex aortic repair: usage of fenestrated and branched stent grafts and thoracoabdominal repairs

Source: NewYork-Presbyterian

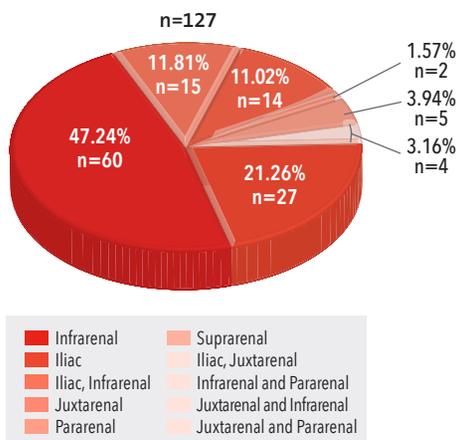
Procedure by Location  
2016



Source: NewYork-Presbyterian

## ENDOVASCULAR ABDOMINAL AORTIC REPAIR

Procedure Volume by Location  
2016



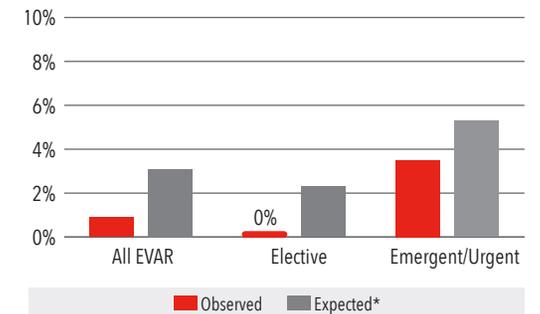
Source: NewYork-Presbyterian

In-Hospital Complications Rate  
2016

Acute Renal Failure - Early Onset Dialysis	0.0%
Postoperative Infection	1.0%
Postoperative Stroke	0.0%
30 Days Readmission - Unplanned	3.6%

Source: NewYork-Presbyterian

In-Hospital Mortality Rate  
2016



\*Expected mortality was determined using Vizion risk-adjustment methodology.

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



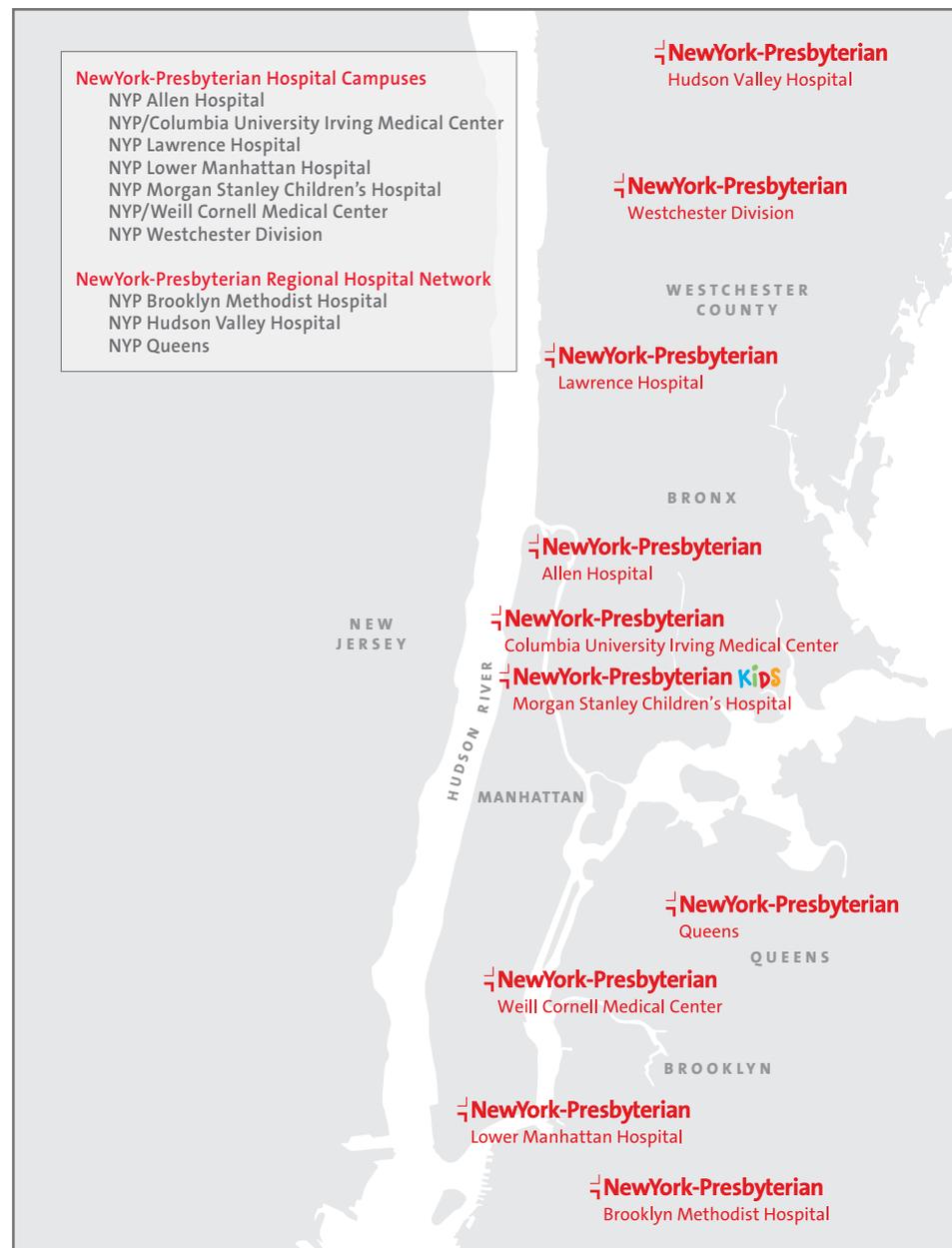
New York's #1 Hospital  
17 Years in a Row

Two decades ago, on January 1, 1998, The New York Hospital announced its full-asset merger with The Presbyterian Hospital to create NewYork-Presbyterian Hospital. In this unprecedented event, two world-class academic healthcare institutions combined to become one of the highest quality medical, teaching, and research institutions in the country. Each hospital shared illustrious histories as providers of exemplary healthcare services, having made innumerable contributions to the field of medicine. The merger resulted in an improved quality of healthcare provided to patients, enhanced availability of clinical services to an expanded population, and lowered costs of services through improved efficiencies.

Today, NewYork-Presbyterian is one of the nation's most comprehensive, integrated academic healthcare delivery systems dedicated to providing the highest quality, most compassionate care and service to patients in the New York metropolitan area, nationally, and throughout the globe. In collaboration with two renowned medical schools, Weill Cornell Medicine and Columbia University Medical Center, NewYork-Presbyterian is consistently recognized as a leader in medical education, groundbreaking research, and innovative, patient-centered clinical care.

NewYork-Presbyterian has four major divisions:

- NewYork-Presbyterian Hospital is ranked #1 in the New York metropolitan area by *U.S. News and World Report* and repeatedly named to the Honor Roll of "America's Best Hospitals."
- NewYork-Presbyterian Regional Hospital Network comprises hospitals and other facilities in the New York metropolitan region.
- NewYork-Presbyterian Physician Services connects medical experts with patients in their communities to expand coordinated healthcare delivery across the region. It includes the NewYork-Presbyterian Medical Groups in Westchester, Queens, and Brooklyn, which increase access to primary care in collaboration with Weill Cornell Medicine Physicians and ColumbiaDoctors, which deliver specialty care.
- NewYork-Presbyterian Community and Population Health encompasses ambulatory care network sites and community healthcare initiatives, including NewYork Quality Care, the Accountable Care Organization jointly established by NewYork-Presbyterian Hospital, Weill Cornell Medicine, and Columbia University Medical Center.





Only one hospital outperforms all six  
government measures on survival rates:  
**NewYork-Presbyterian.**

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NewYork-Presbyterian is the only hospital in the nation with statistically better mortality rates in all six of the Centers for Medicare and Medicaid Services (CMS) 30-day mortality measures: heart failure, pneumonia, COPD, heart attack, stroke and coronary artery bypass graft.

While these statistics are only for Medicare patients, they tell a compelling story: a combination of clinical excellence, dedicated patient care, and the experience and resources of two great medical schools.

We invite you to learn why so many doctors trust us for their most challenging conditions and difficult procedures at [nyp.org/amazingadvances](https://nyp.org/amazingadvances)



**Weill Cornell  
Medicine**

**NewYork-  
Presbyterian**



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