ADULT CORONARY ARTERY BYPASS
GRAFT SURGERY IN THE
COMMONWEALTH OF MASSACHUSETTS

FISCAL YEAR 2011 REPORT
(OCTOBER 1, 2010 THROUGH SEPTEMBER 30, 2011)

HOSPITAL RISK-STANDARDIZED
30-DAY MORTALITY RATES

Massachusetts Data Analysis Center
Department of Health Care Policy
Harvard Medical School
180 Longwood Avenue
Boston, MA 02115
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February 2013

CONTRACTED BY THE MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
Massachusetts Data Analysis Center

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<table>
<thead>
<tr>
<th>Cardiac Surgery</th>
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<tr>
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<td>Research Director</td>
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<td>Center for Quality and Safety</td>
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<td>Department of Surgery</td>
<td>Lahey Hospital &amp; Medical Center</td>
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<tr>
<td>Massachusetts General Hospital</td>
<td>Kalon Ho, M.D.</td>
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<tr>
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<td>Director of Quality Assurance</td>
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<td>Cardiovascular Division</td>
</tr>
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<td></td>
<td>Beth Israel Deaconess Medical Center</td>
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## Massachusetts Cardiac Surgery Centers

<table>
<thead>
<tr>
<th>Center</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>Zip Code</th>
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<tr>
<td>Baystate Medical Center</td>
<td>759 Chestnut Street</td>
<td>Springfield</td>
<td>MA</td>
<td>01199</td>
</tr>
<tr>
<td>Beth Israel Deaconess Medical Center</td>
<td>330 Brookline Avenue</td>
<td>Boston</td>
<td>MA</td>
<td>02215</td>
</tr>
<tr>
<td>Boston Medical Center</td>
<td>1 Boston Medical Center Place</td>
<td>Boston</td>
<td>MA</td>
<td>02118</td>
</tr>
<tr>
<td>Brigham and Women’s Hospital</td>
<td>75 Francis Street</td>
<td>Boston</td>
<td>MA</td>
<td>02115</td>
</tr>
<tr>
<td>Cape Cod Hospital</td>
<td>27 Park Street</td>
<td>Hyannis</td>
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<td>Lahey Hospital &amp; Medical Center</td>
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<td>Burlington</td>
<td>MA</td>
<td>01805</td>
</tr>
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<td>Massachusetts General Hospital</td>
<td>55 Fruit Street</td>
<td>Boston</td>
<td>MA</td>
<td>02114</td>
</tr>
<tr>
<td>Mount Auburn Hospital</td>
<td>330 Mount Auburn Street</td>
<td>Cambridge</td>
<td>MA</td>
<td>02138</td>
</tr>
<tr>
<td>North Shore Medical Center</td>
<td>81 Highland Avenue</td>
<td>Salem</td>
<td>MA</td>
<td>01970</td>
</tr>
<tr>
<td>Southcoast Hospital Group</td>
<td>363 Highland Avenue</td>
<td>Fall River</td>
<td>MA</td>
<td>02720</td>
</tr>
<tr>
<td>Salem Hospital</td>
<td>55 Lake Avenue North</td>
<td>Worcester</td>
<td>MA</td>
<td>01608</td>
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<tr>
<td>Saint Elizabeth’s Medical Center</td>
<td>736 Cambridge Street</td>
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<td>MA</td>
<td>02135</td>
</tr>
<tr>
<td>Saint Vincent Hospital</td>
<td>123 Summer Street</td>
<td>Worcester</td>
<td>MA</td>
<td>01608</td>
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<tr>
<td>Tufts Medical Center</td>
<td>800 Washington Street</td>
<td>Boston</td>
<td>MA</td>
<td>02111</td>
</tr>
<tr>
<td>UMass Memorial Medical Center</td>
<td>55 Lake Avenue North</td>
<td>Worcester</td>
<td>MA</td>
<td>01655</td>
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1  A Message from the Director of the Massachusetts Bureau of Health Care Safety and Quality

This is the tenth in a series of reports summarizing the quality of care provided by the 14 state licensed cardiac surgery programs in the Commonwealth. The report is contracted by the Bureau of Health Care Safety and Quality in the Massachusetts Department of Public Health. The provision of these data is part of a broad, statewide initiative to increase accessibility of health care data to consumers, policy makers, and providers. This report is meant to give residents information about the relative performance of cardiac surgery programs as an aid to decision making, and to provide hospitals in the Commonwealth with key information to help drive quality improvement.

This report contains analysis of data on 2,840 hospital admissions in which an isolated coronary artery bypass graft (CABG) surgery was performed during the period October 1, 2010 through September 30, 2011. Mass-DAC and the Department of Public Health no longer publicly report on surgeon-specific mortality rates, to be consistent with the Massachusetts reporting for interventional cardiologists performing percutaneous coronary interventions (PCI). Data on individual cardiac surgeons and PCI operators will continue to be collected and analyzed. After review by a committee of content experts, information about providers who have higher than expected mortality rates and for whom there are serious concerns about the quality of care that is provided will be shared with the leadership of the hospital department in which that provider operates, and with the Board of Registration in Medicine, the licensing body for physicians. The Department will continue to collect, monitor, and validate patient-specific outcome data from all hospitals that perform cardiac surgery or PCI.

The data collection, verification, audit, and analytical procedures implemented in this report constitute the most comprehensive, reliable, and rigorous used in the United States. This is
due in no small part to the dedicated work of the hospital data managers and cardiac surgeons, many of whom volunteered their efforts to participate in many late night meetings to review and adjudicate data. I would also like to thank staff from the Board of Registration in Medicine and the Massachusetts Chapter of the Society of Thoracic Surgeons for their ongoing support, and of course, all the staff at Massachusetts Data Analysis Center (Mass-DAC) for their hard work and dedication.

Madeleine Biondolillo, M.D.
Director
Bureau of Health Care Safety and Quality
Massachusetts Department of Public Health
2 Key Findings: Hospitals

- In the period October 1, 2010 through September 30, 2011 (fiscal year 2011), there were 6,644 hospital admissions in Massachusetts in which at least one cardiac surgery was performed.
  
  - 42.7% of the admissions involved isolated coronary artery bypass graft (CABG) surgery.
- In the 14 hospitals that performed cardiac surgery during fiscal year 2011, the number of isolated CABG surgery admissions ranged from 86 to 356.
- The unadjusted 30-day all-cause mortality rate (defined as the number of patients dying within 30 days of surgery from any cause divided by the number of isolated CABG surgery admissions) in Massachusetts during fiscal year 2011 was 0.99%. This corresponded to 28 deaths out of 2,840 isolated CABG admissions.
- After adjusting for patient risk, the risk of 30-day mortality in a hospital one standard deviation above the state average was 2.59 times that of a hospital one standard deviation below the state average.
- In fiscal year 2011, no hospital was identified as a statistical outlier for isolated coronary artery bypass surgery.
3 Introduction

3.1 What is in this Report?

This report describes procedures for calculating hospital-specific risk-standardized 30-day mortality rates following isolated coronary artery bypass graft (CABG) surgery performed in Massachusetts hospitals in the period October 1, 2010 through September 30, 2011 (fiscal year 2011). Surgeries performed in federal hospitals (e.g., VA Boston Healthcare System–Jamaica Plain Campus) are not included in this report. Information pertains to patients who were 18 years of age or older at the time of surgery.

Not all hospitals in Massachusetts are permitted to perform cardiac surgery. Hospitals wishing to establish a new cardiac surgery program must submit an application to the Determination of Need Program in the Massachusetts Department of Public Health. In fiscal year 2011, there were 14 cardiac surgery programs in Massachusetts, each of which submitted data to Mass-DAC.

This document is the tenth report (www.massdac.org/reports/surgery.html) describing hospital-specific risk-standardized mortality rates following isolated CABG surgery in Massachusetts. It describes risk-standardized mortality rates for the 14 cardiac surgery programs in Massachusetts that performed at least one isolated CABG surgery during October 1, 2010 through September 30, 2011.

3.2 What is Coronary Artery Bypass Surgery?

For a heart to function properly, it needs an oxygen-rich blood supply. Coronary arteries send oxygen-rich blood to the heart. When the coronary arteries are healthy, blood flows easily so that the heart muscle gets the oxygen it needs. Coronary artery disease begins when blood flow to the heart is reduced due to plaque buildup. Plaque may build up because of high cholesterol,
high blood pressure, smoking, diabetes, genetic predisposition, or other factors. As the plaque buildup increases, the coronary arteries narrow and blood flow to the heart is reduced, often leading to angina (chest pain, arm pain, or jaw tightness that occurs with exertion, or in more serious cases, at rest). If blood flow is completely blocked by the sudden development of a clot within a coronary artery, the presence of the clot usually results in a heart attack or myocardial infarction (MI), which may irreversibly damage the heart muscle.

Coronary artery disease is usually treated by one of three methods: medication, coronary intervention, or cardiac surgery. The choice of treatment depends on the degree of blockage, patient symptoms, and the number of coronary arteries involved. CABG surgery is a type of cardiac surgery that creates a new route or bypass around the blocked part of the artery, allowing the blood flow to reach the heart muscle again. During CABG surgery, the blocked coronary arteries are bypassed using some of the patient’s own blood vessels. The internal mammary arteries are commonly used for the bypass, but the saphenous vein in the leg or the radial artery in the arm can also be used. Surgical procedures in which CABG surgery is the only major heart surgery performed are referred to as isolated CABG procedures.

### 3.3 Definition of Study Population

The patient population includes all patients aged 18 years or older undergoing isolated CABG surgery in Massachusetts adult acute care non-federal hospitals in the period October 1, 2010 through September 30, 2011. If multiple cardiac surgeries occur during an admission, admissions are categorized by the primary (initial) surgery. Isolated CABG surgery includes CABG alone as well as CABG undertaken in combination with the following procedures: maze (closed epicardial approach and radio frequency), pacemaker lead insertions, ventricular lead insertion for automatic implantable cardioverter defibrillator, patent foramen ovale closure, and femoral artery procedures. If CABG is performed in combination with maze (open heart approach), im-
plantation of a cardioverter defibrillator, transmyocardial revascularization, or opening of the right atrium for tumor resection, then these surgeries are classified as “Other Cardiac Surgery.” Lung biopsies performed in conjunction with a CABG are considered on a case by case basis (see Appendix A, pg. 46). Table 3.1 lists the distribution of the 6,644 cardiac surgery admissions stratified by surgical procedure type in Massachusetts hospitals during fiscal year 2011.

### 3.4 Why Report on CABG Surgery?

CABG surgeries are costly procedures that account for the majority of cardiac surgeries performed nationally. In fiscal year 2011, isolated CABG surgeries accounted for 42.7% of all cardiac surgery hospital admissions in Massachusetts. Only data on patients who have undergone isolated CABG surgery are used to determine the mortality rates in this report.

### 3.5 What is Mass-DAC?

Mass-DAC is a data-coordinating center responsible to the Massachusetts Department of Public Health for the collection, storage, cleaning, and analysis of the cardiac data submitted by Massachusetts hospitals. Mass-DAC is located in the Department of Health Care Policy within Harvard Medical School in Boston (www.massdac.org). Mass-DAC is advised by several committees on an ongoing basis, including the Massachusetts Cardiac Care Hospital Outlier

<table>
<thead>
<tr>
<th>Surgical Procedure Type</th>
<th>No. of Admissions</th>
<th>% of Admissions</th>
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<tr>
<td>Isolated CABG</td>
<td>2,840</td>
<td>42.75</td>
</tr>
<tr>
<td>Mitral Valve Replacement (MVR)</td>
<td>176</td>
<td>2.65</td>
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<td>Aortic Valve Replacement (AVR)</td>
<td>934</td>
<td>14.06</td>
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<td>MVR and CABG</td>
<td>63</td>
<td>0.95</td>
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<td>AVR and CABG</td>
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<td>AVR and MVR</td>
<td>49</td>
<td>0.74</td>
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<td>Other Cardiac Surgery</td>
<td>1,892</td>
<td>28.48</td>
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<td>Non-Cardiac (Thoracic) Procedures</td>
<td>49</td>
<td>0.74</td>
</tr>
<tr>
<td>Mitral Valve Repair</td>
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<td>0.74</td>
</tr>
<tr>
<td>Mitral Valve Repair and CABG</td>
<td>42</td>
<td>0.63</td>
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**Table 3.1: Surgical Procedure Type Classification of Adult Cardiac Surgeries: Oct 1, 2010–Sep 30, 2011**

<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>No. of Admissions</th>
<th>% of Admissions</th>
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<tbody>
<tr>
<td>All Cardiac Surgery Admissions</td>
<td>6,644</td>
<td>100.00</td>
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Committee, the Cardiac Surgery Physician Reporting Committee, and the Cardiac Surgery Data Adjudication Committee. In addition, the national Society of Thoracic Surgeons (STS) and the Massachusetts STS serve as resources.

Starting July 2011, the STS version 2.73 data collection tool added two new procedure type classifications, Mitral Valve (MV) Repair, and MV Repair and CABG. These two procedure type classifications were included in the STS version 2.61 Other Cardiac Surgery classification.

3.6 Software Utilized in Analysis

The data collection and analysis for this report utilized three different statistical software applications;

- SAS®, versions 9.2 and 9.3 Unix/Windows [5],

- WinBUGS version 1.4 [11],

- R version 2.6 [4].

The data collection process utilized Base SAS to aggregate the core data elements for the analytic data sets. The statistical analysis used a combination of SAS/Stat, WinBugs, and R to generate the results in this report. SAS Institute Inc. and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.
4 Summary of Data Collection and Verification Procedures

4.1 Definition of Patient Outcome

Mortality, regardless of cause and measured within 30 days of the date of CABG surgery, is the primary patient outcome. Mortality was selected as the primary measure of quality because it is serious and unambiguous.

4.2 Massachusetts Cardiac Surgery Programs

Fourteen cardiac surgery centers treated patients in Massachusetts in the period October 1, 2010 through September 30, 2011.

4.3 Data Sources

Four different data sources were used to create this report:

- The Mass-DAC cardiac surgery patient-specific data collected using the Society of Thoracic Surgeons (STS) National Cardiac Surgery data collection tool [6, 7, 9, 10];
- Hospital administrative discharge billing data [2] from the Massachusetts Center for Health Information and Analysis;
- Vital statistics information [3] from the Massachusetts Registry of Vital Records and Statistics; and
- The Mass-DAC PCI procedures database with data collected using the American College of Cardiology–National Cardiovascular Data Registry (ACC-NCDR–CathPCI) data collection tool [1].
4.3.1 Mass-DAC STS Data

Patient-specific risk factor and outcome data were collected by hospital personnel using two STS National Cardiac Surgery data collection tools. For surgery dates from October 2010 through June 2012, version 2.61 (see Appendix B), containing 349 variables, was used. For surgery dates from July 2011 through September 2011, version 2.73 (see Appendix C), containing 788 variables, was used.

4.3.2 Massachusetts Inpatient Acute Hospital Case Mix and Charge Database

Hospital discharge data for Fiscal Years 2002 through 2011 (October 1, 2001 through September 30, 2011) were obtained from the Massachusetts Center for Health Information and Analysis. Data elements include hospital identifier, sex, race, age, patient’s zip code, up to 15 diagnoses and up to 15 procedure codes, discharge status, dates of admission and discharge, date of surgery, and patient medical record number. Social Security numbers were removed from this database. Data were used for validation of surgery volume.

4.3.3 Massachusetts Mortality Index Database

Death date information obtained from Massachusetts Registry of Vital Records and Statistics was available for deaths occurring in Massachusetts between January 1, 2002, and October 30, 2011. While the primary source of 30-day mortality was the hospital-reported information, the mortality index database was employed as a verification tool. Using a confidential and secure transmission procedure, Mass-DAC submitted to the Registry, patient names, dates of birth, and Social Security numbers for all Mass-DAC patients, regardless of hospital-reported survival status. Registry personnel subsequently linked the data submitted by Mass-DAC to the Registry
mortality index database using these variables and supplied Mass-DAC with the date of death for all applicable patients.

4.4 Mass-DAC Data Collection Procedures

The majority of Massachusetts hospitals used clinical staff, such as physicians, nurses, and perfusionists, to collect information. Data were entered directly into the STS vendor software database by the clinical staff or by a data manager. Alternatively, the data manager collected the STS information under the direction of clinical staff and then entered the data following a retrospective chart review. Data managers were also responsible for maintaining their hospital database, ensuring the accuracy of the data, and transmitting data to both the STS and Mass-DAC.

Data were regularly transmitted by hospitals and harvested by Mass-DAC (Table 4.1). This process involved submitting protected data during specific harvest periods. Hospitals encrypted and password-protected the data, and transmitted it electronically using a secure repository on a secure website. Hospitals submitted subsequent corrected data as often as desired during the three months following a harvest, and they could sign off on its accuracy and completeness at any time during that period. However, all fiscal year 2011 cardiac surgery data were required to be complete by April 1, 2012, after which no changes were accepted without written permission from Mass-DAC.

Table 4.1: Fiscal Year 2011 Cardiac Surgery Data Harvest Schedule

<table>
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<th>Harvest Month</th>
<th>Corresponding Dates of Cardiac Surgery</th>
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<td>March 2011</td>
<td>October 1, 2010–December 31, 2010</td>
</tr>
<tr>
<td>September 2011</td>
<td>April 1, 2011–June 30, 2011</td>
</tr>
<tr>
<td>December 2011</td>
<td>July 1, 2011–September 30, 2011</td>
</tr>
<tr>
<td>April 2012</td>
<td>Final close date for fiscal year 2011 data</td>
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</table>
4.5 Cleaning and Validation Procedures

Hospital data submissions were cleaned and verified using a variety of procedures, including continuous feedback via ongoing data quality reports, meetings and communication, and reviews of concordance with administrative datasets and medical chart audits.

4.5.1 Hospital-Specific Data Quality Reports

For each data submission, Mass-DAC provided a data quality report to each hospital describing the distribution of all STS variables and identifying cases with missing, out of usual range, or inconsistent coding. The hospitals were given 30 days to correct the data deficiencies identified by Mass-DAC following receipt of each data quality report. There were a total of 140 data submissions sent by 14 hospitals during fiscal year 2011 with a mean of 2.5 submissions per hospital per collection period. Data submissions for fiscal year 2011 ranged from 1 to 6 per hospital per collection period.

4.5.2 Massachusetts Administrative Datasets

Mass-DAC found high agreement between the hospital report of 30-day mortality and information linked to Massachusetts vital records. After verifying the mortality status of these patients, three cases were changed to 30-day mortalities, none of which were isolated CABG patients.

The Massachusetts inpatient case mix data was used as an additional method in determining whether all appropriate cases of cardiac surgery from each institution were submitted to Mass-DAC. Seven cases were found in the case mix data that had not been submitted to the Mass-DAC database. The seven cases were confirmed with each hospital, the data submitted, and included in the Mass-DAC database. Three of the seven cases were isolated CABGs.
4.5.3 Meetings and Communication

Mass-DAC communicated regularly via email and telephone with the data managers to clarify definitions or procedural issues, resolve data submission concerns, and to serve as a facilitator to the national STS. Data managers were given the opportunity to ask and discuss questions at data manager meetings or through an email network. Results were shared at the Mass-DAC Data Manager meetings. This process helped identify areas where data may be inconsistent, incorrectly coded, or outlying.

4.5.4 Audit Data

In the spring and again in the fall of 2011, a sample of the fiscal year 2011 isolated CABG data was audited. Twelve cardiac surgeons and two data managers, representing 9 of the 14 cardiac surgery programs, volunteered for the Adjudication Committee to perform audits. All participants underwent mandatory human subjects training prior to participating and were approved by the Harvard Medical School Institutional Review Board. Records requested from the hospitals included those for:

1. All isolated coronary artery bypass graft (CABG), isolated aortic valve replacement (AVR), or isolated mitral valve replacement (MVR) patients coded as a death within 30 days of surgery;

2. Those admissions coded as having an “other” cardiac procedure in combination with one of the following: isolated CABG, AVR, or MVR (to determine if those should have been coded as an isolated CABG, AVR, or MVR) that resulted in death within 30 days of surgery;

3. All isolated CABG, AVR, or MVR patients coded as having shock prior to surgery;
4. All isolated CABG, AVR, or MVR patients coded with emergent or emergent salvage status;

5. All isolated CABG, AVR, or MVR patients coded as having a myocardial infarction (MI) less than 24 hours prior to surgery;

6. All isolated CABG, AVR, or MVR patients coded as having dialysis prior to surgery; and

7. A sample of isolated CABG, AVR, or MVR patients coded as not having ejection fraction evaluated prior to surgery.

For the variable audit, 284 records were requested from the 14 hospitals. The records were reviewed to determine data consistency and accuracy of coding.

An additional 328 records were requested for a subset of surgery admissions having CABG + other or valve + other surgery (see Appendix A, pg. 46, Procedure Identification Guidelines for Adult Cardiac Surgery, which outlines the rules used by Mass-DAC for classifying surgeries as isolated CABG versus CABG + other). These records were reviewed for the procedure audit to determine if some might be considered isolated CABG surgery or isolated valve surgery. Documentation requested from the hospitals included discharge summaries, operative reports, anesthesia records, admission and history summaries, and catheterization reports. Records that were reviewed and identified by the auditors to be isolated CABG or isolated valve procedures were then also reviewed for the variables of shock, emergent or emergent salvage status, MI within 24 hours of surgery, dialysis, and ejection fraction not done.

In all, 602 records (10 records included in both variable and procedure audits) were reviewed by the Adjudication Committee to determine agreement with the information submitted by the hospitals. If the Adjudication Committee did not agree with the coding of the presence of shock, emergent status, emergent salvage status, dialysis, or MI less than 24 hours before surgery, the coding was changed. Hospitals were notified of any disagreement in coding and given an oppor-
tunity to appeal the Adjudication Committee decisions. All changes made by the Adjudication Committee for the census (100% audited) variables were then made in the Mass-DAC database. Because the Adjudication Committee did not review every case coded with ejection fraction not done, Mass-DAC did not make any changes to the submitted values for that variable in the database, regardless of the Adjudication Committee decisions.

Table 4.2 summarizes changes that were made. For example, 38% of admissions coded as having shock, 11% of admissions coded as emergent, and 33% of admissions coded as \textit{CABG + other} were changed.

\textbf{Table 4.2: Summary of Census Variable and Procedure Adjudication}

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Total Reviewed</th>
<th>Final Adjudicated Status</th>
<th>Number</th>
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<tbody>
<tr>
<td>Shock</td>
<td>39</td>
<td>Shock (no change)</td>
<td>24</td>
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<td></td>
<td></td>
<td>No Shock</td>
<td>15</td>
</tr>
<tr>
<td>Emergent</td>
<td>99</td>
<td>Elective</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>Urgent</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emergent (no change)</td>
<td>88</td>
</tr>
<tr>
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<td>Emergent Salvage (no change)</td>
<td>0</td>
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<tr>
<td>Emergent Salvage</td>
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<td>Emergent Salvage (no change)</td>
<td>0</td>
</tr>
<tr>
<td>MI within 24 Hours of Surgery</td>
<td>87</td>
<td>No MI</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MI &lt;24 Hours (no change)</td>
<td>75 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MI ≥24 Hours</td>
<td>a</td>
</tr>
<tr>
<td>Dialysis</td>
<td>72</td>
<td>Dialysis (no change)</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Dialysis</td>
<td>a</td>
</tr>
<tr>
<td>CABG + other</td>
<td>133</td>
<td>Isolated CABG</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CABG + other (no change)</td>
<td>89</td>
</tr>
<tr>
<td>Valve + other</td>
<td>195</td>
<td>Isolated Valve</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valve + other (no change)</td>
<td>127</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Frequencies from 1 to 6 suppressed as required by the Massachusetts Department of Public Health data security guidelines.
5 Risk Adjustment

5.1 Who Receives Isolated CABG Surgery in Massachusetts?

Table 5.1 on page 16 lists the age/sex/race distribution for 2,840 adult isolated CABG surgery patients at 14 cardiac surgery programs in Massachusetts. The STS data collection tool allows patients to be identified with more than one race; in addition, Hispanic is an ethnicity choice and is separate from the race designations. Patients not selecting any race designation are defined as “Other Race.” The majority of patients were male (77.9%). In fiscal year 2011, 56.5% of the admissions corresponded to patients aged 65 years of age or older at the time of surgery. Patients who resided outside of Massachusetts at the time of surgery comprised 9.6% of the 2,840 CABG admissions (data not shown).

5.2 Risk Adjustment for Assessing Hospital Mortality

Specific risk factors are known to contribute to heart disease. These risk factors include high cholesterol, smoking, high blood pressure, family history of heart disease, diabetes, age, gender, and general health status. Such factors have an impact on the risk of mortality following CABG surgery. Such factors also have an impact on the risk of mortality following surgery. Sicker patients or patients with more health-related risks may be more likely to die following a CABG surgery than healthier patients. Moreover, patients who are sicker may be more likely to be treated at particular hospitals while patients who are healthier may be more likely to be treated at other hospitals. To fairly assess hospitals and avoid penalizing hospitals that treat sicker patients, it is important to consider differences in a patient’s health prior to surgery. Mass-DAC selects risk factors for the annual report based on advice obtained from its Senior Medical Advisors, Mass-DAC surgeon committees, as well as the Massachusetts STS.
Table 5.1: *Demographic Distribution for All Adult Isolated CABG Surgery Admissions (N = 2,840) in Massachusetts Hospitals: Oct 1, 2010–Sep 30, 2011.*

Note: Patients may select more than one race category. The Hispanic Ethnicity category is independent of the race categories and may be selected in addition to a race.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total by Age</th>
<th>White</th>
<th>African American</th>
<th>Other Race</th>
<th>Hispanic Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–44</td>
<td>48</td>
<td>≤64</td>
<td>917</td>
<td>35</td>
<td>74</td>
</tr>
<tr>
<td>45–54</td>
<td>288</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55–64</td>
<td>688</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>699</td>
<td>≥65</td>
<td>1,120</td>
<td>23</td>
<td>48</td>
</tr>
<tr>
<td>≥75</td>
<td>489</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,212</td>
<td></td>
<td>2,037</td>
<td>58</td>
<td>122</td>
</tr>
</tbody>
</table>

| Female    |              |       |                 |            |                   |
| 18–44     | 10           | ≤64   | 185             | 12         | 13                | 12               |
| 45–54     | 54           |       |                 |            |                   |
| 55–64     | 146          |       |                 |            |                   |
| 65–74     | 218          | ≥65   | 386             | 20         | 19                | 10               |
| ≥75       | 200          |       |                 |            |                   |
| Total     | 628          |       | 571             | 32         | 32                | 22               |

| Total Male and Female |          |       |                 |            |                   |
| 18–44     | 58           | ≤64   | 1,102           | 47         | 87                | 58               |
| 45–54     | 342          |       |                 |            |                   |
| 55–64     | 834          |       |                 |            |                   |
| 65–74     | 917          | ≥65   | 1,506           | 43         | 67                | 36               |
| ≥75       | 689          |       |                 |            |                   |
| Total     | 2,840        |       | 2,608           | 90         | 154               | 94               |

The statistical process of accounting for differences in patient sickness prior to surgery is called risk adjustment. This statistical process aims to “level the playing field” by accounting for health risks that patients have prior to surgery. The hospital-specific 30-day mortality rates in this report have been adjusted in order to account for patient health prior to surgery. The numbers reported compare each hospital’s mortality rate to what would be expected to happen given the health of patients undergoing surgery in its program. The numbers are not designed to provide
comparisons between pairs of hospitals—such comparisons would only be valid to the extent that
the pairs of hospitals treated patients with very similar health status prior to surgery.

5.3 How are Hospital Differences in Patient Outcomes Measured?

If there are differences in hospital quality, due to staff, experience, or other factors, then the risks
of 30-day mortality for two patients having exactly the same risk factors prior to a CABG surgery
but who are treated in different hospitals should be different. The statistical model used to cal-
culate mortality rates in this report, a hierarchical Poisson regression model, permits a difference
to exist between the risks of mortality for patients with the same risk factors treated at different
hospitals. This is accomplished by including a hospital-specific (random) effect. If no key risk
factor that varies by hospital is missing from the statistical model, then the hospital-specific ran-
dom effect represents quality for each hospital. If there are no differences in the hospital-specific
effects across the hospitals, then there is no evidence of quality differences.
6 Identifying Outlying Cardiac Surgery Programs

One of the purposes of this report is to identify hospitals that have unusually high or unusually low mortality rates. Such hospitals are denoted as “outlying”—however, the designation of outlying depends on how large the difference is. Two methods are used to identify outlying hospitals. The first method calculates a 95% interval estimate for each hospital’s risk-standardized mortality rate. If the interval estimate excludes the Massachusetts unadjusted 30-day mortality rate, the hospital is designated as “outlying.”

Because any one hospital could influence the estimates of the risk-standardized mortality rate for other hospitals, Mass-DAC also calculates the expected number of mortalities at each hospital using the experience of all other hospitals in Massachusetts. If it is unlikely that the actual number of mortalities observed at a hospital and the number of mortalities predicted using the combined experience of all Massachusetts hospitals except the hospital under study is the same, then the hospital is classified as “outlying.” We refer to the measure of the likelihood of this event as a cross-validated p-value. Intuitively, this strategy provides a quantitative measure of how likely the hospital’s outcome is compared to its peers.

If the 95% interval estimate for a particular hospital excludes the Massachusetts unadjusted 30-day mortality rate or if the probability of the observed mortality predicted from all other hospitals for a particular hospital is small, then the hospital is designated as outlying. It is important to note that the classification in this report is relative to all hospitals in Massachusetts performing isolated CABG surgery. For example, a Massachusetts hospital identified as having higher (or lower) than expected mortality based on our analysis may not be classified as having higher (or lower) than expected mortality compared to hospitals outside of Massachusetts.
6.1 Standardized Mortality Incidence Rates (SMIR)

Mass-DAC calculated a standardized mortality incidence rate (SMIR) and a corresponding 95% posterior interval for each hospital. The SMIR is interpreted as the projected mortality rate at the hospital today if hospital quality remained the same as in Fiscal Year 2011. The SMIR consists of an estimate of the hospital’s underlying (true) risk-adjusted rate divided by an estimate of the mortality rate expected at the hospital given its case mix. Each hospital’s SMIR should only be interpreted in the context of its posterior interval. If the 95% interval includes the unadjusted Massachusetts mortality rate, then the hospital mortality is not different than expected. If the interval excludes the Massachusetts unadjusted rate, then the hospital is an outlier. In this case, if the upper limit of the interval is lower than the unadjusted Massachusetts rate, then fewer patients than expected died. Such a hospital would be categorized as having lower than expected mortality. If the lower limit of the interval is higher than the Massachusetts unadjusted rate, then more patients than expected died. Such a hospital would be categorized as having higher than expected mortality.

Hospital-specific 30-day mortality rates, standardized to the population of adults undergoing isolated CABG surgery in Massachusetts hospitals, were calculated using the following procedure:

1. A hierarchical Poisson regression model was estimated that assumes the log of 30-day mortality is related linearly to the set of risk factors and permits baseline risk to vary across hospitals. Let $Y_{ij} = 1$ if the $j^{th}$ patient treated at the $i^{th}$ CABG hospital died within 30 days of CABG surgery and 0 otherwise, and let $n_i$ equal the total number of CABG surgery admissions at the hospital. The model estimated had the general form:

$$\log[\text{Probability}(Y_{ij} = 1)] = \beta_0i + \beta(\text{Risk Factors})_{ij}$$  \hspace{1cm} (1)

where $\beta_0i \sim \text{Normal}(\mu, \tau^2)$  \hspace{1cm} (2)
The parameters, $\mu$ and $\tau^2$ represent the overall mean risk-adjusted log of mortality and between-hospital variation, respectively. If there are no mortality differences based on 30-day mortality across the 14 CABG surgery hospitals after adjusting for patient risk, then

$$\beta_{0,1} = \beta_{0,2} = \cdots = \beta_{0,14} = \beta_0 \quad \text{and this happens if and only if} \quad \tau^2 = 0 \quad (3)$$

The hierarchical regression models were estimated using WinBUGS software. The prior distributions assumed for $\beta$, $\mu$, and $\tau^2$ were, respectively: independent normal distributions with mean 0 and variance 1,000 for the components of $\beta$; $\mu$ from a normal distribution with mean 0 and variance 1,000. We assumed that between-hospital standard deviation, $\tau$, arose from a half normal distribution with mean 0 and variance 0.26. This half normal distribution has its mode at 0, permitting no differences in between-hospital log-odds of mortality, but has a median of 0.39, permitting the range in the log-odds of 30-day mortality to be as large as 5. We vary these parameters as part of a sensitivity analysis. The hierarchical Poisson regression models were estimated using the WinBUGS software. A burn-in of 100,000 draws was used and conclusions were based on an additional 5,000 draws. Convergence of the model was assessed using the Gelman-Rubin statistic via three parallel chains.

2. The risk factors are those listed in Table 7.1. The term $\beta$ describes the association of each risk factor and log(30-day mortality). Large values of $\beta$ indicate that patients with the particular risk factor are at higher risk of dying compared to patients without the risk factor.
3. The expected mortality rate at hospital $i$, $\pi_i$, is:

$$\pi_i = \frac{\sum_{j=1}^{n_i} \exp[\mu + \beta \text{(Risk Factors)}_{ij}]}{n_i}$$

(4)

This is the mortality rate expected at hospital $i$ using the mortality intensity for the entire state, $\beta$, and the case mix reported at the hospital, $(\text{Risk Factors})_{ij}$. Thus, it represents the severity of cases at the institution.

4. The observed mortality rate at hospital $i$, $p_i$, is:

$$p_i = \frac{\sum_{j=1}^{n_i} \exp[\beta_0 i + \beta \text{(Risk Factors)}_{ij}]}{n_i}$$

(5)

This is interpreted as the mortality rate at the $i^{th}$ hospital adjusted for case mix. This mortality rate is not the actual observed rate but rather a smoothed rate. The estimate weights the observed mortality rate by the amount of information available at the hospital relative to the amount of information available between hospitals. Because the model assumes that the probability of dying is greater than 0, the smoothed estimate must be greater than 0.

5. The Massachusetts unadjusted 30-day mortality rate is:

$$\bar{Y} = 100 \times \frac{\sum_{i} \sum_{j} Y_{ij}}{\sum_{i} n_i}$$

(6)

6. The standardized mortality incidence rate (SMIR) at institution $i$ is:

$$\text{SMIR}_i = \bar{Y} \times \frac{p_i}{\pi_i}$$

(7)

The SMIR is interpreted as the projected mortality rate at the hospital today if hospital quality remained the same as in Fiscal Year 2011.

7. Ninety-five percent posterior intervals were calculated for each hospital’s SMIR.
6.2 Cross-Validated P-Values

Because data from all hospitals are used to estimate the expected number of deaths in any hospital, there is a risk that outlying hospitals may influence the estimates of $\mu$ and, in particular, $\tau^2$. One method to avoid this risk involves identifying hospitals as outlying through “cross-validation”. This process involves systematically dropping each hospital from the data set and re-estimating the risk-adjusted model. Using the new model, the predicted number of deaths at the dropped hospital is calculated. This predicted number may be interpreted as the number of mortalities expected at the dropped hospital if the dropped hospital had the same level of quality as the remaining Massachusetts hospitals.

Mass-DAC compared the predicted number of deaths to the actual number of deaths at the dropped hospital and calculated a posterior probability. This probability, loosely called a posterior “p-value,” quantifies how likely the observed number of deaths would be if the dropped hospital had the same level of quality as all remaining isolated CABG hospitals. Small p-values (those $\leq 0.01$) indicate that the dropped hospital is outlying. When the p-value is small and the actual number of deaths is larger than that predicted by the remaining hospitals, the dropped hospital is classified as having higher than predicted mortality. When the p-value is small and the actual number of deaths is smaller than predicted by its peers, then the hospital is classified as having lower than predicted mortality. Mass-DAC eliminated each isolated CABG hospital from the data set, re-estimated the regression parameters, predicted mortality at the eliminated hospital, and calculated a posterior probability of the comparison of the observed mortality and the predicted mortality. The eliminated hospital was replaced into the data set, and Mass-DAC eliminated another hospital from the data set, repeating the entire process.
6.3 Sensitivity Analyses

Several sensitivity analyses were undertaken to determine whether conclusions would change when making reasonable changes to some of the underlying assumptions. A key assumption, given the small number of hospitals in Massachusetts, is the assumed distribution for the between-hospital variance. The parameter $\tau$ represents the standard deviation of the hospital-specific risk-adjusted log(mortality) and $\tau^2$ represents between-hospital variance. The main analyses assumed that $\tau$ arose from a half normal distribution with mean 0 and variance 0.26. Mass-DAC re-estimated the hierarchical model using different prior distributions for $\tau^2$ to determine how sensitive results are to the assumed prior distribution of the variance component.

1. We assumed that the between-hospital standard deviation arose from a uniform distribution over the range 0 to 1.5. This translates to assuming that small values in between-hospital heterogeneity are just as likely as large values.

2. We assumed a vague prior distribution for the precision, $\frac{1}{\tau^2}$. Specifically, we assumed the precision parameter arose from a highly dispersed Gamma distribution having scale parameter 0.001 and rate parameter 0.001.
7 Hospital Quality Following Isolated CABG Surgery: Fiscal Year 2011

Of the 2,840 isolated CABG surgery admissions in fiscal year 2011 in Massachusetts, 28 patients (0.99%) died within 30 days of their surgery. Table 7.1 lists the prevalence (as a percentage) of important risk factors and the relationship of each risk factor (controlling for all other risk factors) to 30-day mortality following surgery. For example, 1.76% of the 2,840 isolated CABG surgery admissions were associated with patients who had a prior CABG surgery. Relative risks greater than 1 correspond to increased risk of mortality while those less than 1 correspond to decreased risk of mortality. The relative risk of 1.96 for those having a prior CABG surgery indicates that those with such a history are almost twice as likely as those not having a prior CABG surgery to die within 30 days of CABG surgery. Patients coded in cardiogenic shock prior to isolated CABG surgery are 14.87 times more likely to die within 30 days than patients not coded as in cardiogenic shock. Because age is measured in years, the table reports the average number of years over age 65 for the cohort.

The estimate of between-hospital variation after adjusting for patient case mix is 0.226. This may be interpreted as indicating that the risk of dying if admitted to a Massachusetts cardiac surgery program one standard deviation above the state mean is 2.59 times that of dying if admitted to a program one standard deviation below the state mean. The estimated area under the ROC curve is 0.77 (Figure 7.1).

![Figure 7.1: ROC Curve-Hierarchical: Isolated CABG Cohort](image-url)
Table 7.1: Prevalences and Relative Risks of 30-Day Mortality Following Isolated CABG Surgery in Adults: Oct 1, 2010–Sep 30, 2011. Based on 2,840 surgeries with 28 deaths (0.99%).

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Prevalence (%)</th>
<th>Relative Risk</th>
<th>95% Interval for Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years over 65</td>
<td>1.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.04</td>
<td>(1.00, 1.09)</td>
</tr>
<tr>
<td>Renal Failure–Dialysis</td>
<td>2.01</td>
<td>4.33</td>
<td>(0.90, 11.24)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>40.28</td>
<td>1.37</td>
<td>(0.58, 2.75)</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>15.63</td>
<td>3.19</td>
<td>(1.27, 6.47)</td>
</tr>
<tr>
<td>Prior CABG Surgery</td>
<td>1.76</td>
<td>1.96</td>
<td>(0.05, 7.85)</td>
</tr>
<tr>
<td>Cardiogenic Shock</td>
<td>0.53</td>
<td>14.87</td>
<td>(0.96, 68.46)</td>
</tr>
<tr>
<td>Ejection Fraction $&lt;30%$</td>
<td>6.27</td>
<td>0.92</td>
<td>(0.15, 2.69)</td>
</tr>
</tbody>
</table>

Status of CABG (Ref = Elective)
- Urgent: 59.68, 1.51, (0.57, 3.56)
- Emergent or Emergent Salvage: 2.78, 3.70, (0.28, 12.60)

**Between-Hospital Parameters**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>95% Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between-Hospital Average  log, $\mu$</td>
<td>-5.76</td>
<td>(-6.78, -4.90)</td>
</tr>
<tr>
<td>Between-Hospital Variance in logs, $\tau^2$</td>
<td>0.226</td>
<td>(7.533×10&lt;sup&gt;-5&lt;/sup&gt;, 1.124)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Average age of patients undergoing isolated CABG surgery is 65 + 1.32 = 66.32 years of age. For age, the mean is used instead of prevalence because age is continuous and not categorical.
Figure 7.2: Ninety-Five Percent Posterior Intervals for Standardized 30-Day Mortality Incidence Rates (SMIRs) Following Isolated CABG Surgery in Massachusetts: Oct 1, 2010–Sep 30, 2011

# of cases refers to the number of isolated CABG surgery admissions; expected mortality is the percentage of cases expected to die given the case mix of the patients treated in the hospital. The white vertical line in each box is the hospital’s SMIR while the black vertical line denotes the unadjusted Massachusetts 30-day mortality rate of 0.99%.

HOSPITAL KEY:
B&W = Brigham and Women’s Hospital; BIDMC = Beth Israel Deaconess Medical Center; BMC = Boston Medical Center; Baystate = Baystate Medical Center; Cape Cod = Cape Cod Hospital; Charlton = Southcoast Hospital Group–Charlton Memorial Hospital; Lahey = Lahey Hospital & Medical Center; MGH = Massachusetts General Hospital ; Mt. Auburn = Mount Auburn Hospital; Salem = North Shore Medical Center–Salem Hospital; St. Elizabeth’s = Saint Elizabeth’s Medical Center; St. Vincent = Saint Vincent Hospital; TMC = Tufts Medical Center; UMass = UMass Memorial Medical Center.

Figure 7.2 displays the SMIRs and corresponding 95% posterior intervals. The solid black vertical line in the figure is the unadjusted state 30-day mortality rate of 0.99%. Listed on the left-hand side of the figure are the total number of isolated CABG surgery admissions and the expected 30-day mortality rates for each hospital. The expected mortality rate provides an overall assessment of case mix severity at each program. Increasing values of the expected 30-day
mortality rates correspond to increasing admission severity. Listed on the right-hand side are the estimated SMIRs. All 95% posterior intervals (horizontal boxes) include the unadjusted Massachusetts rate of 0.99%.

**Figure 7.3:** Cross-Validated P-Values: Isolated Cardiac Surgery Admissions: Oct 1, 2010–Sep 30, 2011.

Posterior probabilities (p-values) of observed with predicted mortality for each of the 14 cardiac surgery programs are listed on the y-axis; the x-axis identifies the hospital. Results present the half normal prior for fitting the hierarchical regression model.

```
HOSPITAL KEY:

B&W = Brigham and Women’s Hospital; BIDMC = Beth Israel Deaconess Medical Center; BMC = Boston Medical Center;
Baystate = Baystate Medical Center; Cape Cod = Cape Cod Hospital; Charlton = Southcoast Hospital Group–Charlton Memorial Hospital;
Lahey = Lahey Hospital & Medical Center; MGH = Massachusetts General Hospital ; Mt. Auburn = Mount Auburn Hospital; Salem = North Shore Medical Center–Salem Hospital; St. Elizabeth’s = Saint Elizabeth’s Medical Center; St. Vincent = Saint Vincent Hospital; TMC = Tufts Medical Center; UMass = UMass Memorial Medical Center.
```

Figure 7.3 presents the cross-validated posterior probabilities (p-values) where the reference line on the graph at 0.01 indicates the cutoff for outliers based on the p-value. Any hospital with a bar entirely under this line is considered to be different than predicted. The cross validated p-values indicate that there were no cardiac surgery program outliers in fiscal year 2011.
8 Annual Hospital 30-Day Mortality Trends Following Isolated CABG Surgery in Massachusetts: January 1, 2002 through September 30, 2011

8.1 Key Changes in Reporting

- FY 2006:
  1. Cohorts analyzed over a fiscal year October–September instead of a calendar year January–December.
  2. The number of categories for the MI variable was reduced from five to three in the hospital model.

- FY 2007:
  1. Admissions coded with shock, emergent status, or emergent salvage status were removed from the surgeon cohort.

- FY 2008:
  1. Renal failure was replaced with dialysis as a risk factor.
  2. Patients for whom ejection fraction (EF) was not done or its value missing were included with the reference group in the model, while the model variable EF<30 or missing or not done was changed to EF<30.
  3. Intra-aortic balloon pump was removed from the model.
• FY 2009:

1. The number of categories for the MI variables was reduced from three to two in the surgeon model.

• FY 2010:

1. The number of covariates in both the hospital and surgeon models were reduced by eliminating the following:

   ◦ Male
   ◦ Hypertension
   ◦ Prior PCI
   ◦ Ejection fraction 30-39%
   ◦ Myocardial infarction >24 hours

2. The categories describing timing of myocardial infarction (MI) combined within 6 hours and 7-24 hours to the category MI within 24 hours.

3. The model changed from a hierarchical logistic–normal regression to a Poisson–normal regression.

• FY 2011:

1. The number of covariates in the model was reduced, eliminating myocardial infarction within 24 hours.
Table 8.1: Summary of Isolated CABG Admissions and 30-Day Crude Mortality Percentages CY 2002 through FY 2011

<table>
<thead>
<tr>
<th>Year of Surgery</th>
<th>Number of Hospitals</th>
<th>Number of Admissions</th>
<th>30-Day Crude Mortality (%)</th>
<th>Between-Hospital Variance in Log-Odds of Mortality</th>
<th>Between-Hospital Standard Deviation in SMIRS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 2002</td>
<td>13</td>
<td>4,603</td>
<td>2.19</td>
<td>0.042</td>
<td>0.13</td>
</tr>
<tr>
<td>CY 2003</td>
<td>14</td>
<td>4,393</td>
<td>2.25</td>
<td>0.094</td>
<td>0.29</td>
</tr>
<tr>
<td>CY 2004</td>
<td>14</td>
<td>3,986</td>
<td>2.01</td>
<td>0.349</td>
<td>0.72</td>
</tr>
<tr>
<td>CY 2005</td>
<td>14</td>
<td>3,883</td>
<td>1.65</td>
<td>0.130</td>
<td>0.31</td>
</tr>
<tr>
<td>FY 2006</td>
<td>14</td>
<td>3,684</td>
<td>1.41</td>
<td>0.035</td>
<td>0.045</td>
</tr>
<tr>
<td>FY 2007</td>
<td>14</td>
<td>3,396</td>
<td>1.47</td>
<td>0.389</td>
<td>0.58</td>
</tr>
<tr>
<td>FY 2008</td>
<td>14</td>
<td>3,336</td>
<td>1.38</td>
<td>0.049</td>
<td>0.069</td>
</tr>
<tr>
<td>FY 2009</td>
<td>14</td>
<td>3,284</td>
<td>1.19</td>
<td>0.049</td>
<td>0.054</td>
</tr>
<tr>
<td>FY 2010</td>
<td>14</td>
<td>3,169</td>
<td>1.23</td>
<td>0.067</td>
<td>0.066</td>
</tr>
<tr>
<td>FY 2011</td>
<td>14</td>
<td>2,840</td>
<td>0.99</td>
<td>0.226</td>
<td>0.208</td>
</tr>
</tbody>
</table>

CY denotes calendar year (Jan-Dec); FY denotes fiscal year (Oct-Sep).
9 Important Definitions

STS Version 2.61 refers to the STS data collection variable definitions used by the Massachusetts hospitals for data collection for surgeries from October 2010 through June 2011. STS Version 2.73 was used for data collection for surgeries performed between July 2011 through September 2011. Many of the definitions used in this section were extracted from the STS Adult Cardiac Data Specifications.[7, 10]

Admissions: Refers to a single episode of care at one facility from the date of admission to the date of discharge.

Aortic Valve Repair: Surgical repair of the aortic valve of the heart. The aortic valve is responsible for facilitating the flow of blood into the aorta.

Aortic Valve Replacement (AVR): A surgical procedure involving replacement of the aortic valve of the heart.

Cardiac Catheterization: A procedure that determines the extent and the location of the coronary artery obstruction or blockage.

Cardiac Surgery: (Massachusetts Cardiac Study definition) Surgery on the heart and the thoracic great vessels. Examples of cardiac surgery include coronary artery bypass grafts, heart valve repair or replacement, heart transplantation, surgery of the thoracic aorta, repair of congenital heart defects, and minimally invasive heart surgery.

Cardiogenic Shock: (STS Version 2.61) Indicate whether the patient was, at the time of procedure, in a clinical state of hypoperfusion sustained for greater than 30 minutes, according to either of the following criteria:

a. Systolic BP <80 and/or Cardiac Index <1.8 despite maximal treatment;
b. IV inotropes and/or IABP necessary to maintain Systolic BP >80 and/or Cardiac Index > 1.8.

**Cardiogenic Shock: (STS Version 2.73)** Indicate whether the patient was, at the time of procedure, in a clinical state of end organ hypoperfusion due to cardiac failure according to the following criteria:

a. persistant hypotension (Systolic BP <80-90 or mean arterial pressure 30 mmhg lower than baseline) and

b. severe reduction in Cardiac Index (<1.8 without support or <2.2 with support).

**Cardiovascular Disease:** Includes diseases of the heart or vessels that supply the body and the heart muscle with blood and oxygen.

**Coronary Artery Disease:** A disease affecting the coronary arteries in which the flow of oxygen-containing blood to the heart muscle is partially or completely blocked, resulting in angina or a heart attack.

**Coronary Artery Bypass Graft (CABG) Surgery:** An operation in which the blocked coronary vessels are bypassed with the patient’s own vessels to improve flow to the heart muscle. Coronary vessels are those vessels that supply the heart muscle with blood and oxygen.

**Cross-Validation:** Model validation is done to ascertain whether predicted values from a statistical model are likely to accurately predict responses on future subjects or on subjects not used to develop the analytical model. Cross-validation involves dropping a set of observations from the analytical process and the outcomes for the dropped set are predicted. This process is repeated many times in order to characterize the accuracy of the predictions.
**Diabetes: (STS Version 2.61)** Indicates the patient has a history of diabetes, regardless of duration of disease or need for anti-diabetic agents. Includes on admission or preoperative diagnosis. Does not include gestational diabetes.

**Diabetes: (STS Version 2.73)** Indicate whether patient has a history of diabetes diagnosed and/or treated by a physician. The American Diabetes Association criteria include documentation of the following:

- **a.** A1c $\geq 6.5\%$; or
- **b.** Fasting plasma glucose $\geq 126$ mg/dl (7.0 mmol/l); or
- **c.** Two-hour plasma glucose $\geq 200$ mg/dl (11.1 mmol/l) during an oral glucose tolerance test; or
- **d.** In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose $\geq 200$ mg/dl (11.1 mmol/l) It does not include gestational diabetes.

**Dialysis: (STS Version 2.61)** Indicates whether the patient is currently undergoing dialysis.

**Ejection Fraction: (STS Version 2.61)** Indicates the percentage of the blood emptied from the ventricle at the end of the contraction.

**Hypertension: (STS Version 2.61)** Indicate whether the patient has a diagnosis of hypertension, documented by one of the following:

- **a.** Documented history of hypertension diagnosed and treated with medication, diet and/or exercise;
- **b.** Prior documentation of blood pressure $>140$ mmHg systolic or $90$ mmHg diastolic for patients without diabetes or chronic kidney disease, or prior documentation of blood pressure $>130$ mmHg systolic or $80$ mmHg diastolic on at least two occasions for patients with diabetes or chronic kidney disease;
- **c.** Currently on pharmacologic therapy to control hypertension.
Mitral Valve Repair: Surgical repair of the mitral valve of the heart. The mitral valve is responsible for facilitating the flow of blood from the left atrium into the left ventricle.

Mitral Valve Replacement (MVR): A surgical procedure which involves the replacement of the mitral valve of the heart.

Myocardial Infarction (MI): (STS Version 2.61) Indicates the patient has a history of an MI.

For MI occurrence prior to current hospitalization, one of the following is necessary:

a. MI documented in the medical record; or

b. EKG Documented Q wave. Q waves to be 0.03 seconds in width and/or greater than or equal to one third of the total QRS complex in two or more contiguous leads.

For MI occurrence during current hospitalization, two of the following three criteria are necessary:

a. Ischemic symptoms in the presence or absence of chest discomfort. Ischemic symptoms may include:
   1. Chest, epigastric, arm, wrist, or jaw discomfort with exertion or at rest; or
   2. Unexplained nausea and vomiting; or
   3. Persistent shortness of breath secondary to left ventricular failure; or
   4. Unexplained weakness, dizziness, lightheadedness, diaphoresis, or syncope.

b. Enzyme level elevation. One of the following four are necessary:

   1. CK-MB: Maximal value of CK-MB more than two times the upper limit of normal on one occasion during the first hours after the index clinical event or maximal value of CK-MB, preferable CK-MB mass, greater than upper limit of normal on two successive samples; or
   2. CK greater than two times the upper limit of normal; or
3. LDH subtype 1 greater than LDH subtype 2; or

4. Maximal concentration of troponin T or I greater than the MI decision limit on at least one occasion during the first 24 hours after the index clinical event.

c. Serial ECG (at least two) showing changes from baseline or serially in ST-T.

Myocardial Infarction (MI): (STS Version 2.73) Indicate if the patient has a history of MI. A myocardial infarction is evidenced by any of the following:

a. A rise and fall of cardiac biomarkers (preferably troponin) with at least one of the values in the abnormal range for that laboratory [typically above the 99th percentile of the upper reference limit (URL) for normal subjects] together with at least one of the following manifestations of myocardial ischemia:

   1. Ischemic symptoms;

   2. ECG changes indicative of new ischemia (new ST-T changes, new left bundle branch block, or loss of R-wave voltage),

   3. Development of pathological Q-waves in 2 or more contiguous leads in the ECG (or equivalent findings for true posterior MI);

   4. Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality;

   5. Documentation in the medical record of the diagnosis of acute myocardial infarction based on the cardiac biomarker pattern in the absence of any items enumerated in a-d due to conditions that may mask their appearance (e.g., peri-operative infarct when the patient cannot report ischemic symptoms; baseline left bundle branch block or ventricular pacing)

b. ECG changes associated with prior myocardial infarction can include the following (with or without prior symptoms):

   1. Any Q-wave in leads V2-V3 $\geq 0.02$ seconds or QS complex in leads V2 and V3.

   2. Q-wave $\geq 0.03$ seconds and $\geq 0.1$ mV deep or QS complex in leads I, II, aVL, aVF, or V4-V6 in any two leads of a contiguous lead grouping (I, aVL, V6; V4-V6; II, III, and aVF).
3. R-wave $\geq 0.04$ seconds in V1-V2 and R/S $\geq 1$ with a concordant positive T-wave in the absence of a conduction defect.

c. Imaging evidence of a region with new loss of viable myocardium at rest in the absence of a non-ischemic cause. This can be manifest as:

1. Echocardiographic, CT, MR, ventriculographic or nuclear imaging evidence of left ventricular thinning or scarring and failure to contract appropriately (i.e., hypokinesis, akinesis, or dyskinesis)

2. Fixed (non-reversible) perfusion defects on nuclear radioisotope imaging (e.g., MIBI, thallium)

d. Medical record documentation of prior myocardial infarction.

**Percutaneous Coronary Intervention (PCI):** A non-surgical procedure designed to open and maintain the patency of obstructed coronary vessels. This treatment is an invasive procedure performed in the cardiac catheterization lab (e.g., outside of an operating room) by an interventional cardiologist in which a balloon, stent, or other device is delivered to the affected vessel to open and maintain its patency.

**Peripheral Arterial Disease: (STS Version 2.61)** Indicate whether the patient has a history of peripheral arterial disease (includes upper and lower extremity, renal, mesenteric, and abdominal aortic systems). This can include the following: (Peripheral arterial disease excludes disease in the carotid or cerebrovascular arteries.)

a. Claudication, either with exertion or at rest;

b. Amputation for arterial vascular insufficiency;

c. Vascular reconstruction, bypass surgery, or percutaneous intervention to the extremities (excluding dialysis fistulas and vein stripping);

d. Documented aortic aneurysm with or without repair;


e. Positive noninvasive test (e.g., ankle brachial index $\leq 0.9$, ultrasound, magnetic resonance or computed tomography imaging of $>50\%$ diameter stenosis in any peripheral artery, i.e., renal, subclavian, femoral, iliac).

**Prior CABG Surgery:** Indicates the patient had a previous coronary bypass graft prior to the current admission.

**Prior Percutaneous Coronary Intervention:** *(STS Version 2.61)* Indicates a previous percutaneous cardiac intervention (PCI) was performed any time prior to the surgical procedure. PCI refers to those treatment procedures that unblock narrowed coronary arteries without performing surgery. PCI may include, but is not limited to:

- a. Balloon Catheter Angioplasty, Percutaneous Transluminal Coronary Angioplasty (PTCA);
- b. Rotational Atherectomy;
- c. Directional Atherectomy;
- d. Extraction Atherectomy;
- e. Laser Atherectomy;
- f. Intracoronary Stent Placement.

**Renal Failure–Dialysis:** *(STS Version 2.61)* Indicates whether the patient is currently undergoing dialysis.

**Risk Factors:** Factors that contribute to an individual’s risk of coronary artery disease or of death. These factors are classified as those that can be modified or changed by an individual, and those that cannot be changed. Examples of risk factors that cannot be modified include age, gender, family history of coronary artery disease, and ethnicity. Risk factors that can be controlled include diet, cholesterol levels, obesity, smoking, hypertension, inactive lifestyle, stress, and diabetes.
Standardized Mortality Incidence Rate (SMIR): The ratio of smoothed number of deaths (the number of deaths adjusted for the number of admissions treated at the hospital and the hospital case mix) to expected number of deaths (the expected number of deaths calculated on the basis of the mortality experience of all cardiac surgery programs) multiplied by the state unadjusted rate. SMIRs are interpreted in terms of their corresponding probability intervals. If the probability interval includes the state rate, then the SMIR is no different from what was expected. If the interval excludes the state rate, then the SMIR is “significantly different” from what was expected. In this case, if the upper limit of the interval is lower than the state rate, then fewer patients than expected died; if the lower limit of the 95% interval is higher than the state rate, then more patients than expected died.

Status of CABG: (STS Version 2.61) Indicate the clinical status of the patient prior to entering the operating room:

Elective: The patient’s cardiac function has been stable in the days or weeks prior to the operation. The procedure could be deferred without increased risk of compromised cardiac outcome.

Urgent: Procedure required during same hospitalization in order to minimize chance of further clinical deterioration. Examples include but are not limited to: Worsening, sudden chest pain, congestive heart failure, acute myocardial infarction, anatomy, IABP, unstable angina with intravenous nitroglycerin or rest angina.

Emergent: Patients requiring emergency operations will have ongoing, refractory (difficult, complicated, and/or unmanageable) unrelenting cardiac compromise, with or without hemodynamic instability, and not responsive to any form of therapy except cardiac surgery. An emergency operation is one in which there should be no delay in providing operative intervention. The patient’s clinical status includes any of the following:
a. Ischemic dysfunction (any of the following):
   1. Ongoing ischemia including rest angina despite maximal medical therapy (medical and/or IABP);
   2. Acute Evolving Myocardial Infarction within 24 hours before surgery; or
   3. Pulmonary edema requiring intubation

b. Mechanical dysfunction (either of the following):
   1. Shock with circulatory support; or
   2. Shock without circulatory support.

**Emergent Salvage:** The patient is undergoing CPR en route to the operating room or prior to anesthesia induction.

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**Emergent Salvage:** The patient is undergoing CPR en route to the operating room or prior to anesthesia induction or has ongoing ECMO to maintain life.
10 Advisory Committees

Mass-DAC gratefully acknowledges the support from the members of the Mass-DAC Committees who have donated their time to improve the database and the quality of cardiac care in the Commonwealth of Massachusetts.

<table>
<thead>
<tr>
<th>FY 2011 Massachusetts Cardiac Care Hospital Outlier Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Massachusetts Department of Public Health Committee charged with reviewing hospital outlier findings.</td>
</tr>
</tbody>
</table>

Madeleine Biondolillo, M.D.  
Director  
Bureau of Health Care Safety and Quality  
Massachusetts Department of Public Health  

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Thomas Piemonte, M.D.  
Director, Cardiac Catheterization Laboratory  
Lahey Hospital & Medical Center  

David Torchiana, M.D.  
Chairman and Chief Executive Officer  
Mass. General Physicians Organization  

Continued on next page . . .
Continued from prior page

Thomas Carr, M.D.  Ralph M. Bolman, III, M.D.
Cardiac Surgeon  Chief of Cardiac Surgery
North Shore Medical Center–Salem Hospital  Brigham and Women’s Hospital

Frederic Resnic, M.D.  Daniel Engelman, M.D.
Chairman  Cardiac Surgeon
Department of Cardiovascular Medicine  Baystate Medical Center
Lahey Hospital & Medical Center

David Shahian, M.D.  Cliff Berger, M.D.
Research Director  Interventionalist
Center for Quality and Safety  Good Samaritan Medical Center
Department of Surgery  Massachusetts General Hospital
FY 2011 Mass-DAC Oversight Committee for Cardiac Surgery

The members of this committee are charged with the task of reviewing blinded summary data for all cardiac surgeons in Massachusetts in the review year. Such data include risk-standardized 30-day all-cause mortality rates (SMIR), surgeon volume, surgeon complication rates, and other STS recommended process measures. For surgeons identified as having statistically significant higher than expected mortality, unblinded case fatality reports are also reviewed. Selection of Committee members is the responsibility of the current President of the Massachusetts chapter of STS.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Rizzo, M.D.</td>
<td>Chief of Cardiac Surgery</td>
<td>Cape Cod Hospital</td>
</tr>
<tr>
<td>Samuel J. Shubrooks, Jr., M.D.</td>
<td>Interventionalist</td>
<td>Beth Israel Deaconess Medical Center</td>
</tr>
<tr>
<td>Sharon-Lise Normand, Ph.D.</td>
<td>Professor of Health Care Policy</td>
<td>Department of Health Care Policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Harvard Medical School</td>
</tr>
<tr>
<td>Ralph M. Bolman, III, M.D.</td>
<td>Chief of Cardiac Surgery</td>
<td>Brigham and Women’s Hospital</td>
</tr>
<tr>
<td></td>
<td></td>
<td>President of the Mass. Chapter of STS</td>
</tr>
<tr>
<td>Kenneth Warner, M.D.</td>
<td>Chief of Cardiac Surgery</td>
<td>Tufts Medical Center</td>
</tr>
<tr>
<td>Vladimir Birjiniuk, M.D.</td>
<td>Chief of Cardiac Surgery</td>
<td>Mount Auburn Hospital</td>
</tr>
<tr>
<td>David Shahian, M.D.</td>
<td>Research Director</td>
<td>Center for Quality and Safety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Department of Surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Massachusetts General Hospital</td>
</tr>
<tr>
<td>Thomas Vander Salm, M.D.</td>
<td>Cardiac Surgeon</td>
<td>North Shore Medical Center–Salem Hospital</td>
</tr>
</tbody>
</table>

Mass-DAC (www.massdac.org)
The FY 2011 Mass-DAC Cardiac Surgery Data Adjudication Committee

This committee reviewed patient-specific data elements and corresponding data documentation submitted by hospitals to Mass-DAC in order to determine validity of coding.

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Tamar Yehoshua
Data Manager
Saint Elizabeth’s Medical Center
The charge of this committee is to facilitate utilization of shared data from the Massachusetts Cardiac Surgery Data Registry for purposes of reporting observations that are of interest to the medical community and are based on sound scientific principles of study design and analysis. This committee will approve or deny the request before sending the proposal to the Massachusetts Department of Public Health for final approval. The selection of committee members is done by the current president of the Massachusetts STS.

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Joren Madsen, M.D.
Cardiac Surgeon
Massachusetts General Hospital
# Appendix

## Procedure Identification Guidelines for Adult Cardiac Surgery

A comparison of rules used by Mass-DAC, New York State, and the National Society of Thoracic Surgeons for classifying surgeries as *isolated CABG* versus *CABG + other*.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Mass-DAC</th>
<th>New York State</th>
<th>STS v2.61</th>
<th>STS v2.73</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maze: <strong>Open</strong> heart approach</td>
<td>Other</td>
<td>Other</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>Maze: <strong>Closed</strong> epicardial approach and radio frequency</td>
<td>CABG</td>
<td>CABG</td>
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<td>CABG</td>
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<tr>
<td>Implantable Cardioverter Defibrillator (ICD)</td>
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<td>CABG</td>
<td>Other</td>
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<td>Ventricular Lead Insertion for ICD</td>
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<td>CABG</td>
<td>Other</td>
<td>CABG</td>
</tr>
<tr>
<td>Pacemaker Lead Insertions</td>
<td>CABG</td>
<td>CABG</td>
<td>CABG</td>
<td>CABG</td>
</tr>
<tr>
<td>Lung Biopsy</td>
<td>Case Specific</td>
<td>CABG</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>Patent Foramen Ovale Closure</td>
<td>CABG</td>
<td>CABG</td>
<td>Other</td>
<td>CABG</td>
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<tr>
<td>Femoral Artery Procedures</td>
<td>CABG</td>
<td>CABG</td>
<td>Other</td>
<td>CABG</td>
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<tr>
<td>Transmyocardial Revascularization</td>
<td>Other</td>
<td>CABG</td>
<td>Other</td>
<td>CABG</td>
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<tr>
<td>Opening of the right atrium for tumor resection</td>
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<td>Other</td>
<td>Other</td>
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<tr>
<td>Atrial Appendage</td>
<td>CABG</td>
<td>CABG</td>
<td>CABG</td>
<td>CABG</td>
</tr>
<tr>
<td>Myoxoma</td>
<td>Other</td>
<td>Other</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>Unplanned Ventricular Assist Device (VAD) Placement</td>
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<td>CABG</td>
<td>Other</td>
<td>CABG</td>
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<tr>
<td>Planned Ventricular Assist Device (VAD) Placement</td>
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<tr>
<td>Carotid Surgery</td>
<td>Other</td>
<td>CABG</td>
<td>Other</td>
<td>Other</td>
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<tr>
<td>Lead and Device Explants</td>
<td>Other</td>
<td>CABG</td>
<td>Other</td>
<td>Other</td>
</tr>
</tbody>
</table>

*No information available regarding how this procedure is categorized by STS.*
B Appendix

STS Data Abstraction Tool [6, 7]  
Version 2.61

Mass-DAC harvests all optional and not harvested STS variables

This tool is the property of The Society of Thoracic Surgeons and is protected by copyright and other intellectual property laws.
A. Administrative

Participant ID: ___________  Cost Link: ___________  STS Trial Link Number: ___________

B. Demographics

Patient Last Name: _______________________  Patient First Name: _________________  Patient M.I.: ____

Date of Birth (mm/dd/yyyy): __ / __ / ___________  Patient Age: ___________  System Calculation

Sex: Male  Female

Social Security #: ___________________________  Optional Harvest

Health Insurance Claim Number: ___________________  Optional Harvest

Patient ZIP Code: ______________ Optional Harvest

Race: (Select all that apply)  White  Black / African American  Asian

American Indian / Alaskan Native  Native Hawaiian / Pacific Islander  Other

Hispanic or Latino Ethnicity: Yes  No

Referring Cardiologist: ___________________  Not Harvested

Referring Physician: ________________________  Not Harvested

C. Hospitalization

Hospital Name: ______________________________  Hospital ZIP Code: ___________

Hospital State: ___________

Hospital National Provider Identifier: ______________________________

Payor – (Select all that apply)

Government Health Insurance: Yes  No  If Yes, select all that apply: → Medicare  Medicaid

Military Health Care  State-Specific Plan  Indian Health Service

Commercial Health Insurance: Yes  No

Health Maintenance Organization: Yes  No

Non-U.S. Insurance: Yes  No

None / Self: Yes  No

Date of Admission: __ / __ / ___________  Date of Surgery: __ / __ / ___________  Date of Discharge: __ / __ / ___________

ICU Visit: Yes  No  If Yes → Initial ICU Hours: _________

Readmission to ICU: Yes  No  If Yes → Additional ICU Hours: _________  Total Hrs ICU: _________

D. Risk Factors

Weight (kg): _________  Height (cm): _________

Current Or Recent Cigarette Smoker: Yes  No

Family History of Coronary Artery Disease: Yes  No

Last Hematocrit: _________

Last White Blood Cell Count: _________

Diabetes: Yes  No  If Yes → Diabetes Control: (select one)  None  Diet  Oral  Insulin  Other

Last A1c Level: _________

Dyslipidemia: Yes  No

Last Creatinine Level: _________

Renal Failure – Dialysis: Yes  No

Hypertension: Yes  No

Infectious Endocarditis: Yes  No  If Yes → Infectious Endocarditis Type: Treated  Active

Chronic Lung Disease: No  Mild  Moderate  Severe

Immunosuppressive Therapy: Yes  No

Peripheral Arterial Disease: Yes  No
<table>
<thead>
<tr>
<th>Cerebrovascular Disease:</th>
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<tbody>
<tr>
<td>If Yes →</td>
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<tr>
<td>Coma:</td>
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<td>No</td>
</tr>
<tr>
<td>CVA:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If Yes →</td>
<td>CVA-When: Recent (&lt;=2 weeks) Remote (&gt;2 weeks)</td>
<td></td>
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<tr>
<td>CVD RIND:</td>
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<td>No</td>
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<tr>
<td>CVD TIA:</td>
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<tr>
<td>CVD NonInvasive &gt;75%:</td>
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<tr>
<td>CVD Prior Carotid Surgery:</td>
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<td>No</td>
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E. **Previous CV Interventions**

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<thead>
<tr>
<th>Previous CV Interventions:</th>
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<tbody>
<tr>
<td>If Yes, complete the remainder of this section ↓</td>
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<tr>
<td>Previous Coronary Artery Bypass:</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Previous Valve:</td>
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<td>Previous Other Cardiac</td>
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<td>Congenital</td>
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<td>AICD (Automatic Implanted Cardioverter / Defibrillator):</td>
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<td>Pacemaker:</td>
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<td>PCI (Percutaneous Cardiac Intervention):</td>
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<td>PCI Stent:</td>
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<td>Stent Type: Bare Metal Drug-eluting Unknown</td>
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<td>PCI Interval:</td>
<td>&lt;= 6 Hours</td>
<td>&gt; 6 Hours</td>
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<td>Other:</td>
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F. **Preoperative Cardiac Status**

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<th>Previous Myocardial Infarction:</th>
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<tbody>
<tr>
<td>If Yes →</td>
<td>When:</td>
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<tr>
<td>Heart Failure:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Classification - NYHA:</td>
<td>Class I</td>
<td>Class II</td>
</tr>
<tr>
<td>Cardiac Presentation on Admission:</td>
<td>No Symptoms or Angina</td>
<td>Symptoms Unlikely to be Ischemia</td>
</tr>
<tr>
<td>STS Cardiogenic Shock:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Resuscitation:</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Arrhythmia:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If Yes →</td>
<td>Arrhythmia Type: Vtach / Vfib</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>3rd degree HB</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Afib / Aflutter</td>
<td>Yes</td>
</tr>
</tbody>
</table>
G. Preoperative Medications

Beta Blockers: Yes No Contraindicated / Not Indicated
ACE or ARB Inhibitors: Yes No Contraindicated / Not Indicated
Nitrates I.V.: Yes No Contraindicated / Not Indicated
Anticoagulants: Yes No Contraindicated / Not Indicated
  If Yes → Medication Name: Heparin (Unfractionated) Heparin (Low Molecular) Thrombin Inhibitors Other
Coumadin: Yes No Contraindicated / Not Indicated
Inotropes: Yes No Contraindicated / Not Indicated
Steroids: Yes No Contraindicated / Not Indicated
Aspirin: Yes No Contraindicated / Not Indicated
Lipid-Lowering: Yes No Contraindicated / Not Indicated
ADP Inhibitors Within Five Days: Yes No Contraindicated / Not Indicated
AntiplATElets Within 5 Days: Yes No Contraindicated / Not Indicated
Glycoprotein IIbIIIa Inhibitor: Yes No Contraindicated / Not Indicated
  If Yes → Medication Name: Abciximab (ReoPro) Eptifibatide (Integrilin) Tirofiban (Aggrastat)

H. Hemodynamics and Cath

Number of Diseased Coronary Vessels: None One Two Three
Left Main Disease >= 50%: Yes No
Ejection Fraction Done: Yes No If Yes → Ejection Fraction: ____ (%)
  Ejection Fraction Method: LV gram Radionucleotide Estimate ECHO MRI/CT Other
Pulmonary Artery Mean Pressure Done: Yes No If Yes → Mean Pressure: _______ (mm Hg)
Aortic Stenosis: Yes No N/A
Mitral Stenosis: Yes No N/A
Tricuspid Stenosis: Yes No N/A
Pulmonic Stenosis: Yes No N/A
Aortic Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe 5= N/A
Mitral Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe 5= N/A
Tricuspid Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe 5= N/A
Pulmonic Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe 5= N/A

I. Operative

Surgeon: ________________________________ Surgeon's National Provider Identifier: __________________
Taxpayer Identification Number: __________________________
Incidence: First cardiovascular surgery
  First re-op cardiovascular surgery
  Second re-op cardiovascular surgery
  Third re-op cardiovascular surgery
  Fourth or more re-op cardiovascular surgery
Status: ↓
  Elective
    Urgent → Reason: AMI IABP Worsening CP CHF Anatomy USA Rest Angina
    Valve Dysfunction Aortic Dissection Angiographic Accident Cardiac Trauma
    Ongoing Ischemia Valve Dysfunction Aortic Dissection Angiographic Accident Cardiac Trauma
  Emergent Salvage
Robotic Technology Assisted: Yes No
Coronary Artery Bypass: Yes No → If Yes, also complete Section J
Valve Surgery: Yes No → If Yes, also complete Section K
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Notes</th>
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<tr>
<td>Ventricular Assist Device:</td>
<td>Yes</td>
<td>No</td>
<td>If Yes, also complete Section L</td>
</tr>
<tr>
<td>Other Cardiac Procedure:</td>
<td>Yes</td>
<td>No</td>
<td>If Yes, also complete Section M</td>
</tr>
<tr>
<td>Other Non-Cardiac Procedure:</td>
<td>Yes</td>
<td>No</td>
<td>If Yes, also complete Section N</td>
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Enter up to 10 CPT-I Codes pertaining to the surgery for which the data collection form was initiated:

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<td>#8.</td>
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<td>#9.</td>
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</tr>
<tr>
<td>#10.</td>
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</table>

OR Entry Date And Time: ___ / ___ / ______     _____ : _____ (mm/dd/yyyy, 24 hr clk)

OR Exit Date And Time: ___ / ___ / ______     _____ : _____ (mm/dd/yyyy, 24 hr clk)

Initial Intubation Date And Time: ___ / ___ / ______     _____ : _____ (mm/dd/yyyy, 24 hr clk)

Initial Extubation Date And Time: ___ / ___ / ______     _____ : _____ (mm/dd/yyyy, 24 hr clk)

Skin Incision Start Date And Time: ___ / ___ / ______     _____ : _____ (mm/dd/yyyy, 24 hr clk)

Skin Incision Stop Date And Time: ___ / ___ / ______     _____ : _____ (mm/dd/yyyy, 24 hr clk)

Antibiotic Selection:     Yes      No

Antibiotic Timing:     Yes      No

Antibiotics Discontinued:     Yes      No

CPB Utilization: None      Combination      Full

- If Combination
  - CPB Utilization - Combination Plan: Planned      Unplanned
  - If Unplanned
    - Unplanned Combination Reason: Exposure/visualization
      - Bleeding
      - Inadequate size and/or diffuse disease of distal vessel
      - Hemodynamic instability
      - Conduit quality and/or trauma
      - Other

- If Combination or Full
  - Perfusion Time (minutes): __________

  - Cannulation Method: Aorta and Femoral/Jugular Vein: Yes      No
  - Femoral Artery and Femoral/Jugular Vein: Yes      No
  - Aorta and Atrial/Caval: Yes      No
  - Femoral Artery and Atrial/Caval: Yes      No
  - Other: Yes      No

Circulatory Arrest: Yes      No

- If Yes
  - Circulatory Arrest Time: __________ (minutes)

Aortic Occlusion: None

- Aortic Crossclamp
  - If Aortic Crossclamp or Balloon Occlusion
    - Cross Clamp Time (minutes): __________

  - Balloon Occlusion
    - Partial Crossclamp

Cardioplegia: Yes      No

Cerebral Oximetry: Optional Harvest

- Pre-Induction Baseline Regional Oxygen Saturation: Left: _____ (%)      Right: _____ (%) (minute-%)

- Cumulative Saturation Below Threshold: Left: _____ (minute-%)      Right: _____ (minute-%)

- Cerebral Oximeter Provided The First Indication: Yes      No

- Skin Closure Regional Oxygen Saturation: Left: _____ (%)      Right: _____ (%) (minute-%)

IABP: Yes      No

- If Yes
  - When Inserted: Preoperatively      Intraoperatively      Postoperatively
  - Indication: Hemodynamic Instab      PTCA Support      Unstable Angina      CPB Wean      Prophylactic

Intraop Blood Products: Yes      No

- If No
  - Intraop Blood Products Refused: Yes      No

- If Yes
  - Red Blood Cell Units: __________
  - Fresh Frozen Plasma Units: __________
  - Cryoprecipitate Units: __________
  - Platelet Units: __________

Intraop Medications:

- Aprotinin: Yes      No
  - If Yes
    - Aprotinin – Dose: Full Dose      Half Dose

  - Epsilon Amino-Caproic Acid: Yes      No
J. Coronary Bypass

Number of Distal Anastomoses with Arterial Conduits: ______
Number of Distal Anastomoses with Venous Conduits: ______

Distal Anastomoses - Vein Harvest Technique: Endovascular Direct Vision Both

Saphenous Vein Harvest Time: ______ (minutes)

Anastomotic Device Used: If Yes → Anastomotic Device: Glue Magnets Clips Staples Other

Internal Mammary Arteries Used as Grafts: Left IMA Right IMA Both IMAs No IMA If Left, Right, or Both ↓

IMA Harvest Technique: Direct Vision Thoracotomy Combination Robotic Assisted

Number of IMA Distal Anastomoses: ______

Radial Artery Used: No Radial Left Radial Right Radial Both Radials if Left, Right, or Both ↓

Number of Radial Artery Distal Anastomoses: ______

Radial Distal Anastomoses Harvest Technique: Endovascular Direct Vision Both

Radial Artery Harvest Time: ______ (minutes)

Number of Gastro-Epiploic Artery Distal Anastomoses: ______

Number of Other Arterial Distal Anastomoses: ______

K. Valve Surgery

Aortic Procedure: Mitral Procedure: Tricuspid Procedure: Pulmonic Procedure

No Replacement No Annuloplasty Only No Annuloplasty Only No Replacement

Repair/Reconstruction Replacement Replacement Replacement

Root Reconstruction w/ Valve Conduit Reconstruction w/ Annuloplasty Reconstruction w/o Annuloplasty Reconstruction w/o Annuloplasty

Reconstruction w/ Valve Sparing

Resuspension Aortic Valve w/ Annuloplasty

Replacement Ascending Aorta Replacement Ascending Aorta

Resuspension Aortic Valve w/o Annuloplasty

Replacement Ascending Aorta

Resection Sub-Aortic Stenosis

Aortic Annular Enlargement: Yes No

↓ Key M = Mechanical B = Bioprosthesis H = Homograft A = Autograft (Ross) R = Ring/Annuloplasty BA = Band/Annuloplasty

Aortic Prosthesis - Implant Type: None M B H A R BA

Implant: ______ Size: ______

Mitrail Prosthesis - Implant Type: None M B H A R BA

Implant: ______ Size: ______

Tricuspid Prosthesis - Implant Type: None M B H A R BA

Implant: ______ Size: ______

Pulmonic Prosthesis - Implant Type: None M B H A R BA

Implant: ______ Size: ______

Valve Key (check STS web site for periodic updates to this list).

Mechanical

ATS Mechanical Prosthesis = 2
Björk-Shiley Convex-Concave Mechanical Prosthesis = 3
Björk-Shiley Monosut Mechanical Prosthesis = 4
CarboMedics Mechanical Prosthesis = 6
CarboMedics Mechanical Prosthesis for Aortic Valve = 57
CarboMedics Carbo-Seal Ascending Aortic Valved Conduit Prosthesis = 58
CarboMedics Carbo-Seal Valsalva Ascending Aortic Valved Conduit Prosthesis = 59
CarboMedics Reduced Cuff Aortic Valve = 60
CarboMedics Standard Aortic Valve = 61
CarboMedics Top-Hat Supra-annular Aortic Valve = 62
CarboMedics OptiForm Mitral Valve = 63
CarboMedics OptiForm Mitral Valve = 64
CarboMedics Small Adult Aortic and Mitral Valves = 65
Edwards Tekna Mechanical Prosthesis = 7
Lillicrap-Kaster Mechanical Prosthesis = 8
MCRI On-X Mechanical Prosthesis = 10
Medtronic Hall/Hall Easy-Fit Mechanical Prosthesis = 11
Medtronic ADVANTAGE Mechanical Prosthesis = 12
OmniCarbon Mechanical Prosthesis = 13
OmniScience Mechanical Prosthesis = 14
Sorin Bicarbon (Baxter Mira) Mechanical Prosthesis = 15
Sorin Monoleaftet Allcarbon Mechanical Prosthesis = 16
St. Jude Medical Mechanical Prosthesis or St. Jude Medical® Mechanical Heart Valve = 17
SJM® Masters Series Mechanical Heart Valve = 18

Medtronic Freestyle Stentless Porcine Bioprosthesis – Subcoronary = 83
Medtronic Freestyle Stentless Porcine Bioprosthesis – Root = 84
Medtronic Intact Porcine Bioprosthesis = 85
Medtronic Mosaic Porcine Bioprosthesis = 86
Medtronic Contegra Bovine Jugular Bioprosthesis = 87
Medtronic Mitroflow Pericardial Bioprosthesis = 88
St. Jude Medical - Toronto SPV® Stentless Porcine Bioprosthesis or SJM® Toronto SPV® Valve = 89
St. Jude Medical-Biologic Porcine Bioprosthesis = 90
SJM Biocor™ Valve = 91
SJM Epic™ Valve = 92
SJM Toronto Root™ Bioprosthesis = 93
Sorin Pericarbon Stentless Pericardial Bioprosthesis = 94

Homograft

CryoLife Aortic Homograft = 95
CryoLife Pulmonary Homograft = 96
CryoLife CryoValve SG(Decellularized) Aortic Homograft = 97
CryoLife CryoValve SG Pulmonary Homograft = 98

Homograft Aortic – Subcoronary = 99
Homograft Aortic Root = 100
Homograft Mitral = 101
Homograft Pulmonary Root = 102
LifeNet CV Allografts = 103

Autograft

Pulmonary Autograft to aortic root (Ross Procedure) = 104

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### Bioprosthesis

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
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<tbody>
<tr>
<td>SJM® Masters Series Aortic Valve Graft Prosthesis = 68</td>
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</tr>
<tr>
<td>St. Jude Medical® Mechanical Heart Valve Hemodynamic Plus (HP) Series = 69</td>
<td></td>
</tr>
<tr>
<td>SJM® Masters Series Hemodynamic Plus Valve with FlexCuff™ Sewing Ring = 70</td>
<td></td>
</tr>
<tr>
<td>SJM Regent™ Valve = 71</td>
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<tr>
<td>Starr-Edwards Caged-Ball Prosthesis = 14</td>
<td></td>
</tr>
<tr>
<td>UltraTrac Mechanical Prosthesis = 15</td>
<td></td>
</tr>
</tbody>
</table>

### Additional Implant(s) Data

- **LVAD Inflow:** Left Atrium
- **LVAD Outflow:** Left Ventricle

#### Additional Implant(s) Data

- **Second Device Implanted:** Yes
- **If Yes ↓**

<table>
<thead>
<tr>
<th>Implant Type</th>
<th>Product Type</th>
<th>Implant Date</th>
<th>Explant Date</th>
<th>Explant Reason</th>
<th>Transplant Date</th>
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<tr>
<td></td>
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<td>mm dd yyyy</td>
<td>mm dd yyyy</td>
<td></td>
<td>mm dd yyyy</td>
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</table>

#### Initial VAD Data

- **LVAD Inflow:** Left Atrium
- **LVAD Outflow:** Left Ventricle

- **RVAD Inflow:** Right Atrium
- **RVAD Outflow:** Right Ventricle

#### Additional Implant(s) Data

<table>
<thead>
<tr>
<th>Implant Type</th>
<th>Product Type</th>
<th>Implant Date</th>
<th>Explant Date</th>
<th>Explant Reason</th>
<th>Transplant Date</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>mm dd yyyy</td>
<td>mm dd yyyy</td>
<td></td>
<td>mm dd yyyy</td>
</tr>
</tbody>
</table>

#### VAD Device Data

- **Implant Type:** Fill in below
- **Product Type:** Fill in below

#### Current Circulatory Support: For Initial VAD Only

- **Implant Type:** Fill in below
- **Product Type:** Fill in below

#### Hemodynamics Pre-VAD:

- **PCWP:** _____mm/Hg
- **CVP:** _____mm/Hg
- **CI:** _____L/(min x m²)
- **RV Function:** Normal

#### VAD Device Data:

- **Implant Type:** Fill in below
- **Product Type:** Fill in below

#### References to “Initial VAD” refer to the initial VAD for this hospitalization, not a VAD placed during a previous hospitalization.
RVAD Inflow: Right Atrium  Right Ventricle

<table>
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<tr>
<th>Third Device Implanted:</th>
<th>Yes</th>
<th>No</th>
<th>If Yes ↓</th>
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</thead>
<tbody>
<tr>
<td>Implant Type #3</td>
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<tr>
<td>Product Type #3</td>
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<td>Explant #3</td>
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<td>Explant Date #3</td>
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<td>Explant Reason #3</td>
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<tr>
<td>Transplant Date #3</td>
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<td></td>
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</tr>
</tbody>
</table>

Implant #3 VAD Cannulation/Attach Site:
LVAD Inflow: Left Atrium  Left Ventricle
RVAD Inflow: Right Atrium  Right Ventricle

### Primary VAD Complications Data:

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<tr>
<th>Intracranial Bleed:</th>
<th>Yes</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>Embolic Stroke:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Driveline and/or Cannula Infection:</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pump Pocket Infection:</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>VAD Endocarditis:</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Device Malfunction:</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Bowel Obstruction:</td>
<td>Yes</td>
<td>No</td>
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</tbody>
</table>

Additional Complications (not specific to initial VAD as above) to be collected in section "P", Complications.

### VAD Discharge Status:

- With VAD
- Without VAD
- Expired in hospital (where initial VAD was implanted)

### M. Other Cardiac Procedures

**Left Ventricular Aneurysm Repair**  
Yes  No  Ventricular Septal Defect Repair  Yes  No  Atrial Septal Defect Repair  Yes  No

**Batista**  
Yes  No  Surgical Ventricular Restoration  Yes  No  Congenital Defect Repair  Yes  No

Transmyocardial Laser Revascularization  
Yes  No  Cardiac Trauma  Yes  No  Cardiac Transplant  Yes  No

Arrhythmia Correction Surgery:  
None

- Permanent Pacemaker
- Permanent Pacemaker with Cardiac Resynchronization Therapy (CRT)
- Automatic Implanted Cardioverter Defibrillator (AICD)
- AICD with CRT
  - If "Permanent Pacemaker with CRT" or "AICD with CRT" ↓
    - Lead Placement:  Epicardial  Endocardial

Atrial Fibrillation Correction Surgery:  
None

- Standard Surgical Maze Procedure
- Other Surgical Ablative Procedure
- Combination of Standard and Other

**Aortic Aneurysm**  
Yes  No  If Yes ↓ Ascending Aorta  Yes  No  Aortic Arch  Yes  No  Descending Aorta  Yes  No  Thoracoabdominal Aneurysm  Yes  No

**Other**  
Yes  No

### N. Other Non Cardiac Procedures

**Carotid Endarterectomy**  
Yes  No  Other Vascular  Yes  No  Other Thoracic  Yes  No  Other  Yes  No
O. **Post Operative**

| Postoperative Creatinine Level | ______ |
| Blood Products Used Postoperatively: | Yes | No | If Yes → Red Blood Cell Units | ______ |
| Fresh Frozen Plasma Units | ______ |
| Cryoprecipitate Units | ______ |
| Platelet Units | ______ |
| Extubated in OR: | Yes | No |
| Re-intubated During Hospital Stay: | Yes | No | If Yes → Additional Hours Ventilated: | ______ |

P. **Complications**

| In Hospital Postoperative Complications: | Yes | No |
| Operative: | | |
| ReOp for Bleeding/Tamponade | Yes | No |
| ReOp for Valvular Dysfunction | Yes | No |
| ReOp for Graft Occlusion | Yes | No |
| ReOp for Other Cardiac Reason | Yes | No |
| ReOp for Other Non-Cardiac Reason | Yes | No |
| Perioperative MI | Yes | No |
| Infection: | | |
| Sternum – Deep | Yes | No |
| Thoracotomy | Yes | No |
| Leg | Yes | No |
| Arm | Yes | No |
| Septicemia | Yes | No |

| Neurologic: | | |
| Postoperative Stroke (Perm > 24 hours) | Yes | No |
| Transient Ischemic Attack (TIA) | Yes | No |
| RIND | Yes | No |
| Continuous Coma >=24Hrs | Yes | No |
| Paralysis | Yes | No | If Yes ↓ Paralysis Type: Transient | Permanent |

| Pulmonary: | | |
| Prolonged Ventilation | Yes | No |
| Pulmonary Embolism | Yes | No |
| Pneumonia | Yes | No |

| Renal: | | |
| Renal Failure | Yes | No | If Yes ↓ Dialysis (Newly Required): | Yes | No |
| Illiac/Femoral Dissection | Yes | No |
| Acute Limb Ischemia | Yes | No |

| Vascular: | | |
| Multi-System Failure | Yes | No |
| Atrial Fibrillation | Yes | No |
| Aortic Dissection | Yes | No |
| Other | Yes | No |

| Other: | | |
| Heart Block | Yes | No |
| Cardiac Arrest | Yes | No |
| Anticoagulant Event | Yes | No |
| Tamponade | Yes | No |
| Gastro-Intestinal Event | Yes | No |

Q. **Mortality**

| Mortality: | Yes | No |
| Discharge Status: | Alive | Dead |
| Status at 30 days After Surgery: | Alive | Dead | Unknown |
| Operative Death: | Yes | No |
| Mortality - Date | | (mm/dd/yyyy) |
| Location of Death: | OR during Initial Surgery | Hospital | Home | Other Care Facility | OR during Reoperation | Unknown |
| Primary Cause of Death (select only one) ↓ | Cardiac | Neurologic | Renal | Vascular | Infection | Pulmonary | Valvular | Unknown | Other |
### R. Discharge
(Note: This section is only answered if Discharge Status is Alive)

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<th>Medication Group</th>
<th>Yes</th>
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<tr>
<td>ADP Inhibitors</td>
<td>Yes</td>
<td>No</td>
<td>Contraindicated / Not Indicated</td>
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<td>Antiarrhythmics</td>
<td>Yes</td>
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</tr>
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<td>Aspirin</td>
<td>Yes</td>
<td>No</td>
<td>Contraindicated / Not Indicated</td>
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<tr>
<td>Ace or ARB Inhibitors</td>
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<td>No</td>
<td>Contraindicated / Not Indicated</td>
</tr>
<tr>
<td>Beta Blockers</td>
<td>Yes</td>
<td>No</td>
<td>Contraindicated / Not Indicated</td>
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<td>Lipid Lowering</td>
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<td>No</td>
<td>Contraindicated / Not Indicated</td>
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<td>Coumadin</td>
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<th>Nursing Home</th>
<th>Hospice</th>
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### S. Readmission
(Note: This section is only answered if Discharge Status is Alive)

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<tbody>
<tr>
<td>Anticoagulation Complication – Valvular</td>
<td>OR for Bleeding</td>
</tr>
<tr>
<td>Anticoagulation Complication - Pharmacological</td>
<td>Pacemaker Insertion/AICD</td>
</tr>
<tr>
<td>Arrhythmia/Heart Block</td>
<td>PCI</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>Pericardiomy / Pericardiocentesis</td>
</tr>
<tr>
<td>Myocardial Infarction and/or Recurrent Angina</td>
<td>OR for Coronary Arteries</td>
</tr>
<tr>
<td>Pericardial Effusion and/or Tamponade</td>
<td>OR for Valve</td>
</tr>
<tr>
<td>Pneumonia or other Respiratory Complication</td>
<td>OR for Sternal Debridement / Muscle Flap</td>
</tr>
<tr>
<td>Coronary Artery Dysfunction</td>
<td>Dialysis</td>
</tr>
<tr>
<td>Valve Dysfunction</td>
<td>OR for Vascular</td>
</tr>
<tr>
<td>Infection - Deep Sternum</td>
<td>No Procedure Performed</td>
</tr>
<tr>
<td>Infection – Conduit Harvest Site</td>
<td>Other Procedure</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>Unknown</td>
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<tr>
<td>TIA</td>
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<tr>
<td>Permanent CVA</td>
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<tr>
<td>Acute Vascular Complication</td>
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<tr>
<td>Subacute Endocarditis</td>
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<tr>
<td>VAD Complication</td>
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<tr>
<td>Transplant Rejection</td>
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<tr>
<td>Other – Related Readmission</td>
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<tr>
<td>Other – Nonrelated Readmission</td>
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</tbody>
</table>
C  Appendix

STS DATA ABSTRACTION TOOL [9, 10]
VERSION 2.73

Mass-DAC harvests all optional and not harvested STS variables

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### A. Administrative

<table>
<thead>
<tr>
<th>Participant ID:</th>
<th>Record ID: (software generated)</th>
<th>STS Cost Link:</th>
<th>Patient ID: (software generated)</th>
</tr>
</thead>
</table>

### B. Demographics

**Patient Last Name:** [ ]  
**Patient First Name:** [ ]  
**Patient Middle Name:** [ ]  
**Date of Birth:** __ __/ __/ __ (mm/dd/yyyy)  
**Patient Age:** [ ]  
**Sex:** [ ] Male  
[ ] Female  
**Social Security Number:** [ ]  
**Medical Record Number:** [ ]  
**Patient’s Address:** [ ]  
**Street Address:** [ ]  
**City:** [ ]  
**Region:** [ ]  
**ZIP Code:** [ ]  
**Country:** [ ]  
**Is This Patient’s Permanent Address:** [ ] Yes  
[ ] No  
**Patient’s Permanent Address:** [ ]  
**Street Address:** [ ]  
**City:** [ ]  
**Region:** [ ]  
**ZIP Code:** [ ]  
**Country:** [ ]  
**Race (Select all that apply):**  
- [ ] White: [ ] Yes  
[ ] No  
- [ ] Black/African American: [ ] Yes  
[ ] No  
- [ ] Asian: [ ] Yes  
[ ] No  
- [ ] Native Hawaiian/Pacific Islander: [ ] Yes  
[ ] No  
- [ ] Am Indian/Alaskan Nat: [ ] Yes  
[ ] No  
- [ ] Other: [ ] Yes  
[ ] No  
**Hispanic, Latino or Spanish Ethnicity:** [ ] Yes  
[ ] No  
**Referring Cardiologist:** [ ]  
**Referring Physician:** [ ]

### C. Hospitalization

**Hospital Name:** ______________________  
(If Not Missing →)  
**Hospital ZIP Code:** [ ]  
**Hospital State:** [ ]  
**Hospital National Provider Identifier:** ______________________  
(If Not Missing →)  
**Payor - (Select all that apply):**  
- [ ] Government Health Insurance: [ ] Yes  
[ ] No  
- [ ] Medicare: [ ] Yes  
[ ] No  
(If Yes →)  
- [ ] Medicaid: [ ] Yes  
[ ] No  
- [ ] Commercial Health Insurance: [ ] Yes  
[ ] No  
- [ ] Health Maintenance Organization: [ ] Yes  
[ ] No  
- [ ] State-Specific Plan: [ ] Yes  
[ ] No  
- [ ] Correctional Facility: [ ] Yes  
[ ] No  
**Arrival Date:** __ __/ __/ __ (mm/dd/yyyy)  
**Arrival Time:** __ __:__ __ (hh:mm 24-hour clock)  
**Admit Date:** __ __/ __/ __ (mm/dd/yyyy)  
**Admit Source:**  
- [ ] Elective Admission  
- [ ] Emergency Department  
(If Transfer →)  
- [ ] Transfer in from another acute care facility  
- [ ] Other Hospital Performs Cardiac Surgery: [ ] Yes  
[ ] No  
[ ] Other  
**Surgery Date:** __ __/ __/ __ (mm/dd/yyyy)  
**Discharge Date:** __ __/ __/ __ (mm/dd/yyyy)

### D. Risk Factors

**Weight (kg):** [ ]  
**Height (cm):** [ ]  
**Cigarette Smoker:** [ ] Yes  
[ ] No  
(If Yes →)  
**Current Cigarette Smoker:** [ ] Yes  
[ ] No  
**Other Tobacco Use:** [ ] Yes  
[ ] No  
**Family History of Premature Coronary Artery Disease:** [ ] Yes  
[ ] No  
**Last Hematocrit:** [ ]  
**Last WBC Count:** [ ]  
**Platelet Count Prior to Surgery:** [ ]  
**International Normalized Ratio prior to Surgery:** [ ]  
**HIT Antibodies:** [ ] Yes  
[ ] No  
[ ] Not Applicable  
**Total Bilirubin Prior to Surgery:** [ ]  
**Total Albumin Prior to Surgery:** [ ]  
**A1c Level prior to surgery:** [ ]  
**Last Creatinine Level Prior to Surgery:** [ ]  
**Diabetes:** [ ] Yes  
[ ] No  
(If Yes →)  
**Diabetes-Control:** [ ] None  
[ ] Diet  
[ ] Oral  
[ ] Insulin  
[ ] Other

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Dyslipidemia: ☐ Yes ☐ No  Dialysis: ☐ Yes ☐ No  MELD Score: ______ (System Calculation)  Hypertension: ☐ Yes ☐ No

Infectious Endocarditis: ☐ Yes ☐ No  
(If Yes →) Infectious Endocarditis Type: ☐ Treated ☐ Active
Infectious Endocarditis Culture: ☐ Culture negative ☐ Staphylococcus aureus ☐ Streptococcus species
☐ Coagulase negative staphylococcus ☐ Enterococcus species ☐ Fungal ☐ Other

Chronic Lung Disease: ☐ No ☐ Mild ☐ Moderate ☐ Severe

Pulmonary Function Test Done: ☐ Yes ☐ No  
(If Yes →) FEV1 % Predicted: ______  DLCO Test Performed: ☐ Yes ☐ No  (If Yes →) DLCO % Predicted: ______

Arterial Blood Gas Performed: ☐ Yes ☐ No  (If Yes →) Oxygen Level: ______  Carbon Dioxide Level: ______

Home Oxygen: ☐ Yes ☐ No  Inhaled Medication or Oral Bronchodilator Therapy: ☐ Yes ☐ No

Immunocompromise Present: ☐ Yes ☐ No  Peripheral Artery Disease: ☐ Yes ☐ No

Unresponsive Neurologic State: ☐ Yes ☐ No  Syncope: ☐ Yes ☐ No

Cerebrovascular Disease: ☐ Yes ☐ No  
(If Yes →) Prior CVA: ☐ Yes ☐ No  (If Yes →) Prior CVA-When: ☐ Recent (<2 wk.) ☐ Remote (>2 wk.)
CVD TIA: ☐ Yes ☐ No  
CVD Carotid stenosis: ☐ None ☐ Right ☐ Left ☐ Both  
(If “Right” or “Both” →) Severity of stenosis on the right carotid artery: ☐ 80 - 99% ☐ 100%
(If “Left” or “Both” →) Severity of stenosis on the left carotid artery: ☐ 80 - 99% ☐ 100%

History of previous carotid artery surgery and/or stenting: ☐ Yes ☐ No

Pneumonia: ☐ Yes ☐ No  Remote Medianal Radiation: ☐ Yes ☐ No  Cancer Within 5 Years: ☐ Yes ☐ No

Five Meter Walk Test Done: ☐ Yes ☐ No  (If Yes →) Time 1: ______ (secs)  Time 2: ______ (secs)  Time 3: ______ (secs)

E. Previous Cardiac Interventions

Previous Cardiac Interventions: ☐ Yes ☐ No  (If Yes ↓)

Previous CAB prior to current admission: ☐ Yes ☐ No

Previous Valve: ☐ Yes ☐ No  (If Yes ↓)

Previous Aortic Valve Replacement - Surgical: ☐ Yes ☐ No
Previous Aortic Valve Repair - Surgical: ☐ Yes ☐ No
Previous Mitral Valve Replacement - Surgical: ☐ Yes ☐ No
Previous Mitral Valve Repair - Surgical: ☐ Yes ☐ No
Previous Tricuspid Valve Replacement - Surgical: ☐ Yes ☐ No
Previous Tricuspid Valve Repair - Surgical: ☐ Yes ☐ No
Previous Pulmonic Valve Repair / Replacement - Surgical: ☐ Yes ☐ No
Previous Aortic Valve Balloon Valvuloplasty: ☐ Yes ☐ No
Previous Mitral Valve Balloon Valvuloplasty: ☐ Yes ☐ No
Previous Transcatheter Valve Replacement: ☐ Yes ☐ No

Previous Percutaneous Valve Repair: ☐ Yes ☐ No

Indication for Reoperation: ☐ Structural Prosthetic Valve Deterioration
☐ Non-structural prosthetic valve dysfunction
(If Non-structural prosthetic →) Primary type: ☐ Paravalvular Leak ☐ Hemolysis
☐ Entrapment by pannus, tissue, or suture ☐ Sizing or positioning issue ☐ Other

Prosthetic Valve Endocarditis
☐ Valve Thrombosis
☐ Failed Repair
☐ Repeat valve procedure on a different valve
☐ Other

Exact Date of Previous Valve Procedure Known: ☐ Yes ☐ No
(If Yes →) Date of Previous Valve Procedure: ______ / ______ / ______
(If No →) Estimate Number of Months Since Previous Valve Procedure: ______

Previous Other Cardiac: ☐ Yes ☐ No  (If Yes →) Previous Arrhythmia Surgery: ☐ Yes ☐ No

Previous Congenital: ☐ Yes ☐ No

Previous ICD (Implantable Cardioverter/Defibrillator): ☐ Yes ☐ No

Previous Pacemaker: ☐ Yes ☐ No

Previous PCI (Percutaneous Cardiac Intervention): ☐ Yes ☐ No
(If Yes →) PCI Performed Within This Episode Of Care: ☐ Yes, at this facility ☐ Yes, at some other acute care facility ☐ No
(If Yes →) Indication for Surgery: ☐ PCI Complication
☐ PCI Failure without Clinical Deterioration
☐ PCI/CABG Hybrid Procedure

PCI Stent: ☐ Yes ☐ No  (If Yes →) Stent Type: ☐ Bare metal ☐ Drug-eluting ☐ Unknown

PCI Interval: ☐ <= 6 Hours ☐ > 6 Hours

Other Previous Cardiovascular Intervention: ☐ Yes ☐ No

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F. Preoperative Cardiac Status

Prior Myocardial Infarction: □ Yes □ No (If Yes ↓)

MI When: □ <= 6 Hrs □ > 6 Hrs but <24 Hrs □ 1 to 7 Days □ 8 to 21 Days □ >21 Days

Anginal Classification Within 2 weeks: □ No Symptoms, No Angina □ CCA I □ CCA II □ CCA III □ CCA IV

Heart Failure Within 2 weeks: □ Yes □ No (If Yes →) Classification-NYHA: □ Class I □ Class II □ Class III □ Class IV

Prior Heart failure: □ Yes □ No

Cardiac Presentation on Admission: □ No Symptoms,No Angina □ Symptoms Unlikely to be ischemia □ Stable Angina □ Unstable Angina □ Non-ST Elevation MI (Non-STEMI) □ ST Elevation MI (STEMI)

Cardiogenic Shock : □ Yes □ No

Resuscitation: □ Yes □ No

Arrhythmia When: □ None □ Remote □ Recent (If Recent ↓)

Arrhythmia Type: Vtach/Vfib: □ Yes □ No

Sick Sinus Syndrome: □ Yes □ No

A fibrillation/Aflutter: □ Yes □ No

Type: □ Paroxysmal □ Continuous/Persistent

G. Preoperative Medications

Beta Blockers : □ Yes □ No □ Contraindicated

ACE or ARB: □ Yes □ No

Nitrates-I.V.: □ Yes □ No

Anticoagulants : □ Yes □ No (If Yes →) Medication Name : □ Heparin (Unfractionated) □ Heparin (Low Molecular)

Preoperative Antiarrhythmics: □ Yes □ No

Coumadin: □ Yes □ No

Inotropes : □ Yes □ No

Steroids : □ Yes □ No

Aspirin: □ Yes □ No

Lipid Lowering: □ Yes □ No (If Yes →) Medication Type : □ Statin □ Non-statin □ Both

ADP Inhibitors Within Five Days: □ Yes □ No (If Yes →) ADP Inhibitors Discontinuation: _______ (# days prior to surgery)

Antiplatelets Within 5 Days : □ Yes □ No

Glycoprotein Ilb/Ilia Inhibitor: □ Yes □ No (If Yes →) Medication Name : □ Abciximab (ReoPro) □ Eptifibatide (Integrilin)

Thrombolytics within 48 hours: □ Yes □ No

H. Hemodynamics/Cath/Echo

Cardiac Catheterization Performed: □ Yes □ No (If Yes →)

Number Diseased Vessels: □ None □ One □ Two □ Three

Proximal LAD >= 70%: □ Yes □ No

Ejection Fraction Done: □ Yes □ No (If Yes ↓)

Ejection Fraction: _____ (%)

Ejection Fraction Method: □ LV Gram □ Radionucleotide □ Estimate □ ECHO □ MRI/CT □ Other

LV Systolic Dimension: _______ (mm) □ LV End-Diastolic Dimension: _______ (mm)

PA Systolic Pressure Measured: □ Yes □ No (If Yes →)

PA Systolic Pressure: _______ mmHg (highest prior to surgery)

Aortic Valve Disease: □ Yes □ No (If Yes ↓)

Aortic Etiology:

□ Degenerative (senile)

□ Endocarditis (If Endocarditis→) Root Abscess: □ Yes □ No

□ Congenital (If Congenital→) Type: □ Bicuspid □ Other

□ Rheumatic

□ Primary Aortic Disease: (If PAD→) Type: □ Marfans □ Other Connective tissue disorder

□ Atherosclerotic Aneurysm □ Inflammatory

□ Aortic Dissection □ Idiopathic Root Dilation

□ LV Outflow Tract Obstruction: (If LV outflow tract obstruction→)

Type: □ HOCM □ Sub-aortic membrane □ Sub-aortic Tunnel

□ Supravalvular Aortic Stenosis

□ Tumor: (If Tumor→) Type: □ Myxoma □ Papillary fibroelastoma □ Carcinoid □ Other

□ Trauma □ Other

Aortic Stenosis: □ Yes □ No (If Yes ↓)

Smallest Aortic Valve Area: _______ cm²

Highest Mean Gradient : _______ mmHg

Aortic Insufficiency: □ None □ Trace/Trivial □ Mild □ Moderate □ Severe
<table>
<thead>
<tr>
<th>Mitral Valve Disease: □ Yes □ No (If Yes ↓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral Etiology: □ Annular or Degenerative Disease (If Annular or Degenerative Disease ↓)</td>
</tr>
<tr>
<td>Location: □ Posterior Leaflet □ Anterior Leaflet □ Bileaflet</td>
</tr>
<tr>
<td>Type: □ Pure Annular Dilation □ Mitral Annular Calcification</td>
</tr>
<tr>
<td>□ Endocarditis □ Rheumatic □ Ischemic (If Ischemic→)</td>
</tr>
<tr>
<td>Type: □ Acute (If acute →) Papillary Muscle Rupture: □ Yes □ No □ Chronic</td>
</tr>
<tr>
<td>□ Congenital □ Hypertrophic Obstructive Cardiomyopathy (HOCM) □ Tumor: (If Tumor→) Type: □ Myxoma □ Papillary fibroelastoma □ Carcinoid □ Other</td>
</tr>
<tr>
<td>□ Trauma □ Non-ischemic cardiomyopathy □ Other</td>
</tr>
<tr>
<td>Mitral Valve Disease Functional Class: □ Type I □ Type II □ Type IIIa □ Type IIIb</td>
</tr>
<tr>
<td>Mitral Stenosis: □ Yes □ No (If Yes ↓)</td>
</tr>
<tr>
<td>Smallest Mitral Valve Area: ________ cm²</td>
</tr>
<tr>
<td>Highest Mean Gradient: _________ mm Hg</td>
</tr>
<tr>
<td>Mitral Insufficiency: □ None □ Trace/trivial □ Mild □ Moderate □ Severe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tricuspid Valve Disease: □ Yes □ No (If Yes ↓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricuspid Etiology: □ Functional □ Endocarditis □ Congenital □ Tumor □ Trauma □ Other</td>
</tr>
<tr>
<td>Tricuspid Stenosis: □ Yes □ No</td>
</tr>
<tr>
<td>Tricuspid Insufficiency: □ None □ Trace/trivial □ Mild □ Moderate □ Severe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pulmonic Valve Disease: □ Yes □ No (If Yes ↓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonic Stenosis: □ Yes □ No</td>
</tr>
<tr>
<td>Pulmonic Insufficiency: □ None □ Trace/trivial □ Mild □ Moderate □ Severe</td>
</tr>
</tbody>
</table>

---

I. Operative

Surgeon: _____________________________
Surgeon NPI: __________________________
Taxpayer Identification Number: _______________________

Incidence: □ First cardiovascular surgery □ Third re-op cardiovascular surgery
□ First re-op cardiovascular surgery □ Fourth or more re-op cardiovascular surgery
□ Second re-op cardiovascular surgery

Status: □ Elective (If Urgent↓)
□ Urgent |
| Reason: □ AMI □ IABP □ Worsening CP □ CHF □ Anatomy □ USA □ Rest Angina |
| □ Valve Dysfunction □ Aortic Dissection □ Angiographic Accident □ Cardiac Trauma |
| □ Infected Device □ Syncope □ PCI/CABG Hybrid □ PCI Failure w/out clinical deterioration |

□ Emergent (If Emergent↓)
| □ Ongoing Ischemia □ Valve Dysfunction □ Aortic Dissection |
| □ Angiographic Accident □ Cardiac Trauma □ Infected Device □ Syncope |
| □ PCI/CABG Hybrid □ Anatomy |

□ Emergent Salvage

Was case previously attempted during this admission, but canceled: □ Yes □ No (If Yes→)
| Date of previous case: ____/____/____ (mm/dd/yyyy) |
| Timing of previous case: □ Prior to induction of anesthesia □ After induction, prior to incision |
| □ After incision made |
| Reason previous case was canceled: □ Anesthesiology event □ Cardiac arrest □ Equipment/supply issue |
| □ Unanticipated tumor □ Other |

Planned previous procedure: CAGB □ Yes □ No □ Valve □ Yes □ No
□ Mechanical Assist Device □ Yes □ No □ Other Cardiac □ Yes □ No
□ Other Non-cardiac □ Yes □ No
Was the current procedure canceled: □ Yes □ No
  (If Yes →)  
  Canceled Reason: □ Anesthesiology event □ Cardiac arrest □ Equipment/supply issue □ Unanticipated tumor □ Other
  Planned procedure: CABG □ Yes □ No  □ Other Cardiac □ Yes □ No  
  Mechanical Assist Device □ Yes □ No  □ Other Non-cardiac □ Yes □ No

Operative Approach: □ Full conventional sternotomy □ Partial sternotomy □ Right or left parasternal incision □ Left Thoracotomy □ Right Thoracotomy □ Transverse sternotomy (includes clamshell) □ Minimally invasive

Robotic Technology Assisted: □ Yes □ No

Coronary Artery Bypass: □ Yes □ No  
  (If “Yes” complete Section J)

Valve Surgery: □ Yes □ No  
  (If Yes→)  (If “Yes” complete Section K)

Valve Prosthesis Explant: □ Yes □ No  
  Explant Position: □ Aortic □ Mitral □ Tricuspid □ Pulmonic
  Explant Type: □ Unknown □ Mechanical Valve □ Bioprosthetic Valve □ Annuloplasty Device □ Mitral Clip □ Transcatheter Device
  Explant Device: _______  (Refer to Explant Device Key below)

Second Valve Prosthesis Explant: □ Yes □ No  
  Explant Position: □ Aortic □ Mitral □ Tricuspid □ Pulmonic
  Explant Type: □ Unknown □ Mechanical Valve □ Bioprosthetic Valve □ Annuloplasty Device □ Mitral Clip □ Transcatheter Device
  Explant Device: _______  (Refer to Explant Device Key below)

Explant Device Key  (Note this list is different from the implant list used below).

<table>
<thead>
<tr>
<th>Device</th>
<th>Manufacturer</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = CarboMedics CarboSeal Ascending Aortic Valved Conduit Prosthesis</td>
<td>Medtronic-OmniScience Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>2 = ATS Mechanical Prosthesis</td>
<td>Medtronic Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>3 = Björk-Shiley Convex-Concave Mechanical Prosthesis</td>
<td>St. Jude Medical Mechanical Heart Valve</td>
<td></td>
</tr>
<tr>
<td>4 = Björk-Shiley Monostrut Mechanical Prosthesis</td>
<td>St. Jude Medical Masters Series Mechanical Heart Valve</td>
<td></td>
</tr>
<tr>
<td>5 = CarboMedics CarboSeal Ascending Aortic Valved Conduit Prosthesis</td>
<td>St. Jude Medical Masters Series Aortic Valve Graft Prosthesis</td>
<td></td>
</tr>
<tr>
<td>6 = CarboMedics Mechanical Prosthesis</td>
<td>St. Jude Medical Mechanical Heart Valve Hemodynamic Plus (HP) Series</td>
<td></td>
</tr>
<tr>
<td>7 = CarboMedics CarboSeal Valsalva Ascending Aortic Valved Conduit Prosthesis</td>
<td>St. Jude Medical Masters Series Hemodynamic Plus Valve with FlexCuff Sewing Ring</td>
<td></td>
</tr>
<tr>
<td>8 = CarboMedics CarboSeal Ascending Aortic Valved Conduit Prosthesis</td>
<td>Sorin Biocare Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>9 = Medtronic ADVANTAGE Mechanical Prosthesis</td>
<td>Sorin Biocare Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>10 = MCRI On-X Mechanical Prosthesis</td>
<td>Sorin Biocare Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>11 = Medtronic-Hall/Hall Easy-Fit Mechanical Prosthesis</td>
<td>Sorin Biocare Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>12 = Sorin Monoleaflet Aicarbon Mechanical Prosthesis</td>
<td>Sorin Biocare Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>13 = St. Jude Medical Mechanical Heart Valve</td>
<td>Sorin Biocare Mechanical Prosthesis</td>
<td></td>
</tr>
<tr>
<td>14 = Starr-Edwards Caged-Ball Prosthesis</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>15 = Ultraroc Mechanical Prosthesis</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>16 = Medtronic-Hall Mechanical Prosthesis</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>17 = Medtronic-Hall/Hall Easy-Fit Mechanical Prosthesis</td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

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Bioprosthesis

108 = ATS Simulus Flex-O Ring
72 = Edwards Prima Stentless Porcine Bioprosthesis - Subcoronary
73 = Edwards Prima Stentless Porcine Bioprosthesis - Root
19 = Bicor Porcine Bioprosthesis
74 = Bicor Stentless Porcine Bioprosthesis - Subcoronary
75 = Bicor Stentless Porcine Bioprosthesis - Root
21 = CarboMedics PhotoFix Pericardial Bioprosthesis
76 = Carpentier-Edwards Porcine Bioprosthesis
77 = Edwards Prima Plus Stentless Porcine Bioprosthesis - Subcoronary
78 = Edwards Prima Plus Stentless Porcine Bioprosthesis - Root
22 = Carpentier-Edwards PERIMOUNT Pericardial Bioprosthesis
103 = Carpentier-Edwards PERIMOUNT Pericardial Magna Bioprosthesis
23 = Carpentier-Edwards Standard Porcine Bioprosthesis
25 = Carpentier-Edwards Supra-Annular Aortic Porcine Bioprosthesis
79 = CryoLife O'Brien Stentless Porcine Bioprosthesis - Subcoronary
80 = CryoLife O'Brien Stentless Porcine Bioprosthesis - Root
55 = Hancock Standard Porcine Bioprosthesis
26 = Hancock II Porcine Bioprosthesis
29 = Hancock Modified Orifice Porcine Bioprosthesis
30 = Ionescu-Shiley Pericardial Bioprosthesis
31 = Laborc Stented Porcine Bioprosthesis
81 = Laborc Stentless Porcine Bioprosthesis - Subcoronary
82 = Laborc Stentless Porcine Bioprosthesis - Root
83 = Medtronic Freestyle Stentless Porcine Bioprosthesis - Subcoronary
84 = Medtronic Freestyle Stentless Porcine Bioprosthesis - Root
35 = Medtronic Intact Porcine Bioprosthesis
36 = Medtronic Mosaic Porcine Bioprosthesis
89 = CryoLife Aortic Homograft
90 = CryoLife Pulmonary Homograft
91 = CryoLife CryoValve SG(Decellularized)Aortic Homograft
92 = CryoLife CryoValve SG Pulmonary Homograft
41 = Homograft Aortic - Subcoronary

Autograft

45 = Pulmonary Autograft to aortic root (Ross Procedure)

Ring - Annuloplasty

109 = ATS Simulus Flex-O Ring
94 = CarboMedics AnnuoFlo Ring
95 = CarboMedics AnnuoFloX Ring
96 = CarboMedics CardioFix Bovine Pericardium with PhotoFix Technology
46 = Carpentier-Edwards Classic Annuloplasty Ring
104 = Carpentier-Edwards Geoflex Ring
105 = Carpentier-Edwards IMR Etlogix Ring
47 = Carpentier-Edwards Physio Annuloplasty System Ring
48 = Cosgrove-Edwards Annuloplasty System Ring
97 = Edwards MC TS Triucipid Annuloplasty System
98 = Genesee Sculptor Annuloplasty Ring
49 = Medtronic Sculptor Ring
50 = Medtronic-Duran Ancore Ring
51 = Sorin-Puig-Messana Ring

Band - Annuloplasty

100 = Medtronic Colvin Galloway Future Band
101 = Medtronic Duran Band
102 = Medtronic Duran - Ancore Band

Other

577 = Other

VAD Implanted or Removed: □ No □ Yes, implanted □ Yes, explanted □ Yes, implanted and explanted (If “Yes” complete Section L)

Other Cardiac Procedure: □ Yes □ No (If “Yes” complete Section M)

Other Non-Cardiac Procedure: □ Yes □ No (If “Yes” complete Section N)

Unplanned: □ No

Procedure: □ Yes, unsuspected patient disease or anatomy
□ Yes, surgical complication (If Yes )

Unplanned CABG: □ Yes □ No
Unplanned Aortic Valve Procedure: □ Yes □ No
Unplanned Mitral Valve Procedure: □ Yes □ No
Unplanned Aorta Procedure: □ Yes □ No
Unplanned VAD Insertion: □ Yes □ No
Unplanned Other Procedure: □ Yes □ No

Enter up to 10 CPT-1 Codes pertaining to the surgery for which the data collection form was initiated:

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

OR Entry Date And Time: __/__/_______:____ mm/dd/yyyy hh:mm - 24 hr clock

OR Exit Date And Time: __/__/_______:____ mm/dd/yyyy hh:mm - 24 hr clock

Initial Intubation Date and Time: __/__/_______:____ mm/dd/yyyy hh:mm - 24 hr clock

Initial Extubation Date and Time: __/__/_______:____ mm/dd/yyyy hh:mm - 24 hr clock
<table>
<thead>
<tr>
<th>Appropriate Antibiotic Selection:</th>
<th>Appropriate Antibiotic Administration Timing:</th>
<th>Appropriate Antibiotic Discontinuation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No ☐ Exclusion</td>
<td>☐ Yes ☐ No ☐ Exclusion</td>
<td>☐ Yes ☐ No ☐ Exclusion</td>
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<table>
<thead>
<tr>
<th>CPB Utilization:</th>
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<tbody>
<tr>
<td>☐ None</td>
</tr>
<tr>
<td>☐ Combination (If Combination)</td>
</tr>
<tr>
<td>Combination Plan:</td>
</tr>
<tr>
<td>☐ Planned</td>
</tr>
<tr>
<td>☐ Unplanned</td>
</tr>
<tr>
<td>(If Unplanned) Reason:</td>
</tr>
<tr>
<td>☐ Exposure/visualization</td>
</tr>
<tr>
<td>☐ Bleeding</td>
</tr>
<tr>
<td>☐ Inadequate size and/or diffuse disease of distal vessel</td>
</tr>
<tr>
<td>☐ Hemodynamic instability (hypotension/arrhythmias)</td>
</tr>
<tr>
<td>☐ Conduit quality and/or trauma</td>
</tr>
<tr>
<td>☐ Other</td>
</tr>
<tr>
<td>☐ Full</td>
</tr>
<tr>
<td>(If &quot;Combination&quot; or &quot;Full&quot;)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circulatory Arrest:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No (If Yes)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circulatory Arrest Without Cerebral Perfusion Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____ (min)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circulatory Arrest With Cerebral Perfusion:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No (If Yes—→)</td>
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</table>

<table>
<thead>
<tr>
<th>Cardiopulmonary Bypass Time (minutes):</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________ (min)</td>
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</table>

<table>
<thead>
<tr>
<th>Lowest Temperature (°C):</th>
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<tbody>
<tr>
<td>___________</td>
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<table>
<thead>
<tr>
<th>Lowest Hematocrit:</th>
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<tbody>
<tr>
<td>___________</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Arterial Cannulation Site:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Select all that apply—→)</td>
</tr>
<tr>
<td>☐ Aortic ☐ Yes ☐ No ☐ No</td>
</tr>
<tr>
<td>☐ Femoral ☐ Yes ☐ No ☐ No</td>
</tr>
<tr>
<td>☐ Other ☐ Yes ☐ No ☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Venous Cannulation Site:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Select all that apply—→)</td>
</tr>
<tr>
<td>☐ Femoral ☐ Yes ☐ No ☐ No</td>
</tr>
<tr>
<td>☐ Jugular ☐ Yes ☐ No ☐ No</td>
</tr>
<tr>
<td>☐ Right Atrial ☐ Yes ☐ No ☐ No</td>
</tr>
<tr>
<td>☐ Left Atrial ☐ Yes ☐ No ☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cardiopulmonary Bypass Time (minutes):</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________ (min)</td>
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</table>

<table>
<thead>
<tr>
<th>Cerebral Perfusion Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________ (min)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cerebral Perfusion Type:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Antegrade ☐ Retrograde ☐ Both antegrade and retrograde</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aortic Occlusion:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ None - beating heart</td>
</tr>
<tr>
<td>☐ None - fibrillating heart</td>
</tr>
<tr>
<td>☐ Aortic Crossclamp (If &quot;Aortic crossclamp&quot; or &quot;Balloon occlusion&quot; —→): Cross Clamp Time:</td>
</tr>
<tr>
<td>___________ (min)</td>
</tr>
<tr>
<td>☐ Balloon Occlusion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cardioplegia Delivery:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ None ☐ Antegrade ☐ Retrograde ☐ Both</td>
</tr>
<tr>
<td>(If &quot;Antegrade&quot;, &quot;Retrograde&quot; or &quot;Both&quot;—→)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of cardioplegia used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Blood ☐ Crystalloid ☐ Both ☐ Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cerebral Oximetry Used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No (If Yes—→)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Induction Baseline Regional Oxygen Saturation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left: _____ (%)</td>
</tr>
<tr>
<td>Right: _____ (%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cumulative Saturation Below Threshold:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left: _____ (min -%)</td>
</tr>
<tr>
<td>Right: _____ (min -%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cerebral Oximeter Provided First Indication:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skin Closure Regional Oxygen Saturation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left: _____ (%)</td>
</tr>
<tr>
<td>Right: _____ (%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentric Calcification:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Echo Assessment of Ascending Aorta/Arch:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No (If Yes—→)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment of Aorta Disease:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Normal Aorta</td>
</tr>
<tr>
<td>☐ Extensive intimal thickening</td>
</tr>
<tr>
<td>☐ Protruding Atheroma &lt; 5 mm</td>
</tr>
<tr>
<td>☐ Protruding Atheroma &gt;= 5 mm</td>
</tr>
<tr>
<td>☐ Mobile plaques</td>
</tr>
<tr>
<td>☐ Not documented</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Assessment Altered Plan:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Intraop Blood Products Used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No</td>
</tr>
<tr>
<td>(If No—→)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Intraop Blood Products Refused:</th>
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<tbody>
<tr>
<td>☐ Yes ☐ No</td>
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<tr>
<td>(If Yes—→)</td>
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</table>

<table>
<thead>
<tr>
<th>Red Blood Cell Units:</th>
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</thead>
<tbody>
<tr>
<td>___________</td>
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<table>
<thead>
<tr>
<th>Fresh Frozen Plasma Units:</th>
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</thead>
<tbody>
<tr>
<td>___________</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Cryoprecipitate Units:</th>
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</thead>
<tbody>
<tr>
<td>___________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Platelet Units:</th>
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</thead>
<tbody>
<tr>
<td>___________</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor VIII:</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Intraop Antifibrinolytic Medications:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Epsilon Amino-Caproic Acid: ☐ Yes ☐ No</td>
</tr>
<tr>
<td>Tranexamic Acid: ☐ Yes ☐ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intraoperative TEE Performed post procedure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Yes ☐ No (If Yes—→)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest level aortic insufficiency found:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ None ☐ Trace/trivial ☐ Mild ☐ Moderate ☐ Severe</td>
</tr>
<tr>
<td>Highest level mitral insufficiency found:</td>
</tr>
<tr>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>☐ None ☐ Trace/trivial ☐ Mild ☐ Moderate ☐ Severe</td>
</tr>
<tr>
<td>Highest level tricuspid insufficiency found:</td>
</tr>
<tr>
<td>----------------------------------------------</td>
</tr>
<tr>
<td>☐ None ☐ Trace/trivial ☐ Mild ☐ Moderate ☐ Severe</td>
</tr>
<tr>
<td>J. Coronary Bypass</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Hybrid Procedure CAB and PCI Performed:</strong> □ Yes □ No (If Yes ↓)</td>
</tr>
<tr>
<td><strong>Status:</strong> □ Planned - concurrent □ Planned - staged □ Unplanned</td>
</tr>
<tr>
<td><strong>PCI Procedure Performed:</strong> □ Angioplasty □ Stent</td>
</tr>
</tbody>
</table>
| **Number of Distal Anastomoses with Arterial Conduits:** _______
| **Number of Distal Anastomoses with Venous Conduits:** _______ (If >0 ↓) |
| **Vein Harvest Technique:** □ Endoscopic □ Direct Vision (open) □ Both □ Cryopreserved |
| **(If “Endoscopic”, “Direct Vision (open)” or “Both” →)** |
| **Saphenous Vein Harvest Time:** ______ (minutes) |
| **Saphenous Vein Preparation Time:** ______ (minutes) |
| **Internal Mammary Artery used for Grafts:** □ Left IMA □ Right IMA □ Both IMAs □ No IMA |
| **(If No IMA →)** Indicate *Primary* Reason: □ The IMA is not a suitable conduit due to size or flow |
| □ Subclavian stenosis □ Previous cardiac or thoracic surgery □ Previous mediastinal radiation |
| □ Emergent or salvage procedure □ No LAD disease |
| **(If Left, Right or Both IMAs →)** Total # of Distal Anastomoses done using IMA grafts: _______
| **IMA Harvest Technique:** □ Direct Vision (open) □ Thoracoscopy □ Combination □ Robotic Assist |
| **Number of Radial Arteries Used for Grafts:** _______ (If >0 ↓) |
| **Number of Radial Artery Distal Anastomoses:** _______
| **Radial Distal Anastomoses Harvest Technique:** □ Endoscopic □ Direct Vision (open) □ Both |
| **Radial Artery Harvest Time:** _______ (minutes) |
| **Radial Artery Preparation Time:** _______ (minutes) |
| **Number Other Arterial Distal Anastomoses Used (other than radial or IMA): _________** |
### Native Coronary Disease Location Key:

<table>
<thead>
<tr>
<th>Location</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Main</td>
<td>1</td>
</tr>
<tr>
<td>Prox LAD</td>
<td>2</td>
</tr>
<tr>
<td>Mid LAD</td>
<td>3</td>
</tr>
<tr>
<td>Prox ROC</td>
<td>4</td>
</tr>
<tr>
<td>Diagonal 1</td>
<td>5</td>
</tr>
<tr>
<td>Diagonal 2</td>
<td>6</td>
</tr>
<tr>
<td>Circumflex</td>
<td>7</td>
</tr>
<tr>
<td>OM 1</td>
<td>8</td>
</tr>
<tr>
<td>OM 2</td>
<td>9</td>
</tr>
<tr>
<td>RCA</td>
<td>10</td>
</tr>
<tr>
<td>PLB</td>
<td>11</td>
</tr>
<tr>
<td>PDA</td>
<td>12</td>
</tr>
<tr>
<td>Ramus</td>
<td>13</td>
</tr>
</tbody>
</table>

### For each question, check the one choice that applies for each graft:

<table>
<thead>
<tr>
<th>CABG NUMBER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td><strong>Graft done</strong></td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Previous conduit</strong></td>
<td>Yes - Diseased</td>
<td>Yes - No disease</td>
<td>No previous conduit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Proximal site</strong></td>
<td>In Situ Mammary</td>
<td>Ascending aorta</td>
<td>Descending aorta</td>
<td>Subclavian artery</td>
<td>Innominate artery</td>
<td>T-graft off SVG</td>
<td>T-graft off Radial</td>
<td>T-graft off LIMA</td>
<td>T-graft off RIMA</td>
<td></td>
</tr>
<tr>
<td><strong>Proximal technique</strong></td>
<td>In Situ Mammary</td>
<td>Running</td>
<td>Interrupted</td>
<td>Anastomotic Device</td>
<td>Anastomotic Assist Device</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conduit</strong></td>
<td>Vein graft</td>
<td>In Situ LIMA</td>
<td>In Situ RIMA</td>
<td>Free IMA</td>
<td>Radial artery</td>
<td>Other arteries, homograft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Distal insertion site</strong></td>
<td>Right Coronary (RCA)</td>
<td>Acute Marginal (AM)</td>
<td>Posterior Descending Artery (PDA)</td>
<td>Posterolateral Branch (PLB)</td>
<td>Proximal LAD</td>
<td>Mid LAD</td>
<td>Distal LAD</td>
<td>Diagonal 1</td>
<td>Diagonal 2</td>
<td>Ramus</td>
</tr>
<tr>
<td><strong>Distal technique</strong></td>
<td>Running</td>
<td>Interrupted</td>
<td>Clips</td>
<td>Anastomotic device</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Distal position</strong></td>
<td>End to Side</td>
<td>Sequential (side to side)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Endarterectomy</strong></td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Hybrid</strong></td>
<td>No</td>
<td>Angioplasty</td>
<td>Stent</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### K. Valve Surgery
(If Valve Surgery=Yes ↓)

**Aortic Valve Procedure Performed:** □ Yes □ No
(If Yes ↓)
- Procedure Performed:
  - □ Replacement
  - □ Repair / Reconstruction
  - **Primary Repair Type:** (Select all that apply)
    - Commissural Annuloplasty □ Yes □ No
    - Leaflet plication □ Yes □ No
    - Leaflet free edge reinforcement (PTFE) □ Yes □ No
    - Leaflet commissural resuspension suture □ Yes □ No
  - Division of fused leaflet raphe □ Yes □ No
  - □ Root Reconstruction with valved conduit
  - □ Replacement and insertion aortic non-valved conduit
  - □ Resuspension AV without replacement of ascending aorta
  - □ Resuspension AV with replacement of ascending aorta
  - □ Apico-aortic conduit (Aortic valve bypass)
  - □ Autograft with pulmonary valve-Ross procedure
  - □ Homograft
  - □ Valve sparing root reimplantation (David)
  - □ Valve sparing root remodeling (Yacoub)
- **Transcatheter Valve Replacement:** □ Yes □ No
  (If Yes →) Replacement approach: □ Transapical □ Transaxillary □ Transfemoral

**Aortic Annular Enlargement:** □ Yes □ No
Resection of sub-aortic stenosis: □ Yes □ No

**Implant Model Number:** __________________________ Size: ___________

### Mitral Valve Procedure Performed: □ Yes □ No
(If Yes ↓)
- Procedure Performed:
  - □ Repair
    - (If Repair→) Repair Type: (Select all that apply)
      - Annuloplasty □ Yes □ No
      - Leaflet Resection □ Yes □ No
      - Sliding Plasty □ Yes □ No
      - Annular decalcification □ Yes □ No
      - Neochords (PTFE) □ Yes □ No
      - Chordal /Leaflet transfer □ Yes □ No
      - Leaflet extension/replacement/patch □ Yes □ No
      - Edge to Edge Repair □ Yes □ No
      - Mitral commissurotomy □ Yes □ No
  - □ Replacement
    - (If Replacement→) Repair attempted prior to Mitral Valve Replacement: □ Yes □ No
- **Implant Model Number:** __________________________ Size: ___________
- **Mitral Chords Preserved:** □ None □ Anterior □ Posterior □ Both

### Tricuspid Valve Procedure Performed:
□ No
□ Annuloplasty only
□ Replacement
□ Reconstruction with Annuloplasty
□ Reconstruction without Annuloplasty
□ Valvectomy

**Implant Model Number:** __________________________ Size: ___________

### Pulmonic Valve Procedure Performed:
□ No
□ Replacement
□ Reconstruction
□ Valvectomy

**Implant Model Number:** __________________________ Size: ___________
### L. Mechanical Cardiac Assist Devices

#### Intra Aortic Balloon Pump (IABP)
- **Primary Reason for Insertion:**
  - Hemodynamic instability
  - PTCA Support
  - Unstable Angina
  - CPB Weaning Failure
  - Prophylactic

- **Date IABP Removed:** __/__/____ (mm/dd/yyyy)

#### Catheter Based Assist Device Used
- **Device:**
  - Impella
  - Tandem Heart
  - Other

- **When Inserted:**
  - Preop
  - Intraop
  - Postop

- **Primary Reason for Insertion:**
  - Hemodynamic instability
  - CPB weaning failure
  - PCI failure
  - Other

- **Date Device Removed:** __/__/____ (mm/dd/yyyy)

#### Extracorporeal Membrane Oxygenation (ECMO)
- **ECMO Initiated:**
  - Preop
  - Intraop
  - Postop

- **Clinical Indication for ECMO Placement:**
  - Cardiac Failure
  - Respiratory Failure
  - Hypothermia
  - Rescue/salvage

#### Previous VAD
- **VAD Discharge Status:**
  - With VAD
  - Without VAD
  - Expired in Hospital

- **Additional Complications (not specific to initial VAD as above) to be collected in Postoperative Events section:**
  - Bowel Obstruction
  - Hemolysis
  - Endocarditis
  - Pump Pocket Infection
  - Endocarditis
  - Driveline and/or cannula Infection
  - Embolic Stroke
  - Intracranial Bleed

#### References to “Initial VAD” refer to the initial VAD for this hospitalization, not a VAD placed during a previous hospitalization.

#### VAD Implant Type
- **Right VAD (RVAD)**
- **Left VAD (LVAD)**
- **Biventricular VAD (BiVAD)**
- **Total Artificial Heart (TAH)**

#### VAD Device
- **Indication for this VAD:**
  - 1. Cardiac Transplant
  - 2. Recovery
  - 3. Device Transfer
  - 4. Device-Related Infection
  - 5. Device Malfunction
  - 6. End of Life

#### Initial Implanted Data

<table>
<thead>
<tr>
<th>Implant Type</th>
<th>VAD Device</th>
<th>Implant Date</th>
<th>Explant</th>
<th>Explant Date</th>
<th>Explant Reason</th>
<th>Transplant Date</th>
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<td>Yes</td>
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#### Additional Implant(s) Data

#### Second Device Implanted
- **Implant Type#2**
- **VAD Device #2**
- **Implant Date#2** __/__/____
- **Explant#2** __/__/____
- **Explant Reason#2**
- **Transplant Date#2** __/__/____

#### Third Device Implanted
- **Implant Type#3**
- **VAD Device #3**
- **Implant Date#3** __/__/____
- **Explant#3** __/__/____
- **Explant Reason#3**
- **Transplant Date#3** __/__/____

#### Primary VAD Complications Data

- **Intracranial Bleed**
- **Embolic Stroke**
- **Driveline and/or cannula Infection**
- **Pump Pocket Infection**
- **Device Malfunction**
- **Hemolysis**
- **Bowel Obstruction**

**Additional Complications (not specific to initial VAD as above) to be collected in Postoperative Events section:**

- **VAD Discharge Status:**
  - With VAD
  - Without VAD
  - Expired in Hospital
### M. Other Cardiac Procedure

(If Other Card = Yes ↓)

- **Left Ventricular Aneurysm Repair:** □ Yes □ No
- **Ventricular Septal Defect Repair:** □ Yes □ No

#### Surgical Ventricular Repair

- **Atrial Septal Defect Repair:** □ Yes □ No
  - (If Yes →) ASD Type: □ Secundum □ Sinus Venosus □ PFO

- **Other Cardiac Procedure:** □ Yes □ No
  - **Carotid Endarterectomy:** □ Yes □ No
  - **Other Vascular:** □ Yes □ No
  - **Other Thoracic:** □ Yes □ No
  - **Other:** □ Yes □ No

#### Congenital Defect Repair

- **Diagnosis 1:** □ Secundum □ Sinus Venosus □ PFO

#### Congenital Diagnoses

- **Diagnosis 2:** □ Secundum □ Sinus Venosus □ PFO

#### Congenital Procedures

- **Diagnosis 3:** □ Secundum □ Sinus Venosus □ PFO

#### Transmyocardial Laser Re-vascularization (TMR):

- □ Yes □ No

#### Cardiac Trauma:

- □ Yes □ No

#### Cardiac Transplant:

- □ Yes □ No

#### Arrhythmia Correction Surgery

- □ None □ Permanent Pacemaker
  - □ Permanent Pacemaker with Cardiac Resynchronization Technique (CRT)
  - □ Implantable Cardioverter Defibrillator (ICD)
  - □ ICD with CRT
  - □ Other

(If not None →)

#### Arrhythmia Correction Surgery Lead Insertion or Replacement:

- □ Yes □ No

#### Atrial Fibrillation Surgical Procedure

- □ Yes □ No

(If Yes →)

- **Surgical Procedure Location:** □ Biatrial □ Left atrial only □ Right atrial only
- **Left Atrial Appendage Obliterated** □ Yes □ No

#### Method of Lesion Creation (Select all that apply)

- □ Radio frequency □ Cryo □ Laser
- □ Ultrasound □ Microwave □ Cut-and-sew

#### Atrial Fibrillation Ablation Procedure

- □ Primarily epicardial procedure (e.g., pulmonary vein isolation with or without connection to left atrial appendage).
- □ Primarily intracardiac procedure (e.g., Maze procedures; lesions to mitral annulus; etc.)

#### Aortic Procedure Type

- □ None

- □ Aneurysm
  - □ Aortic Root: □ Yes □ No
  - □ Dacron graft used: □ Yes □ No
  - □ Repair of ascending aortic aneurysm: □ Yes □ No
  - □ Repair of aneurysm in the arch of the aorta: □ Yes □ No
    - (If Yes →) Extent of repair: □ Hemi-arch □ Total arch
  - □ Repair of a descending aortic aneurysm: □ Yes □ No
    - (If Yes →) Graft replacement used: □ Yes □ No
      - (If Yes →) Intercostal vessels re-implanted: □ Yes □ No
        - □ CSF drainage utilized: □ Yes □ No
          - Extent of descending aorta replacement:
            □ Proximal □ Mid □ Distal
            □ Proximal - Mid
            □ Proximal - Mid - Distal
            □ Mid - Distal

- □ Dissection (including intramural hematoma)
  - □ Trauma
  - □ Coarctation
  - □ Other

#### Endovascular Procedure (TEVAR):

- □ Yes □ No

(If Yes →) Endovascular Debranching: □ Yes □ No

#### Tumor Resection:

- □ None □ Myxoma □ Fibroelastoma □ Hypernephroma □ Sarcoma □ Other

#### Pulmonary Thromboembolectomy:

- □ None □ Yes, Acute □ Yes, Chronic

#### Other:

- □ Yes □ No

---

**N. Other Non Cardiac Procedures**

(If Other Non-Card = Yes ↓)

- **Carotid Endarterectomy:** □ Yes □ No
- **Other Vascular:** □ Yes □ No
- **Other Thoracic:** □ Yes □ No
- **Other:** □ Yes □ No

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O. Post Operative

Postoperative Creatinine Level: □ Yes □ No (If Yes ↓)

Blood Products Used Postoperatively: □ Yes □ No (If Yes ↓)

- Red Blood Cell Units: ______
- Fresh Frozen Plasma Units: ______
- Cryoprecipitate Units: ______
- Platelet Units: ______

Exhusted in OR: □ Yes □ No

Re-intubated During Hospital Stay: □ Yes □ No (If yes →) Additional Hours Ventilated: ______

ICU Visit: □ Yes □ No (If Yes ↓)

Initial ICU Hours: ______

Readmission to ICU: □ Yes □ No (If Yes ↓) Additional ICU Hours: ______

Post Op Echo Performed: □ Yes □ No (If Yes ↓)

- Post Op Ejection Fraction Done: □ Yes □ No
- Post Op Ejection Fraction: (%)

Cardiac Enzymes (biomarkers) Drawn: □ Yes □ No (If Yes ↓)

- Peak CKMB: ______
- Peak Troponin I ______
- Peak Troponin T ______

12-Lead EKG Findings: □ Not performed □ No significant changes □ New Pathological Q-wave or LBBB

Imaging Study Findings:

- □ Not performed
- □ Angiographic evidence of new thrombosis or occlusion of graft or native coronary
- □ Imaging evidence of new loss of viable myocardium
- □ No evidence of new myocardial injury

P. Postoperative Events

In Hospital Postoperative Event Occurred: □ Yes □ No (If Yes ↓)

Operative

- ReOp for Bleeding/Tamponade: □ Yes □ No (If Yes →)
- Bleed Timing: □ Acute □ Late
- ReOp for Valvular Dysfunction: □ Yes □ No
- ReOp for Graft Occlusion: □ Yes □ No
- ReOp for Other Cardiac Reasons: □ Yes □ No
- ReOp for Other Non-Cardiac Reasons: □ Yes □ No

- Open chest with planned delayed sternal closure: □ Yes □ No
- Sternotomy Issue: □ Yes □ No (If Yes ↓)

Infection (see CDC definitions in training manual)

- Surgical Site Infection: □ Yes □ No (If Yes ↓)
- Sternal Superficial Wound Infection: □ Yes □ No
- Deep Sternal Infection: □ Yes □ No
- Mediastinitis: □ Yes □ No (If Yes ↓)
- Diagnosis Date: ___ / ___ / ___ (mm/dd/yyyy)
- Secondary Procedure Open with Packing/Irrigation: □ Yes □ No
- Secondary Procedure Wound Vac: □ Yes □ No
- Secondary Procedure Muscle Flap: □ Yes □ No
- Secondary Procedure Omental Flap: □ Yes □ No
- Thoracotomy: □ Yes □ No
- Conduit Harvest or Cannulation Site: □ Yes □ No
- Wound Intervention - Open with Packing/Irrigation: □ Yes □ No
- Wound Intervention - Wound Vac - □ Yes □ No
- Sepsis: □ Yes □ No (If Yes ↓)

Neurologic

- Postoperative Stroke (Perm>24 hours): □ Yes □ No
- Transient Ischemic Attack (TIA): □ Yes □ No
- Encephalopathy: □ None □ Anoxic □ Embolic □ Drug □ Metabolic □ Intracranial Bleeding □ Other
- Paralysis: □ Yes □ No (If Yes ↓)

Pulmonary

- Prolonged Ventilation: □ Yes □ No
- Pneumonia: □ Yes □ No
- Venous Thromboembolism - VTE: □ Yes □ No (If Yes ↓)
- Pulmonary Thromboembolism: □ Yes □ No
- Deep Venous Thrombosis: □ Yes □ No
- Pleural Effusion Draining: □ Yes □ No

Renal

- Renal Failure: □ Yes □ No (If Yes ↓)
- Dialysis (Newly Required): □ Yes □ No (If Yes ↓)
- Ultra Filtration Required: □ Yes □ No

Vascular

- Iliac/Femoral Dissection: □ Yes □ No
- Acute Limb Ischemia: □ Yes □ No

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Other
Rhythm Disturbance Requiring Permanent Device: □ Pacemaker □ ICD □ Pacemaker/ICD □ None
Cardiac Arrest: □ Yes □ No
Anticoagulant Event: □ Yes □ No
Tamponade (Non-Surgical Intervention): □ Yes □ No
Gastro-Intestinal Event: □ Yes □ No
Multi-System Failure: □ Yes □ No
Atrial Fibrillation: □ Yes □ No
Aortic Dissection: □ Yes □ No
Recurrent Laryngeal Nerve Injury: □ Yes □ No
Phrenic Nerve Injury: □ Yes □ No
Other: □ Yes □ No

Q. Mortality
Mortality: □ Yes □ No | Discharge Status: □ Alive □ Dead | Status at 30 days After Surgery: □ Alive □ Dead □ Unknown
Primary method used to verify 30-day status:
□ Phone call to patient or family □ Evidence of life in medical record □ Social Security Death Master File
□ Letter from medical provider □ Office visit to surgeon >= 30 days after procedure □ Other
(If Mortality = Yes ↓)
Operative Death: □ Yes □ No
Mortality - Date _____ / _____ / ______ (mm/dd/yyyy)
Location of Death: □ OR During Initial Surgery □ Hospital (Other than OR) □ Home □ Extended Care Facility
□ Hospice □ Acute Rehabilitation □ OR During Reoperation □ Unknown □ Other
Primary Cause of Death (select only one)
□ Cardiac □ Neurologic □ Renal □ Vascular □ Infection □ Pulmonary □ Valvular □ Unknown □ Other

R. Discharge
(If Discharge Status = Alive ↓)
ADP Inhibitors: □ Yes □ No
Antiarrhythmics: □ Yes □ No
Aspirin: □ Yes □ No □ Contraindicated
ACE or ARB Inhibitors: □ Yes □ No, contraindicated □ No, not indicated
Beta Blockers: □ Yes □ No □ Contraindicated
Lipid Lowering: □ Yes □ No □ Contraindicated (If Yes →) □ Statin □ Non Statin □ Both □ Other
Coumadin: □ Yes □ No
Direct Thrombin Inhibitors: □ Yes □ No
Discharge Location: □ Home □ Extended Care/Transitional Care Unit/Rehab □ Other Hospital
□ Nursing Home □ Hospice □ Other
Cardiac Rehabilitation Referral: □ Yes □ No □ Not Applicable
Smoking Cessation Counseling: □ Yes □ No □ Not Applicable

S. Readmission
(If Discharge Status = Alive ↓)
Readmit <=30 Days from Date of Procedure: □ Yes □ No (If Yes ↓)
Readmit Primary Reason:
□ Anticoagulation Complication - Valvular
□ Anticoagulation Complication - Pharmacological
□ Arrhythmia/Heart Block
□ Congestive Heart Failure
□ Myocardial Infarction and/or Recurrent Angina
□ Pericardial Effusion and/or Tamponade
□ Pneumonia or other Respiratory Complication
□ Coronary Artery Dysfunction
□ Valve Dysfunction
□ Infection - Deep Sternal / Mediastinitis
□ Infection - Conduit Harvest Site
□ Renal Failure
□ TIA
□ Permanent CVA
□ Acute Vascular Complication
□ Subacute Endocarditis
□ VAD Complication
□ Transplant Rejection
□ PE
□ DVT
□ Other - Related Readmission
□ Other - Nonrelated Readmission
Readmit Primary Procedure:
□ OR for Bleeding
□ Pacemaker Insertion / AICD
□ PCI
□ Pericardiotomy / Pericardiocentesis
□ OR for Coronary Arteries
□ OR for Valve
□ OR for Sternal Debridement / Muscle Flap
□ Dialysis
□ OR for Vascular
□ No Procedure Performed
□ Other Procedure
□ Unknown
Bibliography


