Adult Coronary Artery Bypass Graft Surgery in the Commonwealth of Massachusetts

Fiscal Year 2008 Report
(October 1, 2007 through September 30, 2008)

Hospital and Surgeon Risk-Standardized 30-Day Mortality Rates

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1 A Message from the Director of the Massachusetts Bureau of Health Care Safety and Quality

This is the seventh in a series of reports summarizing the quality of care provided by the 14 state licensed cardiac surgery programs in the Commonwealth. The report – contracted by the Division of Health Care Quality in the Massachusetts Department of Public Health – is meant to provide residents with information about the relative performance of cardiac surgery programs as an aid to elective decision making, and health care providers in the Commonwealth with information for quality improvement. Persons experiencing chest pain or other emergency conditions should call **911** immediately.

This report contains analysis of data on 3,337 hospital admissions in which an isolated coronary artery bypass graft (CABG) surgery was performed during the period October 1, 2007 through September 30, 2008. This report also includes an analysis of 10,043 hospital CABG admissions by 61 surgeons for the period of October 1, 2005 through September 30, 2008.

The data collection, verification, audit, and analytical procedures implemented in this report constitute the most comprehensive, reliable, and rigorous used in the U.S. 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 at Harvard Medical School. 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.

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2 Key Findings: Hospitals

2.1 Updates

- **February 23, 2010:** Table 9.4 Surgeon-Specific SMIRs, update two surgeon's hospital associations.
- **January 24, 2011:** Table 8.1 Annual Hospital 30-Day Mortality Trends, corrected the Between-Hospital Standard Deviation in SMIRS for FY 2008 from 0.11 to 0.69.

2.2 Hospital Findings

- In the period October 1, 2007 through September 30, 2008 (Fiscal Year 2008), there were 6,866 hospital admissions in Massachusetts in which at least one cardiac surgery was performed. Almost one half of the admissions involved isolated coronary artery bypass graft (CABG) surgery.
- In the 14 hospitals that performed cardiac surgery during Fiscal Year 2008, the number of isolated CABG surgery admissions ranged from 96 to 430.
- 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 2008 was 1.38%. This corresponded to 46 deaths out of 3,336 [1] isolated CABG admissions.
- After adjusting for patient risk, the odds of 30-day mortality in a hospital one standard deviation above the state average was one and one half (odds = 1.55) that of a hospital one standard deviation below the state average.

[1] It was not possible to identify the 30-day mortality status for one of the 3,337 admissions.

- **In Fiscal Year 2008, 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 (1) hospital-specific risk-standardized 30-day mortality rates following CABG surgery performed in Massachusetts hospitals in the period October 1, 2007 through September 30, 2008 (Fiscal Year 2008) and (2) surgeon-specific risk-standardized mortality rates for CABG surgeries performed from October 1, 2005 through September 30, 2008. 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 2008, there were 14 cardiac surgery programs in Massachusetts, each of which submitted data to Mass-DAC.

This document is the seventh 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 in the period October 1, 2007 through September 30, 2008. This report also includes the fifth report of surgeon-specific risk-standardized 30-day mortality rates. These rates are based on isolated CABG surgery admissions performed in the period October 1, 2005 through September 30, 2008.

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 a build-up of plaque. Plaque may build up because of high cholesterol, high blood pressure, smoking, diabetes, genetic predisposition, or other factors. As the plaque build-up 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 consists of all patients aged 18 years or older undergoing isolated CABG surgery in Massachusetts adult acute care non-federal hospitals in the period October 1, 2007

through September 30, 2008. 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), implantation 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, page 60). Table 3.1 lists the distribution of the 6,866 cardiac surgery admissions stratified by surgical procedure type in Massachusetts hospitals during Fiscal Year 2008.

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 2008, isolated CABG surgeries accounted for almost half 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 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.

Table 3.1: *Surgical Procedure Type Classification of Adult Cardiac Surgeries: Oct 1, 2007–Sep 30, 2008*

Surgical Procedure Type	No. of Cardiac Surgery Admissions	% of Cardiac Surgery Admissions
Isolated CABG	**3,337**	**48.60**
Mitral Valve Replacement (MVR)	162	2.36
Aortic Valve Replacement (AVR)	701	10.21
MVR and CABG	71	1.03
AVR and CABG	544	7.92
AVR and MVR	35	0.51
Other Cardiac Surgery	1,997	29.09
Non−Cardiac (Thoracic) Procedures	19	0.28
All Cardiac Surgery Admissions	**6,866**	**100.00**

4 Summary of Data Collection and Verification Procedures

4.1 Definition of Patient Outcome

Mortality, regardless of cause, 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, 2007 through September 30, 2008.

4.3 Data Sources

Three different data sources were used to create this report: patient-specific data collected by trained hospital personnel using the Society of Thoracic Surgeons (STS) National Cardiac Surgery data collection tool; hospital administrative discharge billing data; and vital statistics information provided by the Massachusetts Department of Public Health.

4.3.1 Mass-DAC STS Data

Patient-specific risk factor and outcome data were collected by hospital personnel using the STS National Cardiac Surgery data collection tool. Version 2.52.1 of the STS collection tool (containing 293 variables) was used for all data submissions for surgeries performed between October 1, 2007 and December 31, 2007. Version 2.61 of the STS collection tool (see Appendix 2), contain-

ing 349 variables, was used for all data submissions for surgeries performed between January 1, 2008 and September 30, 2008.

4.3.2 Massachusetts Inpatient Acute Hospital Case Mix and Charge Database

Hospital discharge data for Fiscal Years 2002 through 2008, (October 1, 2001 through September 30, 2008) were obtained from the Massachusetts Division of Health Care Finance and Policy. Data elements include hospital identifier, sex, race, age, patient's zip code, ICD-9 codes, discharge status, dates of admission and discharge, date of surgery, and patient medical record number. Social Security numbers were removed from this database.

4.3.3 Massachusetts Mortality Index Database

Death date information obtained from Massachusetts death certificates was available for all deaths occurring in Massachusetts between January 1, 2002, and October 30, 2008, from the Massachusetts Registry of Vital Records and Statistics. While the primary source of 30-day mortality was the hospital-reported information, the mortality index database was employed as a verification procedure. 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 2008 cardiac surgery data were required to be complete by April 1, 2009, after which no changes were accepted without written permission from Mass-DAC.

Table 4.1: *Cardiac Surgery Data Harvest Schedule for Surgeries Performed: Oct 1, 2007–Sep 30, 2008*

Harvest Month	Corresponding Dates of Cardiac Surgery
March 2008	October 1, 2007 through December 31, 2007
June 2008	January 1, 2008 through March 31, 2008
December 2008	April 1, 2008 through September 30, 2008
April 1, 2009	Final close out date for Fiscal Year 2008 data

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 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 quality report. There were a total of 118 data submissions sent by 14 hospitals during Fiscal Year 2008 with a mean of 2.8 submissions per hospital per collection period. Data submissions for Fiscal Year 2008 ranged from 1 to 9 per hospital per collection period. For each hospital data submission, a Mass-DAC quality report was generated and returned to the hospital.

4.5.2 MA Administrative Datasets

Mass-DAC found high agreement between the hospital report of 30-day mortality and information linked to vital records. After verifying the mortality status of these patients, there was a net increase of six 30-day mortalities for all cardiac surgeries, including an increase of two 30-day mortalities for isolated CABG patients. The Massachusetts Inpatient Case Mix Dataset was used to determine whether all appropriate cases of cardiac surgery from each institution were submitted to Mass-DAC.

4.5.3 Meetings and Communication

Mass-DAC communicated regularly via email and telephone with the data managers to clarify definitions or procedural issues, 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. Preliminary results were shared at the MA STS meeting and at 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 2009, a sample of the Fiscal Year 2008 isolated CABG data was audited. Ten cardiac surgeons and four data managers, representing ten 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 patients coded as having an isolated CABG (CABG), isolated Aortic Valve Replacement (AVR), or an isolated Mitral Valve Replacement (MVR), who died within 30 days;

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

3. All CABG, AVR or MVR patients coded as having shock prior to surgery;

4. All CABG, AVR or MVR patients coded with emergent or emergent salvage status;

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

6. A sample of those CABG, AVR or MVR patients coded as having an ejection fraction of less than 30, an arrhythmia, or severe chronic lung disease.

A total of **461** records were requested from the 14 hospitals. The records were reviewed to determine data consistency and accuracy of coding.

An additional **282** records were requested for a subset of surgery admissions coded as alive within 30 days of surgery and having "CABG + other" or "valve + other" surgery (see Appendix A, page 60). These records were reviewed to determine if some might be considered isolated CABG surgery or isolated valve surgery. Documentation requested from the hospitals included discharge summaries, operative reports, admission and history summaries, and catheterization reports. Records that were reviewed and identified by the auditors to be isolated CABG were then also reviewed for the variables of shock, emergent or emergent salvage status, MI within 24 hours of surgery, ejection fraction, arrhythmia, or severe chronic lung disease.

In all, **743** records 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 shock, emergent status, emergent salvage status, or MI less than 24 hours before surgery, the coding was changed. Hospitals were notified of any disagreement in coding and given an opportunity to appeal the Adjudication Committee decisions. All changes made by the Adjudication Committee for the census variable were then made in the Mass-DAC database. Because the Adjudication Committee did not review every case coded with ejection fraction of less than 30, presence of an arrhythmia, or severe chronic lung disease, Mass-DAC did not make any changes to the coding for those variables 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, 15% of admissions coded as emergent, and 65% of admissions coded as CABG + other were changed.

Table 4.2: *Summary of Adjudication*

Risk Factor	Total Reviewed	Final Adjudicated Status	Number
Shock	85	Shock (no change)	53
		No Shock	32
Emergent	153	Elective	2
		Urgent	21
		Emergent (no change)	130
		Emergent Salvage	0
Emergent Salvage	6	Elective	0
		Urgent	0
		Emergent	4
		Emergent Salvage (no change)	2
MI within 24 hours of surgery	139	No MI	12
		MI $\leq$24 hours (no change)	117
		MI $\geq$24 hours	10
CABG + Other	136	Isolated CABG	89
		CABG + Other (no change)	47
Valve + Other	146	Isolated Valve	87
		Valve + Other (no change)	59

5 Risk Adjustment

5.1 Who Receives Isolated CABG Surgery in Massachusetts?

Table 5.1 lists the age/sex/race distribution for 3,337 adult CABG surgery patients at 14 cardiac surgery programs in Massachusetts. The STS method for collecting information on race changed on January 1, 2008 with version 2.61 (Appendix C). Version 2.61 allows patients to select more than one race; in addition, Hispanic is an ethnicity choice and is separate from the race designations. The race categories from October to December 2007 were mapped to the new STS 2.61 categories. The majority of patients were male (76.8%) and white (90.4%). In Fiscal Year 2008, 55.8% 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 8.8 % of the 3,337 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 prior to the 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 using advice obtained from its Senior Medical Advisors as well as the MA STS. Based on this advice, two changes were made this year. First, receipt of an intra-aortic balloon pump prior to CABG surgery was eliminated from the model. Second, due to definition changes in the STS data collection instrument, the renal failure variable was restricted to include only patients undergoing dialysis.

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 calculate mortality rates in this report, a hierarchical logistic 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 in the statistical model, then the hospital-specific random 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.

Table 5.1: *Demographic distribution for all adult Isolated CABG surgery admissions ($N = 3,337$) in Massachusetts hospitals: Oct 1, 2007–Sep 30, 2008.*

Age Group	White	African Amer.	Other	Hispanic	Total Gender
Male					
18−44	54	2	7	3	63
45−54	315	12	22	14	349
55−64	723	28	58	32	809
65−74	725	11	64	18	799
≥75	507	9	26	13	542
Total	**2,324**	**62**	**177**	**80**	**2,562**
Female					
18−44	17	1	2	2	20
45−54	68	4	9	6	81
55−64	132	10	12	9	154
65−74	231	11	18	10	260
≥75	243	9	8	4	260
Total	**691**	**35**	**49**	**31**	**775**
Total Male and Female					
18−44	71	3	9	5	83
45−54	383	16	31	20	430
55−64	855	38	70	41	963
65−74	956	22	82	28	1,059
≥75	750	18	34	17	802
Total	**3,015**	**97**	**226**	**111**	**3,337**

Patients may select more than one race category. The Hispanic category is independent of the race categories. The Total Gender column represents unique patient admissions and is not a summation across the row.

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 MA 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 MA hospitals except the hospital under study is the same, then the hospital is classified as 'outlying.' 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 MA 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 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 2008. 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 MA mortality rate, then the hospital mortality is not different than expected. If the interval excludes the MA unadjusted rate, then the hospital is an outlier. In this case, if the upper limit of the interval is lower than the unadjusted MA 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 MA 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 CABG surgery in Massachusetts hospitals, were calculated using the following procedure:

1. A hierarchical logistic regression model was estimated that assumes the log-odds 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:

$$\text{Log-odds}[Probability(Y_{ij} = 1)] = \beta_{0i} + \beta(\text{Risk Factors})_{ij} \quad (1)$$

$$\text{where} \quad \beta_{0i} \sim \text{Normal}(\mu, \tau^2) \quad (2)$$

The parameters, μ and τ^2 represent the overall mean risk-adjusted log-odds of mortality

and between-hospital variation, respectively. If there are no mortality differences based on 30-day mortality across the 14 CABG surgery hospitals, then

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

The hierarchical regression models were estimated using WinBUGS software. The prior distributions assumed for β, μ, and τ^2 were, respectively: independent normal distributions with mean 0 and variance 1,000 for the components of β; μ from a normal distribution with mean 0 and variance 1,000; and τ^{-2} from a gamma distribution with shape and inverse scale 0.001. We vary these parameters as part of a sensitivity analysis. The hierarchical logistic regression models were estimated using the WinBUGS software. A burn-in of 5,000 draws was used and conclusions were based on an additional 5000 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 β describes the association of each risk factor and the log-odds of 30-day mortality. Large values of β 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, π_i, is:

$$\pi_i \quad = \quad \frac{\sum_{j=1}^{n_i} \text{logit}^{-1}[\mu + \beta(\text{Risk Factors})_{ij}]}{n_i} \tag{4}$$

This is the mortality rate expected at hospital i using the mortality intensity for the entire state, β, 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:

$$p_i = \frac{\sum_{j=1}^{n_i} \text{logit}^{-1}[\beta_{0i} + \beta(\text{Risk Factors})_{ij}]}{n_i} \quad (5)$$

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:

$$\bar{Y} = 100 \times \frac{\sum_{ij} Y_{ij}}{\sum_i n_i} \quad (6)$$

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

$$\text{SMIR}_i = \bar{Y} \times \frac{p_i}{\pi_i} \quad (7)$$

The SMIR is interpreted as the projected mortality rate at the hospital today if hospital quality remained the same as in Fiscal Year 2008.

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 μ and, in particular, τ^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* MA 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 CABG hospitals. Small p-values (those ≤ 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 CABG hospital from the data set, re-estimated the regression parameters, predicted mortality at the eliminated hospital, and calculated a posterior probabilty 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 τ represents the standard deviation of the hospital-specific risk-adjusted log-odds of mortality and the parameter τ^2 represents between-hospital variance.

The main analyses assumed that precision, defined as $\frac{1}{\tau^2}$, arose from a gamma distribution. Because the prior distribution for the variance component can influence the results, Mass-DAC re-estimated the hierarchical model using different prior distributions for τ^2.

1. We changed our assumptions regarding the likely values of the standard deviation. For example, a value of $\tau = 0.75$ implies that between-hospital mortality log-odds could range anywhere from 1 to 1.5. We thus 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 that between-hospital standard deviation arose from a half normal distribution with mean 0 and variance 0.26. This half normal distribution has its mode at 0, thereby permitting the possibility of no differences in between-hospital log-odds of mortality. However, because its median is 0.39, this assumption also permits the range in hospital log-odds of mortality of about 5.

7 Hospital Quality Following Isolated CABG Surgery: Fiscal Year 2008

Of the 3,336 [2] isolated CABG surgery admissions in Fiscal Year 2008 in Massachusetts, 46 patients (1.38%) 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, 2.3% of the 3,336 isolated CABG surgery admissions were associated with patients who had a prior CABG surgery. Odds ratios greater than 1 correspond to increased risk of mortality while those less than 1 correspond to decreased risk of mortality. The odds ratio of 5.69 for those having a prior CABG surgery indicates that those with such a history are about five and one half times 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 10.9 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.

Based on a simple logistic regression model, the Hosmer-Lemeshow Goodness-of-Fit test did not indicate a lack of fit (χ^2_8 = 9.74, p = 0.28). Model discrimination ranged from 0.0% (0 deaths in 334 admissions) in the lowest risk decile to 5.5% (18 deaths in 325 admissions) in the highest risk decile. The model had good discrimination between those surviving 30 days from CABG surgery and those who did not. The area under the Receiver Operating Characteristic (ROC) using the hierarchical model was 0.801 (Figure 7.3).

The estimate of between-hospital variation after adjusting for patient case mix is 0.049. This may be interpreted as indicating that the odds of dying if admitted to a Massachusetts cardiac

[2] It was not possible to identify the 30-day mortality status for one of the 3,337 admissions. This admission was excluded from this part of the analysis.

surgery program one standard deviation above the state mean is 1.56 times that of dying if admitted to a program one standard deviation below the state mean.

Table 7.1: *Prevalences and Adjusted Odds Ratios of 30-Day Mortality Following Isolated CABG Surgery in Adults: Oct 1, 2007–Sep 30, 2008. Based on 3,336 surgeries with 46 deaths (1.38%).*

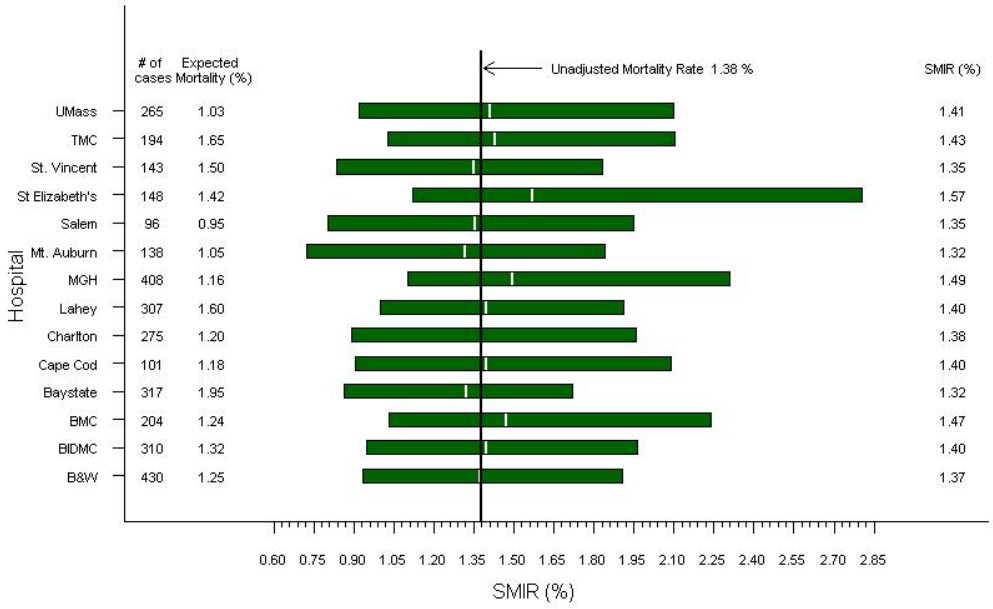
Risk Factor	Prevalence %	Adjusted Odds Ratio	95% Interval for the Adjusted Odds Ratio
Years over 65 [a]	0.94	1.05	(1.02, 1.09)
Male	76.77	1.87	(0.92, 4.83)
Renal Failure–Dialysis	1.77	1.38	(0.03, 5.66)
Diabetes	37.50	1.25	(0.62, 2.25)
Hypertension	85.25	2.20	(0.75, 5.41)
Peripheral Vascular Disease	14.99	0.83	(0.30, 1.74)
Prior CABG Surgery	2.31	5.69	(1.42, 13.86)
Prior Percutaneous Coronary Intervention (PCI)	23.32	1.28	(0.56, 2.38)
Cardiogenic Shock	1.08	10.90	(2.06, 34.34)
Ejection Fraction (Ref = ≥40% or not done)			
<30%	5.64	3.03	(1.05, 6.46)
30%-39%	10.28	1.56	(0.55, 3.43)
Myocardial Infarction (MI) (Ref = None)			
<6 Hours	1.08	0.21	(0.00, 1.12)
7-24 Hours	2.37	3.88	(0.72, 11.57)
≥1 day	48.59	1.94	(0.85, 3.96)
Status of CABG (Ref = Elective)			
Urgent	62.95	0.97	(0.42, 1.98)
Emergent or Emergent Salvage	3.39	6.40	(1.38, 17.86)

Between-Hospital Parameters	**Mean**	**95% Interval**
Between-Hospital Average logit, μ	-5.94	(-7.05, -5.01)
Between-Hospital Variance in logits, τ^2	0.04948	(0.000753, 0.2959)

[a] Average age of patients undergoing isolated CABG surgery is $65 + 0.94 = 65.94$ years of age.

Figure 7.1: *Ninety-Five Percent Posterior Intervals for Standardized 30-Day Mortality Incidence Rates (SMIRs) Following Isolated CABG Surgery in Massachusetts: Oct 1, 2007–Sep 30, 2008*

# 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 MA 30-day mortality rate of 1.38%.

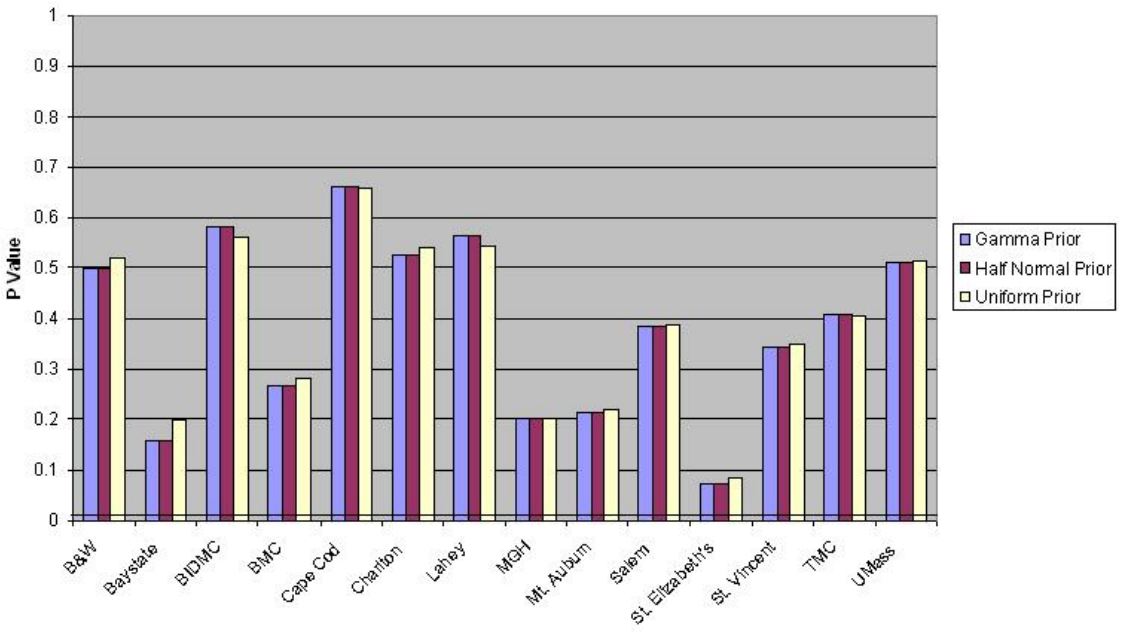


HOSPITAL KEY:
B&W = Brigham & Women's Hospital; **BIDMC** = Beth Israel Deaconess Medical Center; **BMC** = Boston Medical Center; **Baystate** = Baystate Medical Center; **Cape Cod** = Cape Cod Hospital; **Charlton** = Southcoast Hospital Group - Charlton Memorial Hospital; **Lahey** = Lahey Clinic;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

Figure 7.1 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 1.38%. 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 include the unadjusted MA rate of 1.38%.

Figure 7.2: *Cross-Validated P-Values: Isolated Cardiac Surgery Admissions: Oct 1, 2007–Sep 30, 2008.*

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 are presented under a variety of assumptions for fitting the hierarchical regression model. From left to right, bars represent gamma, half normal, and uniform prior distributions.



HOSPITAL KEY:
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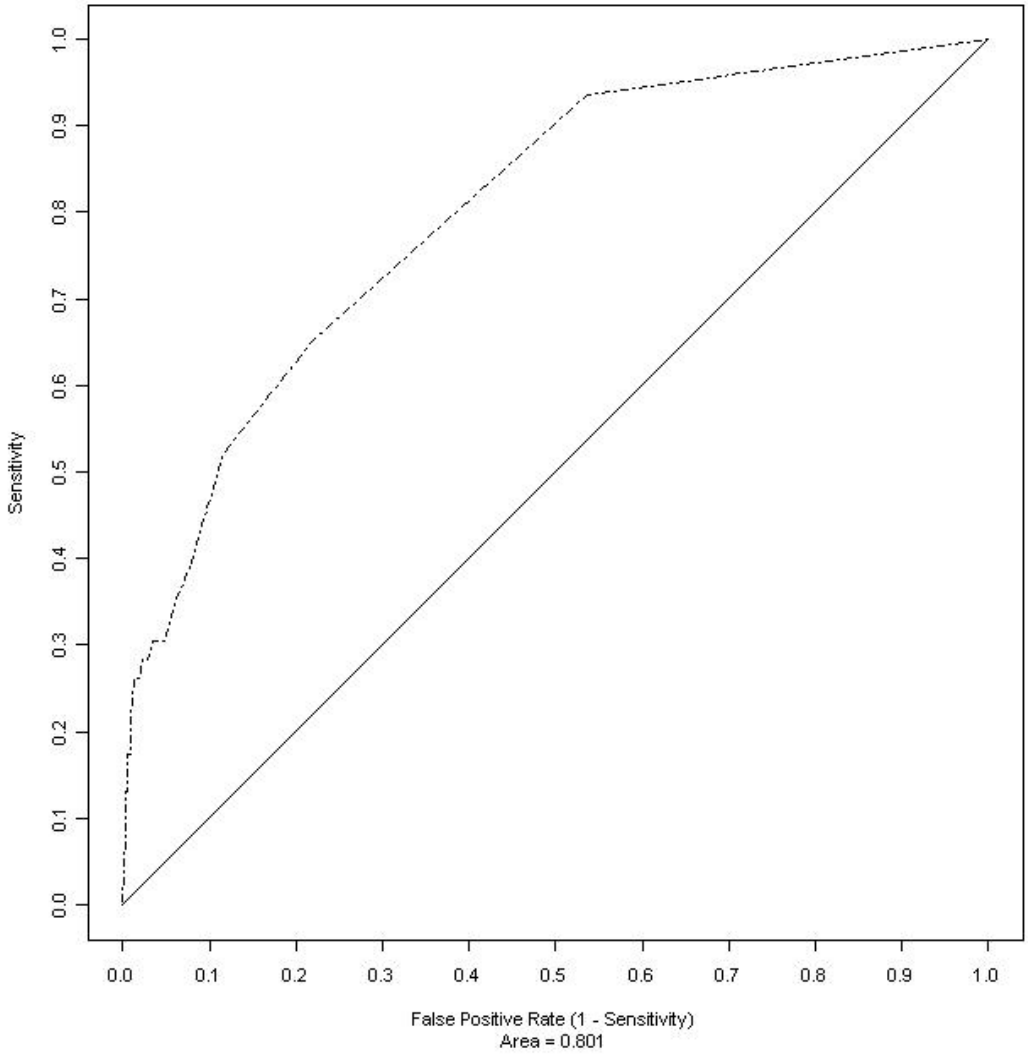
Figure 7.2 presents the cross-validated posterior probabilities (p-values)under the different assumed prior distributions for the between-hospital variation parameter. The reference line on the graph at 0.01 indicates the cutoff for outliers based on p-value. Any hospital with a bar entirely under this line is considered to be different than expected. The cross validated p-values indicate that there were **no cardiac surgery program outliers** in Fiscal Year 2008.

Figure 7.3: *ROC Curve-Hierarchical: Isolated CABG Cohort*



8 Annual Hospital 30-Day Mortality Trends Following Isolated CABG Surgery in Massachusetts: January 1, 2002 through September 30, 2008

Table 8.1: *Summary of Isolated CABG Admissions and 30-Day Crude Mortality Percentages CY 2002 through FY 2008*

Year of Surgery	CY 2002	CY 2003	CY 2004	CY 2005	FY 2006	FY 2007	FY 2008
Number of Hospitals	13	14	14	14	14	14	14
Number of Admissions	4,603	4,393	3,986	3,883	3,684	3,396	3,336
30-Day Crude Mortality, %	2.19	2.25	2.01	1.65	1.41	1.47	1.38
Between-Hospital Variance in Log-Odds of Mortality	0.042	0.094	0.349	0.130	0.035	0.389	0.049
Between-Hospital Standard Deviation in SMIRS, %	0.13	0.29	0.72	0.31	0.05	0.58	0.069

CY denotes calendar year; FY denotes fiscal year.

9 Surgeon-Specific Standardized 30-Day Mortality Incidence Rates: October 1, 2005 through September 30, 2008

9.1 Key Findings: Surgeons

- 67 surgeons were identified with 10,417 Isolated CABG surgery admissions in Massachusetts over the period October 1, 2005 through September 30, 2008.
- Before exclusions, the isolated CABG surgery volumes ranged from 3 to 457 across the 67 surgeons.
- Surgeon analyses were based on 61 surgeons who had 11 or more CABG admissions.
- While this report contains summaries based on all isolated CABG surgery admissions, the primary analyses exclude admissions for patients with shock prior to surgery, emergent status, or emergent salvage status. The primary analyses are based on 10,043 admissions.
- 86.9% of the 61 surgeons performed isolated CABG surgery at exactly one hospital in Massachusetts over the 3-year period.
- The unadjusted 30-day all-cause mortality rate following isolated CABG surgery in Massachusetts during the period October 1, 2005 through September 30, 2008 was:
  - 1.43% when admissions with shock and emergent status are included.
  - 1.13% when admissions with shock and emergent status are excluded.
- After adjusting for patient risk, the odds of 30-day mortality associated with a surgeon one standard deviation above the state average was one and one-half (1.55) that for a surgeon one standard deviation below the state average. The odds are the same whether shock and emergent status admissions are included or excluded.

- **No surgeon was identified as a statistical outlier.**

9.2 What Data are Used for the Surgeon Analysis?

All patients undergoing isolated coronary artery bypass graft (CABG) surgery in the period October 1, 2005 through September 30, 2008 were identified. The Massachusetts Cardiac Surgery STS Quality and Outcomes Committee made recommendations regarding surgeon inclusion and exclusion criteria for the purpose of public reporting. These recommendations involved:

1. Excluding surgeons with 10 or fewer isolated CABG surgeries;

2. Surgeon should be active for at least two years and still active in the year after the end of the reporting period;

We note that for those surgeons with fewer than 163 admissions, the power to detect a higher than expected mortality may be less than 75% when assuming a one-sided one-group χ^2-test that the surgeon rate is larger than the state rate by at least 2.4% (absolute increase) or an odds ratio of 3. The Type I error rate was assumed to be 0.05 and an *effective sample size* for each surgeon that was larger than the observed number of admissions due to shrinkage was used. The number of admissions is approximate because the surgeon-specific expected mortality rates depend on the surgeon's case-mix distribution. For surgeons with fewer than 163 isolated CABG surgery admissions over the three year period, a pound symbol # is included in figures and tables to indicate that "small sample size may have reduced power to detect higher than expected mortality."

The committee also made recommendations regarding patient inclusion criteria for assessing surgeon quality. They recommended that patients who were coded as in shock, emergent status, or emergent salvage status prior to the surgery be excluded from the analysis because their expected mortality was very high. The Department of Public Health agreed to these recom-

mendations. Mass-DAC eliminated these patients when computing surgeon-specific estimates. Surgeon outlier status is based on the SMIR alone and not posterior predictive p-values.

The surgeon-specific 30-day mortality rates in this report have been adjusted in order to account for differences in patient health prior to surgery using methods similar to those for hospitals. The risk factors included in the model are the same as those risk factors that are used in the hospital model. Methodology similar to the hospital analysis is utilized to identify surgeons who have unusually high or unusually low risk-standardized mortality rates. It is important to note that all patients treated by a surgeon are assigned to each surgeon, regardless of the hospital in which the surgery was performed. Thus, patients are assigned to the surgeon that performed their Isolated CABG surgery. Currently, there is no separation of surgeon and hospital "effects" in this report.

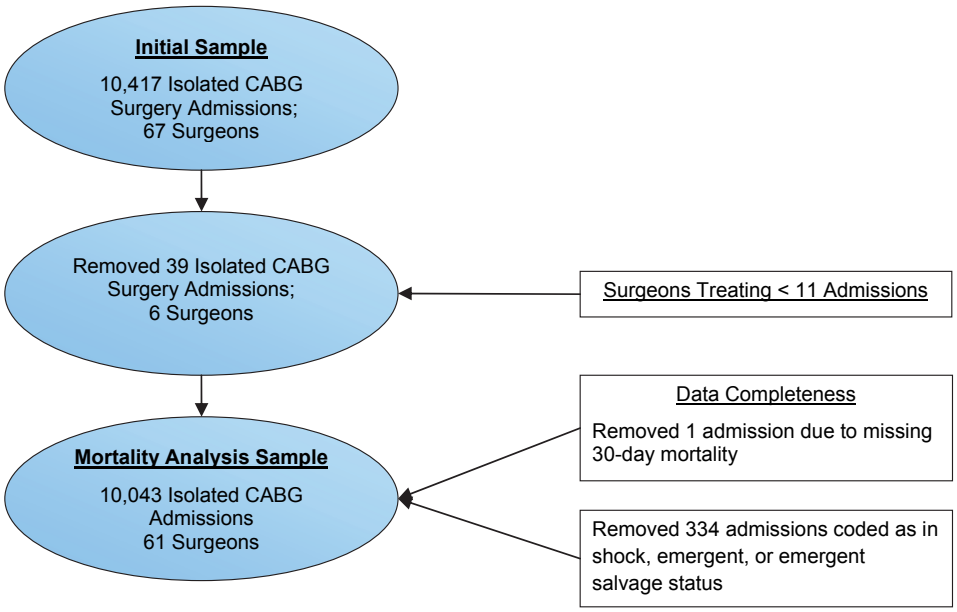
9.3 Results

A total of 10,417 Isolated CABG surgery admissions corresponding to 67 surgeons were initially identified. Six surgeons who treated a total of 39 patients were eliminated from the analyses because they each treated less than 11 patients during the three years. One Isolated CABG admission was eliminated from analyses because its 30-day mortality status could not be verified. For Fiscal Year 2008 all patients with shock prior to surgery, emergent status, or emergent-salvage status were excluded from the analysis. Consequently, the surgeon analysis sample consists of 10,043 adults treated by 61 surgeons in Massachusetts (Figure 9.1).

Of the 61 surgeons, 53 (86.9%) treated patients at exactly one hospital in Massachusetts, 7 (11.5%) at exactly two hospitals, and 1 (1.6%) treated patients at exactly three hospitals. Table 9.1 provides descriptive age-sex-race/ethnicity statistics for the sample of 10,417 patients.

Table 9.3, page 40, lists the frequencies of the risk factors used to account for patient differ-

Figure 9.1: *Surgeon-Specific Isolated CABG Surgery Analysis: Oct 1, 2005–Sep 30, 2008*



ences across surgeons as well as the association of each risk factor with mortality for all patients and for the primary analysis cohort having 30-day mortality rates of 1.43% and 1.13% respectively.

For the subset of 10,043 admissions, the Hosmer-Lemeshow Goodness-of-Fit test did not indicate a lack of fit (χ^2_8 = 3.41, p = 0.91). Model discrimination ranged from 0.2% (2 deaths in 1,006 admissions) in lowest risk decile to 4.2% (42 deaths in 1,010 admissions) in the highest risk decile. The area under the ROC curve using predictions from the hierarchical regression model was 0.73 (Figure 9.4). The odds of dying 30-days post CABG surgery when treated by a MA surgeon one standard deviation above the MA average was 1.55 times that when treated by a MA surgeon one standard deviation below the MA average.

Figures 9.2 and 9.3, starting on page 37, display the surgeon-specific SMIRs and corresponding 95% posterior intervals. The solid black vertical line in each figure is the unadjusted state 30-day mortality rate of 1.13%. Listed on the left-hand side of the figures are the total number

of isolated CABG surgery admissions and the expected 30-day mortality rates for each surgeon. The expected mortality rate provides an overall assessment of case-mix severity for each surgeon. Listed on the right-hand side of the figures are the estimated SMIRs.

Table 9.4, starting on page 41, identifies each surgeon, the hospital(s) where the surgeon treated cases in the period October 1, 2005 through September 30, 2008, and summary statistics. Seven surgeons who did not have any Isolated CABG surgery admissions during Fiscal Year 2008 are denoted by an asterisk (*); those having fewer than 163 Isolated CABG surgery admissions across the 3 years are denoted by a pound sign (#). We note that 34 (56%) out of 61 surgeons had fewer than 163 admissions. No surgeon outliers were detected during this time period.

Table 9.1: *Surgeon-Specific Demographic distribution for all adult Isolated CABG surgery admissions ($N = 10,417$) in Massachusetts hospitals: Oct 1, 2005–Sep 30, 2008. Entries represent numbers of isolated CABG surgery admissions and include all patients, including those with shock, emergent status, and emergent salvage status.*

Age Group	White	African Amer.	Other	Hispanic	Total Gender
Male					
18–44	158	9	22	8	189
45–54	958	34	100	55	1,092
55–64	2,233	60	187	82	2,480
65–74	2,200	32	189	59	2,420
≥75	1,629	23	76	28	1,728
Total	**7,178**	**158**	**574**	**232**	**7,909**
Female					
18–44	55	3	8	6	66
45–54	190	14	22	14	226
55–64	410	27	52	27	489
65–74	709	27	83	36	819
≥75	849	21	38	16	908
Total	**2,213**	**92**	**203**	**99**	**2,508**
Total Male and Female					
18–44	213	12	30	14	255
45–54	1,148	48	122	69	1,318
55–64	2,643	87	239	109	2,969
65–74	2,909	59	272	95	3,239
≥75	2,478	44	114	44	2,636
Total	**9,391**	**250**	**777**	**331**	**10,417**

Patients may select more than one race category. The Hispanic category is independent of the race categories. The Total Gender column represents unique patient admissions and is not a summation across the row.

Table 9.2: *Surgeon-Specific Demographic distribution for adult Isolated CABG surgery admissions ($N = 10,043$) in Massachusetts hospitals: Oct 1, 2005–Sep 30, 2008. EXCLUDES admissions with shock, emergent status, emergent salvage status, invalid 30-day mortality status, and patients for surgeons with less than 11 admissions. Details in Figure 9.1, page 33.*

Age Group	White	African Amer.	Other	Hispanic	Total Gender
		Male			
18–44	153	9	22	8	184
45–54	917	32	98	54	1,047
55–64	2,159	59	183	79	2,401
65–74	2,130	31	187	58	2,347
≥75	1,578	22	73	26	1,673
Total	**6,937**	**153**	**563**	**225**	**7,652**
		Female			
18–44	50	2	7	4	59
45–54	176	12	22	14	210
55–64	401	25	50	26	476
65–74	681	27	80	34	788
≥75	801	20	37	16	858
Total	**2,109**	**86**	**196**	**94**	**2,391**
		Total Male and Female			
18–44	203	11	29	12	243
45–54	1,093	44	120	68	1,257
55–64	2,560	84	233	105	2,877
65–74	2,811	58	267	92	3,135
≥75	2,379	42	110	42	2,531
Total	**9,046**	**239**	**759**	**319**	**10,043**

Patients may select more than one race category. The Hispanic category is independent of the race categories. The Total Gender column represents unique patient admissions and is not a summation across the row.

Figure 9.2: *Surgeon-Specific 95% Posterior Intervals for Standardized 30-Day Mortality Incidence Rates (SMIRs): Oct 1, 2005–Sep 30, 2008 (Part 1 of 2)*

Rates based on 10,043 Isolated CABG surgeries performed by 61 surgeons. See Table 9.4 starting on 41 for Surgeon details.

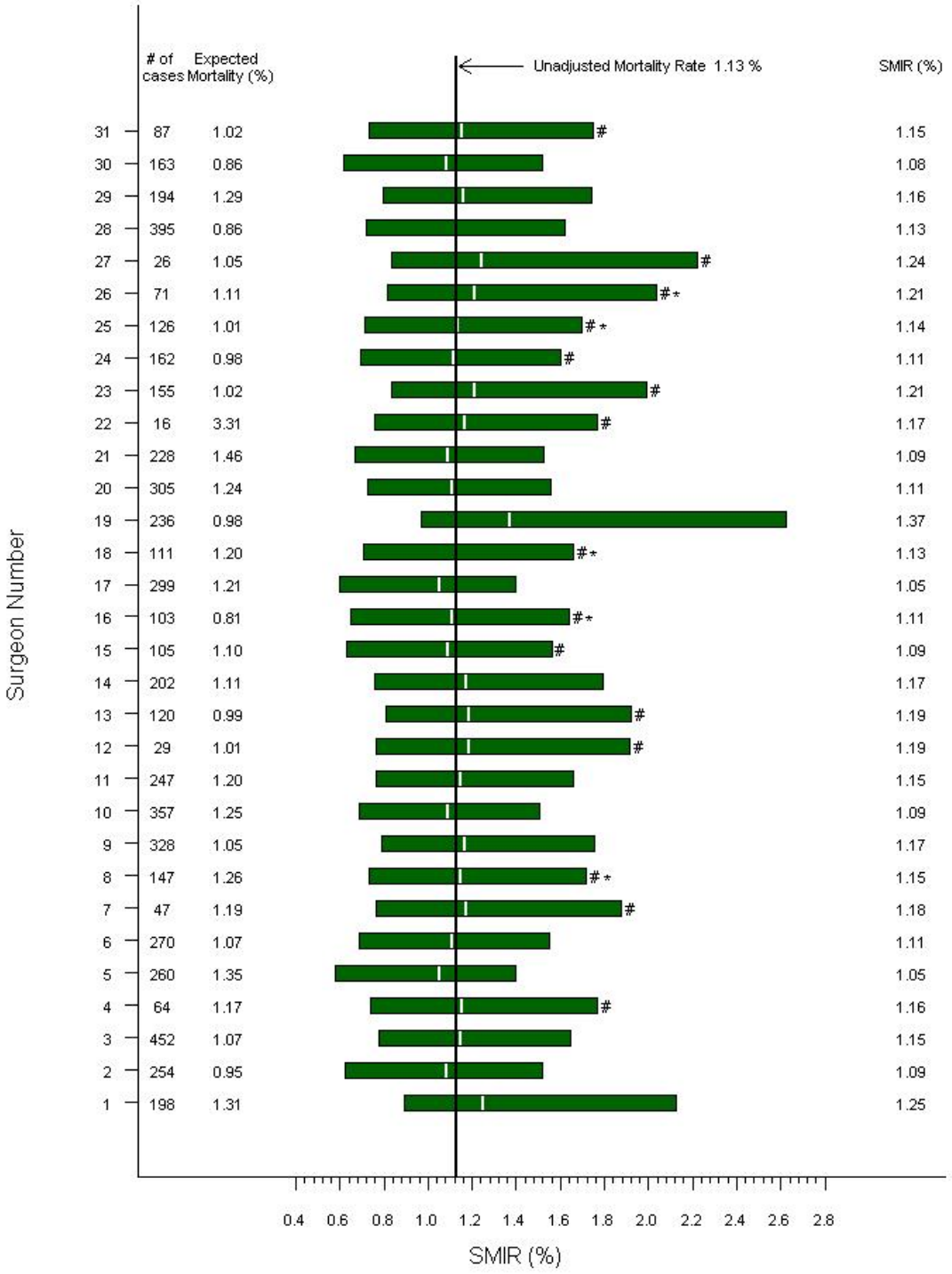


Figure 9.3: *Surgeon-Specific 95% Posterior Intervals for Standardized 30-Day Mortality Incidence Rates (SMIRs): Oct 1, 2005–Sep 30, 2008 (Part 2 of 2)*

Rates based on 10,043 Isolated CABG surgeries performed by 61 surgeons. See Table 9.4 starting on 41 for Surgeon details.

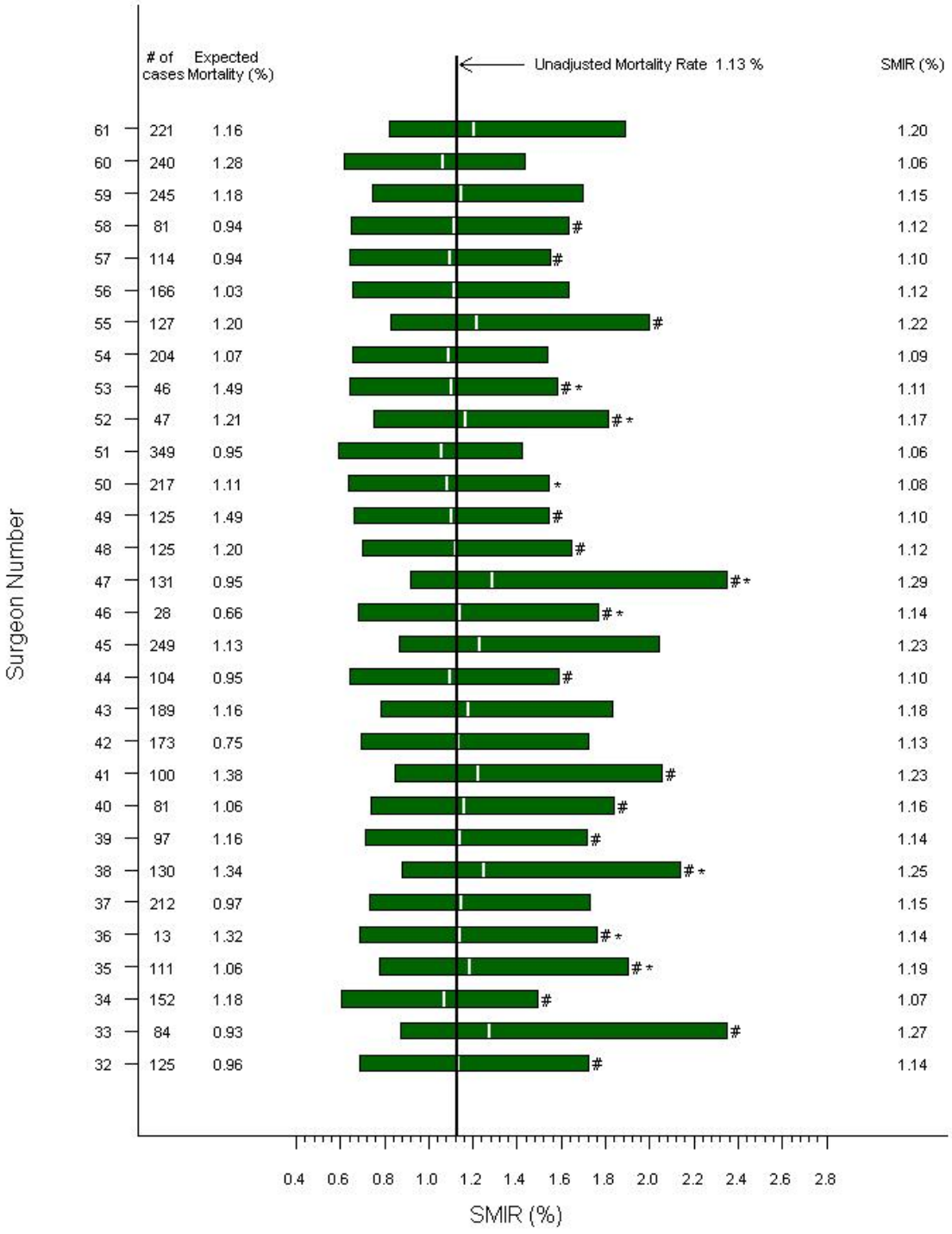


Figure 9.4: *Surgeon-Specific ROC Curve-Hierarchical: Isolated CABG Cohort*

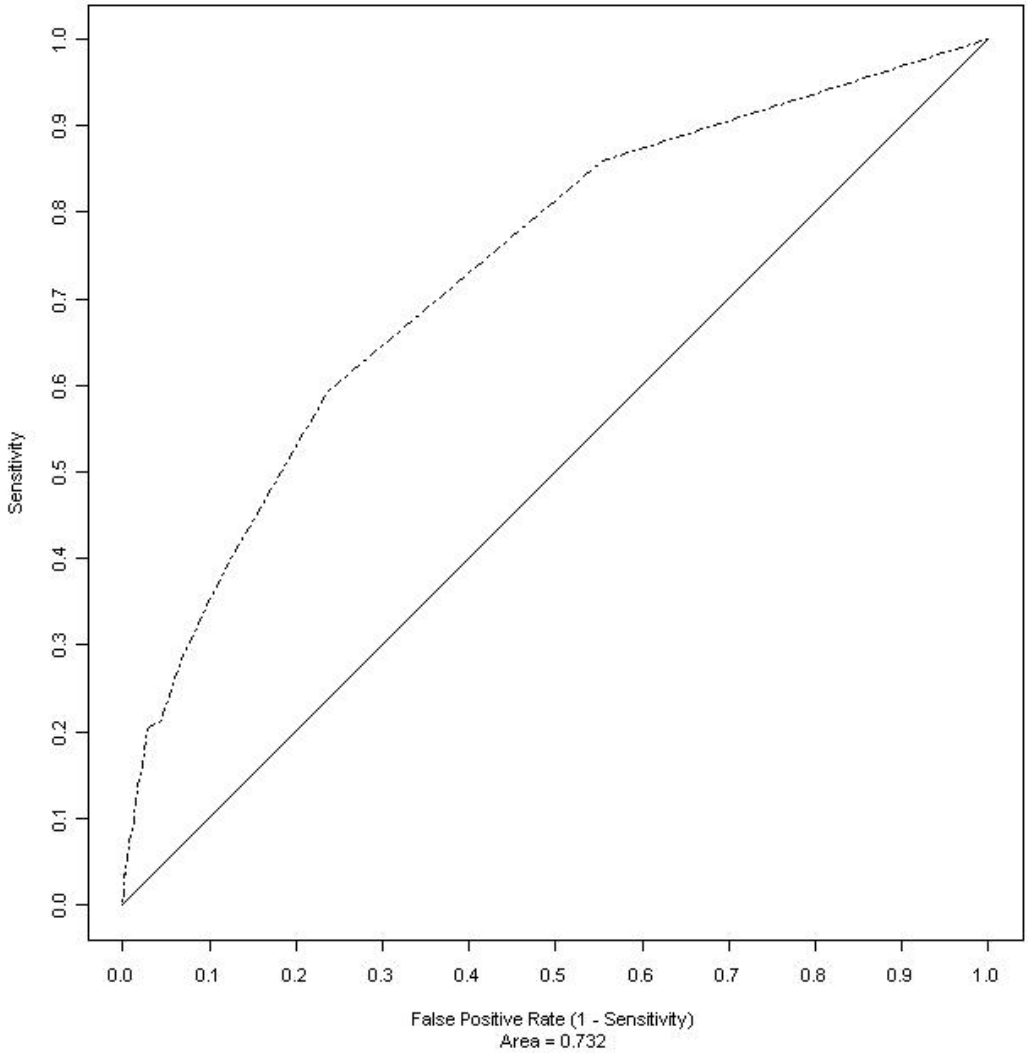


Table 9.3: *Surgeon-Specific Prevalences and Adjusted Odds Ratios of 30-Day Mortality Following Isolated CABG Surgery in Adults: Oct 1, 2005–Sep 30, 2008*

	Includes Shock and Emergent Status $N = 10,377$, $Deaths = 148 (1.43\%)$			Excludes Shock and Emergent Status $N = 10,043$, $Deaths = 113 (1.13\%)$		
Risk Factor	**Prevalence (%)**	**Adjusted Odds Ratio**	**95% Interval for Adjusted Odds Ratio**	**Prevalence (%)**	**Adjusted Odds Ratio**	**95% Interval for Adjusted Odds Ratio**
Years over 65	1.16	1.05	(1.03, 1.07)	1.1592	1.05	(1.03, 1.07)
Male	75.93	0.78	(0.56, 1.15)	76.19	0.70	(0.48, 1.08)
Renal Failure–Dialysis	1.74	3.58	(1.43, 7.12)	1.75	4.61	(1.85, 9.10)
Diabetes	39.87	1.11	(0.77, 1.56)	40.07	1.13	(0.74, 1.63)
Hypertension	84.31	1.81	(0.03, 3.06)	84.48	1.79	(0.91, 3.34)
Peripheral Vascular Disease	16.63	1.29	(0.85, 1.88)	16.57	1.12	(0.68, 1.73)
Prior CABG Surgery	2.06	3.51	(1.55, 6.56)	2.07	3.38	(1.37, 6.51)
Prior Percutaneous Coronary Intervention (PCI)	21.93	1.32	(0.87, 1.90)	21.66	1.34	(0.83, 2.04)
Cardiogenic Shock	0.91	4.24	(1.80, 8.59)		Not applicable	
Ejection Fraction (Ref $\geq$ 40 or not done)						
<30%	6.41	3.47	(2.12, 5.30)	6.02	3.62	(2.03, 5.85)
30-39%	10.25	1.46	(0.83, 2.27)	10.04	1.62	(0.87, 2.67)
Myocardial Infarction (Ref = None)						
<6 Hours	1.12	0.71	(0.20, 1.70)	0.19	0.21	(0.00, 2.34)
7-24 Hours	2.22	2.21	(0.93, 4.32)	1.49	4.38	(1.37, 9.49)
$\geq$1 Day	49.38	1.09	(0.70, 1.59)	50.04	1.07	(0.66, 1.61)
Status of CABG (Ref = Elective)						
Urgent	61.55	1.72	(1.09, 2.59)	63.44	1.56	(0.96, 2.43)
Emergent or Emergent Salvage	3.05	8.13	(3.57, 16.00)		Not applicable	
Between-Surgeon Estimates	**Mean**		**95% Interval**	**Mean**		**95% Interval**
Between-Surgeon Average logit, μ	-6.10		(-6.659, -5.49)	-6.07		(-6.73, -5.28)
Between-Surgeon Variance in logits, τ^2	0.04941		(0.001097, 0.2281)	0.04779		(0.000730, 0.2461)

Table 9.4: *Surgeon-Specific Standardized 30-Day All Cause Mortality Incidence Rates (SMIRs) Following Isolated CABG Surgery (percentage): Oct 1, 2005–Sep 30, 2008*

		Surgeon Name	Hospital(s)	Lower Limit of 95% Interval	SMIR (%)	Upper Limit of 95% Interval
1		Agnihotri, Arvind	Massachusetts General Hospital	0.889	1.249	2.125
2		Akins, Cary	Massachusetts General Hospital	0.627	1.085	1.519
3		Aranki, Sary	Brigham and Womens Hospital	0.776	1.145	1.648
4	#	Arcidi, Joseph	UMass Memorial Medical Center	0.738	1.155	1.769
5		Birjiniuk, Vladimir	Mount Auburn Hospital	0.577	1.049	1.400
6		Bojar, Robert	St. Vincent Hospital Tufts Medical Center	0.686	1.107	1.553
7	#	Bolman, Ralph	Brigham and Womens Hospital	0.765	1.176	1.876
8	# *	Bowen, Frank	Lahey Clinic	0.733	1.149	1.719
9		Campos, Christian	Southcoast Hospital - Charlton	0.789	1.166	1.754
10		Carr, Thomas	Southcoast Hospital - Charlton	0.686	1.089	1.504
11		Chen, Frederick	Brigham and Womens Hospital	0.766	1.145	1.659
12	#	Cohn, Lawrence	Brigham and Womens Hospital	0.764	1.188	1.912
13	#	Couper, Gregory	Brigham and Womens Hospital	0.808	1.186	1.924
14		D'Agostino, Richard	Lahey Clinic	0.757	1.170	1.795

Small sample size may diminish accuracy of estimates. Indicates that the surgeon had volume smaller than or equal to 163

Continued on next page

* Known not to have any Isolated CABG admissions during Fiscal Year 2008

Continued from previous page

		Surgeon Name	Hospital(s)	Lower Limit of 95% Interval	SMIR (%)	Upper Limit of 95% Interval
15	#	Davidson, Michael	Brigham and Womens Hospital	0.632	1.093	1.560
16	# *	De La Torre, Ralph	Beth Israel Deaconess	0.651	1.111	1.638
17		Deaton, David	Baystate Medical Center	0.597	1.052	1.400
18	# *	deGuzman, Brian	Lahey Clinic[3]	0.707	1.126	1.656
19		Ehsan, Afshin	Tufts Medical Center[3] St. Vincent Hospital[3]	0.971	1.369	2.625
20		Engelman, Daniel	Baystate Medical Center	0.728	1.111	1.554
21		Flack, Joseph	Baystate Medical Center	0.666	1.093	1.526
22	#	Geroyannis, Heracles	Caritas St. Elizabeths Medical	0.756	1.166	1.770
23	#	Hagberg, Robert	Beth Israel Deaconess St. Vincent Hospital	0.835	1.214	1.989
24		Harrison, Lynn	UMass Memorial Medical Center	0.691	1.114	1.604
25	*	Hilgenberg, Alan	Massachusetts General Hospital	0.710	1.136	1.698
26	# *	Hunter, Curtis	Boston Medical Center	0.815	1.213	2.034
27		Ketchedjian, Ara	Boston Medical Center	0.835	1.243	2.219
28		Khabbaz, Kamal	Beth Israel Deaconess St. Vincent Hospital	0.720	1.128	1.620

Small sample size may diminish accuracy of estimates. Indicates that the surgeon had volume smaller than or equal to 163

Continued on next page

* Known not to have any Isolated CABG admissions during Fiscal Year 2008

[3]Hospital association updated Feb 23, 2010

Continued from previous page

		Surgeon Name	Hospital(s)	Lower Limit of 95% Interval	SMIR (%)	Upper Limit of 95% Interval
29		Lazar, Harold	Boston Medical Center	0.794	1.162	1.739
30		Lee, Richard	Lahey Clinic	0.614	1.082	1.521
31	#	Liu, David	St. Vincent Hospital	0.732	1.153	1.746
32	#	MacGillivray, Thomas	Massachusetts General Hospital	0.690	1.136	1.721
33	#	Madsen, Joren	Massachusetts General Hospital	0.870	1.273	2.350
34	#	Maggs, Peter	Mount Auburn Hospital	0.604	1.071	1.495
35	# *	Moon, Richard	Caritas St. Elizabeths Medical	0.780	1.187	1.901
36	# *	Moses, Robert	Caritas St. Elizabeths Medical	0.685	1.140	1.763
37		Okike, Okike Nsidinanya	UMass Memorial Medical Center	0.731	1.145	1.730
38	# *	Olenchock, Stephen	Caritas St. Elizabeths Medical	0.882	1.252	2.139
39	#	Pham, Duc	St. Vincent Hospital Tufts Medical Center	0.712	1.139	1.716
40	#	Pirundini, Paul	Cape Cod Hospital	0.737	1.161	1.837
41	#	Poston, Robert	Boston Medical Center	0.848	1.227	2.056
42		Rastegar, Hassan	Tufts Medical Center St. Vincent Hospital Caritas St. Elizabeths Medical	0.692	1.132	1.723

Small sample size may diminish accuracy of estimates. Indicates that the surgeon had volume smaller than or equal to 163

Continued on next page

* Known not to have any Isolated CABG admissions during Fiscal Year 2008

Continued from previous page

		Surgeon Name	Hospital(s)	Lower Limit of 95% Interval	SMIR (%)	Upper Limit of 95% Interval
43		Rizzo, Robert	Cape Cod Hospital Brigham and Womens Hospital	0.785	1.178	1.834
44	#	Rosengard, Bruce	Massachusetts General Hospital	0.640	1.098	1.586
45		Rousou, John	Baystate Medical Center	0.867	1.231	2.041
46	# *	Saltman, Adam	UMass Memorial Medical Center	0.678	1.142	1.769
47	# *	Samy, Sanjay	Lahey Clinic	0.915	1.291	2.347
48	#	Sellke, Frank	Beth Israel Deaconess	0.701	1.123	1.648
49	#	Senthilnathan, Venkatacha	Beth Israel Deaconess	0.661	1.100	1.544
50	*	Shapira, Oz	Boston Medical Center	0.637	1.083	1.545
51		Shekar, Prem	Brigham and Womens Hospital	0.591	1.057	1.423
52	# *	Shemin, Richard	Boston Medical Center	0.754	1.166	1.814
53	# *	Symes, James	Caritas St. Elizabeths Medical	0.643	1.105	1.583
54		Tam, Stanley	UMass Memorial Medical Center	0.656	1.093	1.535
55		Tolis, George	Caritas St. Elizabeths Medical	0.827	1.216	1.995
56		Toran, Ann	North Shore Medical Center - Salem Hospital	0.656	1.116	1.631
57	#	Vandersalm, Thomas	North Shore Medical Center - Salem Hospital	0.644	1.095	1.547
58	#	Vlahakes, Gus	Massachusetts General Hospital	0.650	1.115	1.631

Small sample size may diminish accuracy of estimates. Indicates that the surgeon had volume smaller than or equal to 163

Continued on next page

* Known not to have any Isolated CABG admissions during Fiscal Year 2008

Continued from previous page

	Surgeon Name	Hospital(s)	Lower Limit of 95% Interval	SMIR (%)	Upper Limit of 95% Interval
59	Walker, Jennifer	Massachusetts General Hospital	0.747	1.148	1.698
60	Warner, Kenneth	Tufts Medical Center St. Vincent Hospital	0.618	1.063	1.434
61	Williamson, Christina	Lahey Clinic	0.822	1.202	1.888

Small sample size may diminish accuracy of estimates. Indicates that the surgeon had volume smaller than or equal to 163

* Known not to have any Isolated CABG admissions during Fiscal Year 2008

10 Important Definitions

Because the STS changed versions during Fiscal Year 2008, definitions for variables in both Version 2.52.1 and 2.61 have been included where applicable.

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: 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 legislature for the 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:

(Version 2.52.1) Indicates the patient was, at the time of surgery, in a clinical state of hypoperfusion according to either of the following criteria:

a. Systolic BP < 80 and/or Cardiac Index < 1.8 despite maximal treatment; or

b. IV inotropes and/or IABP necessary to maintain Systolic BP > 80 and/or CI > 1.8.

(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:

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

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 variable definition) 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.

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

Ejection Fraction: (STS variable definition) Indicates the percentage of the blood emptied from the ventricle at the end of the contraction.

Hypertension:

(Version 2.52.1) Indicates 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; or
- **b.** Blood pressure > 140 systolic or > 90 diastolic on at least 2 occasions; or
- **c.** Currently on antihypertensive medication.

(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 2 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: A surgical procedure which involves the replacement of the mitral valve of the heart.

Myocardial Infarction: (Version 2.52.1) (Changed in Version 2.61 to Previous MI) 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, $>$ upper limit of normal on two successive samples; or

2. CK $>$ 2x the upper limit of normal; or

3. LDH subtype 1 $>$ LDH subtype 2; or

4. Maximal concentration of troponin T or I $>$ 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.

Percutaneous Coronary Intervention: 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: (Version 2.61) (Formerly Peripheral Vascular Disease in Version 2.52.1) 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.)

1. Claudication , either with exertion or at rest,
2. Amputation for arterial vascular insufficiency,
3. Vascular reconstruction, bypass surgery, or percutaneous intervention to the extremities (excluding dialysis fistulas and vein stripping),
4. Documented aortic aneurysm with or without repair,
5. Positive noninvasive test (e.g., ankle brachial index =< 0.9, ultrasound, magnetic resonance or computed tomography imaging of > 50% diameter stenosis in any peripheral artery, i.e., renal, subclavian, femoral, iliac).

Peripheral Vascular Disease: (Version 2.52.1) (Changed in Version 2.61 to Peripheral Arterial Disease) Indicates the patient has Peripheral Vascular Disease, as indicated by claudication either with exertion or rest; amputation for arterial insufficiency; aorto-iliac occlusive dis-

ease reconstruction; peripheral vascular bypass surgery, angioplasty, or stent; documented Aortic Abdominal Aneurysm, Aortic Abdominal Aneurysm repair, or stent; positive non-invasive testing documented. Does not include procedures such as vein stripping, carotid disease, or procedures originating above the diaphragm.

Previous MI: (Version 2.61) (Formerly Myocardial Infarction in Version 2.52.1) Indicate if the patient has had at least one documented previous myocardial infarction prior to first onset of symptoms leading to this episode of care. An acute myocardial infarction is evidenced by any of the following:

1. 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: Ischemic symptoms; ECG changes indicative of new ischemia (new ST-T changes, new left bundle branch block, or loss of R wave voltage); development of pathological Q waves in 2 or more contiguous leads in the ECG (or equivalent findings for true posterior MI); imaging evidence of new loss of viable myocardium or new regional wall motion abnormality; 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).

2. Development of new pathological Q waves in 2 or more contiguous leads in the ECG, with or without symptoms.

3. Imaging evidence of a region with new loss of viable myocardium at rest in the absence of a nonischemic cause. This can be manifest as: 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); Fixed (non-reversible) perfusion defects on nuclear radioisotope imaging (e.g., MIBI, thallium); Medical records documentation of prior myocardial infarction.

Prior CABG Surgery: Indicates the patient had a previous Coronary Bypass Graft prior to the current admission.

Prior Percutaneous Coronary Intervention: (STS variable definition) 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: (Version 2.52.1) Indicates the patient has 1) a documented history of renal failure and/or 2) a history of creatinine > 2.0. Prior renal transplant patients are not included as pre-op renal failure unless since transplantation their creatinine has been or currently is > 2.0.

Renal Failure–Dialysis: (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:

(Version 2.52.1) Indicates the status that best describes the clinical status of the patient at the time of surgery.

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

Emergent: The patient's clinical status includes any of the following:

a. Ischemic dysfunction (any of the following):

1. Ongoing ischemia including rest angina despite max-

imal medical therapy (medical and/or IABP)); or

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.

Urgent All of the following conditions are met:

a. Not elective status; and

b. Not emergent status; and

c. Procedure required during same hospitalization in order to minimize chance of further clinical deterioration and Worsening, sudden chest pain, CHF, acute myocardial infarction, anatomy, IABP, unstable angina with intravenous nitroglycerin or rest angina may be included.

(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, CHF, acute myocardial infarction (AMI), anatomy, IABP, unstable angina (USA) with intravenous (IV) nitroglycerin (NTG) 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 OR or prior to anesthesia induction.

11 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.

FY 2008 Massachusetts Cardiac Care Hospital Outlier Committee

A Massachusetts Department of Public Health Committee charged with reviewing hospital outlier findings.

Alice Bonner. Ph.D., R.N.
Director (current)
Bureau of Health Care Safety and Quality
Massachusetts Department of Public Health

Paul Dreyer, Ph.D.
Director (former)
Bureau of Health Care Safety and Quality
Massachusetts Department of Public Health

Nancy Murphy
Policy Analyst
Massachusetts Department of Public Health

Elizabeth Daake
Director, Policy Development and Planning
Massachusetts Department of Public Health

Thomas Piemonte, M.D.
Director, Cardiac Catheterization Laboratory
Lahey Clinic

David Shahian, M.D.
Chair, Center for Quality and Safety
Department of Surgery
Massachusetts General Hospital

Sharon-Lise Normand, Ph.D.
Professor of Health Care Policy
Department of Health Care Policy
Harvard Medical School

Stanley Lewis, M.D.
Associate Professor of Medicine
Harvard Medical School
Beth Israel Deaconess Medical Center

John Pastore, M.D.
Clinical Cardiologist
St. Elizabeth's Medical Center

Frank Sellke, M.D.
Professor of Surgery
Harvard Medical School
Beth Israel Deaconess Medical Center

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

FY 2008 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 MA 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.

Susan Edgman-Levitan, Executive Director
The John D. Stoeckle Center for
Primary Care Innovation
Massachusetts General Hospital

Samuel Shubrooks, M.D.
Cardiac Catheterization Lab
Beth Israel Deaconess Medical Center

Sharon-Lise Normand, Ph.D.
Professor of Health Care Policy
Department of Health Care Policy
Harvard Medical School

David Torchiana, M.D.
Chairman and CEO
Mass. General Physicians Organization

David Shahian, M.D.
Chair, Center for Quality and Safety
Department of Surgery
Massachusetts General Hospital

Thomas Vander Salm, M.D.
Chief, Department of Cardiac Surgery
North Shore Medical Center - Salem Hospital

Frank Sellke, M.D.
Professor of Surgery
Harvard Medical School
Beth Israel Deaconess Medical Center

The FY 2008 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.

Susan April, RN/Data Manager
North Shore Medical Center - Salem Hospital

Sary Aranki, M.D.
Brigham and Women's Hospital

Vladimir Birjiniuk, M.D.
Mount Auburn Hospital

Thomas Carr, M.D.
Southcoast Charlton Memorial Hospital

Richard D'Agostino, M.D.
Lahey Clinic

Michelle Doherty, RN/Data Manager
Beth Israel Deaconess Medical Center

Daniel Engelman, M.D.
Baystate Medical Center

Robert Hagberg, M.D.
Beth Israel Deaconess Medical Center

Karen Lynch, RN/Data Manager
Massachusetts General Hospital

Robert Poston, M.D.
Boston Medical Center

Roberto Rodriguez, M.D.
Caritas St. Elizabeth's Medical Center

David Shahian, M.D.
Massachusetts General Hospital

Prem Shekar, M.D.
Brigham and Women's Hospital

Tamar Yehoshua, Data Manager
Caritas St. Elizabeth's Medical Center

FY 2008 Publications Committee for Cardiac Surgery

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 review and comment on the request before sending the proposal to the Massachusetts Department of Public Health for final approval.

Kamal Khabbaz, M.D.
Beth Israel Deaconess Medical Center

Ralph M. Bolman, M.D.
Brigham and Women's Hospital

Robert Poston, M.D.
Boston Medical Center

David Shahian, M.D.
Massachusetts General Hospital

Frank Sellke, M.D.
Beth Israel Deaconess Medical Center

A 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 plus Other*.

Procedure	Mass-DAC	NY State	STS
Maze: **Open** heart approach	Other	Excluded	Other
Maze: **Closed** epicardial approach and radio frequency	CABG	Excluded	Other
Implantable Cardioverter Defibrillator (ICD)	Other	CABG	Other
Ventricular Lead Insertion for ICD	CABG	CABG	Other
Pacemaker Lead Insertions	CABG	CABG	CABG
Lung Biopsy	Case Specific	CABG	Other
Patent Foramen Ovale Closure	CABG	CABG	Other
Femoral Artery Procedures	CABG	CABG	Other
Transmyocardial Revascularization	Other	CABG	Other
Opening of the right atrium for tumor resection	Other	Other	Other
Atrial Appendage	CABG	No information available regarding how these procedures are categorized	
Myoxoma	Other		
Unplanned Ventricular Assist Device (VAD) Placement	CABG		
Planned Ventricular Assist Device Placement	Other		
Carotid Surgery	Other		
Lead and Device Explants	Other		

B Appendix

STS DATA ABSTRACTION TOOL – VERSION 2.52.1

(Variables considered optional and not harvested by STS are harvested by Mass-DAC)

The Society of Thoracic Surgeons
Adult Cardiac Surgery Database
Data Collection Form
Version 2.52.1

A. Administrative

Participant ID: |___|___|___|___|___|___| Record ID _____

Cost Link Field: _____ STS Trial Link Number: |___|___|___|___|___|___| Patient ID _____

B. Demographics

Last Name: _____ First Name: _____ Patient M.I.: ____ Name Fields Not Harvested

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

Gender: Male Female

Social Security (or National Patient ID) Number: _____ Not Harvested Medical Record Number: _____ Not Harvested

Patient ZIP or Postal Code: _____ Race: Caucasian Black Hispanic Asian Native American Other

Referring Cardiologist's Name: _____ Not Harvested Referring Physician's Name: _____ Not Harvested

C. Hospitalization

Hospital Name: _____ Hospital ZIP Code |_____| Hospital State |___|___|

Payor: _____ Not Harvested

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

ICU Visit: Yes No If Yes, → Initial ICU Hours:_____

Readmn to ICU: Yes No If Yes, → Additional ICU Hours _____

Total Hours in ICU:_____

D. Risk Factors

Weight (kg): _____ Height (cm): _____

Smoker: Yes No If Yes, → Current Smoker: Yes No

Family History of Coronary Artery Disease: Yes No

Diabetes: Yes No If Yes, select one: → Diabetes Control: None Diet Oral Insulin

Dyslipidemia: Yes No

Last Creatinine Level Preop: _____

Renal Failure: Yes No If Yes, → Dialysis: Yes No

Hypertension: Yes No

Cerebrovascular Accident: Yes No If Yes, → When: Recent <= 2 weeks Remote > 2 weeks

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

Chronic Lung Disease: No Mild Moderate Severe

Immunosuppressive Therapy: Yes No

Peripheral Vascular Disease: Yes No

Cerebrovascular Disease: Yes No If Yes, → CVD Type: Coma CVA RIND TIA Non Invasive > 75% Prior Carotid Surgery

E. Previous CV Interventions

Incidence: First CV Surgery First Re-op CV Surgery Second Re-op CV Surgery Third Re-op CV Surgery Fourth or More Re-op Surgery

Previous CV Interventions: Yes No If Yes, complete the rest of this section ↓

Previous Coronary Artery Bypass: Yes No

Previous Valve: Yes No

Previous Other Cardiac – Intrapericardial or Great Vessel: Yes No

Previous Other Cardiac – AICD: Yes No

Previous Other Cardiac – Pacemaker: Yes No If Yes, → Previous Other Cardiac – Pacemaker Type: Biventricular Univentricular

Previous Other Cardiac – PCI: Yes No If Yes, → Previous Other Cardiac – PCI Interval: <= 6 Hours > 6 Hours

F. Preoperative Cardiac Status

Myocardial Infarction: Yes No If Yes, → When: <= 6 hours > 6 hours but <24 hours 1 - 7 days 8 - 21 days > 21 days

Congestive Heart Failure: Yes No

Angina: Yes No If Yes, → Angina Type: Stable Unstable

Cardiogenic Shock: Yes No If Yes, → Cardiogenic Shock Type: Refractory Shock Hemodynamic Instability

Resuscitation: Yes No

Arrhythmia: Yes No If Yes, → Arrhythmia Type: Sust VT/VF Heart Block AFib/Flutter None

Classification - NYHA: I II III IV

G.. Preoperative Medications

Beta Blockers: Yes No

ACE Inhibitors: Yes No

Nitrates I.V.: Yes No

Anticoagulants: Yes No If Yes, → Anticoagulants Medication Name: Heparin (Unfractionated) Heparin (Low Molecular) Thrombin Inhibitors

Coumadin: Yes No

Inotropes: Yes No

Steroids: Yes No

Aspirin: Yes No

Lipid-Lowering: Yes No If Yes, → Lipid Lowering Medication Name: Statin Non statin

ADP Inhibitors: Yes No

Glycoprotein IIbIIIa Inhibitor: Yes No If Yes, → Glycoprotein IIbIIIa Inhibitor Medication Name: Abciximab (ReoPro)
Eptifibatied (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: _____
Method: LV gram Radionucleotide Estimate ECHO

Pulmonary Artery Mean Pressure Done? Yes No If Yes, → Pulmonary Artery Mean Pressure: _____

Aortic Stenosis: Yes No If Yes, → Gradient: _____

Mitral Stenosis: Yes No

Tricuspid Stenosis: Yes No

Pulmonic Stenosis: Yes No

Aortic Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe

Mitral Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe

Tricuspid Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe

Pulmonic Insufficiency: 0=None 1=Trivial 2=Mild 3= Moderate 4= Severe

I. Operative

Surgeon's Name: _____ Surgeon ID: _____

Status of the procedure: ↓

Elective

Urgent → Reason: AMI IABP Worsening CP CHF Anatomy USA Rest Angina
Valve Dysfunction Aortic Dissection Angiographic Accident

Emergent → Reason: Shock Circ Support Shock No Circ Support Pulmonary Edema AEMI
Ongoing Ischemia Valve Dysfunction Aortic Dissection Angiographic Accident

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

Ventricular Assist Device: Yes No → If Yes, also complete Section L

Other Cardiac Procedure: Yes No → If Yes, also complete Section M

Other Non-Cardiac Procedure: Yes No → If Yes, also complete Section N

Skin Incision Start Time: _____ 24 hour clock Skin Incision Stop Time: _____ 24 hour clock

CPB Utilization: None Combination Full ↓

If Combination, → 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 (min): _____

Cannulation Method: → Aorta and Fem/Jug Vein
Fem Art and Fem/Jug Vein
Aorta and Atrial/Caval
Fem Art and Atrial/Caval
Other

Aortic Occlusion: → None
Aortic Crossclamp → If Aortic Crossclamp or Balloon Occlusion, → Cross Clamp Time (min): _____
Balloon Occlusion
Partial Crossclamp

Cardioplegia: Yes No

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 Yes, Red Blood Cell Units _____
Fresh Frozen Plasma Units _____
Cryoprecipitate Units _____
Platelet Units _____

J. Coronary Bypass

Number of Distal Anastomoses with Arterial Conduits: _____

Number of Distal Anastomoses with Venous Conduits: _____

Anastomotic Device Used: Yes No If Yes, → Anastomotic Device: Glue Magnets Clips Staples Other

IMAs Used as Grafts: Left IMA Right IMA Both IMAs No IMA If Left, Right, or Both ↓
IMA Harvest Technique: Direct Vision Thoracoscopy 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: _____

Number of Gastro-Epiploic Artery Distal Anastomoses: _____

Number of Other Arterial Distal Anastomoses: _____

K. Valve Surgery

Aortic:	Mitral:	Tricuspid:	Pulmonic:
No	No	No	No
Replacement	Annuloplasty Only	Annuloplasty Only	Replacement
Repair/Reconstruction	Replacement	Replacement	Reconstruction
Root Reconstruction w/ Valve Conduit	Reconstruction w/ Annuloplasty	Reconstruction w/ Annuloplasty	
Replacement + Aortic Graft Conduit	Reconstruction w/out Annuloplasty	Reconstruction w/out Annuloplasty	
Root Reconstruction w/ Valve Sparing		Valvectomy	
Resuspension Aortic Valve with replacement ascending Aorta			
Resuspension Aortic Valve without replacement ascending Aorta			
Resection Sub-Aortic Stenosis			

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: _____
Mitral 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

Mechanical
ATS Mechanical Prosthesis = M1
Björk-Shiley Convex-Concave Mechanical Prosthesis = M2
Björk-Shiley Monostrut Mechanical Prosthesis = M3
CarboMedics Mechanical Prosthesis = M4
CarboMedics Carbo-Seal Ascending Aortic Valved Conduit Prosthesis = M16
CarboMedics Carbo-Seal Valsalva Ascending Aortic Valved Conduit Prosthesis = M17
CarboMedics Reduced Cuff Aortic Valve = M18
CarboMedics Standard Aortic Valve = M19
CarboMedics Top-Hat Supra-annular Aortic Valve = M20
CarboMedics OptiForm Mitral Valve = M21
CarboMedics Standard Mitral Valve = M22
CarboMedics Orbis Universal Valve = M23
CarboMedics Small Adult Aortic and Mitral Valves = M24
Edwards Tekna Mechanical Prosthesis = M5
Lillehei-Kaster Mechanical Prosthesis = M6
MCRI On-X Mechanical Prosthesis = M10
Medtronic-Hall/Hall Easy-Fit Mechanical Prosthesis = M7
Medtronic ADVANTAGE Mechanical Prosthesis= M25
OmniCarbon Mechanical Prosthesis = M8
OmniScience Mechanical Prosthesis = M9
Sorin Bicarbon (Baxter Mira) Mechanical Prosthesis = M11
Sorin Monoleaflet Allcarbon Mechanical Prosthesis = M12
St. Jude Medical Mechanical Prosthesis or St. Jude Medical® Mechanical Heart Valve = M13
SJM® Masters Series Mechanical Heart Valve = M26
SJM® Masters Series Aortic Valve Graft Prosthesis = M27
St. Jude Medical® Mechanical Heart Valve Hemodynamic Plus (HP) Series = M28
SJM® Masters Series Hemodynamic Plus Valve with FlexCuff™ Sewing Ring = M29
SJM Regent™ Valve = M30
Starr-Edwards Caged-Ball Prosthesis = M14
Ultracor Mechanical Prosthesis = M15

Bioprosthetic
Baxter Prima Stentless Porcine Bioprosthesis – Subcoronary = B24
Baxter Prima Stentless Porcine Bioprosthesis – Root = B25
Biocor Porcine Bioprosthesis = B3
Biocor Stentless Porcine Bioprosthesis – Subcoronary = B26
Biocor Stentless Porcine Bioprosthesis – Root = B27
CarboMedics PhotoFix Pericardial Bioprosthesis = B5
Carpentier-Edwards Duraflex Porcine Bioprosthesis = B28
Carpentier-Edwards Prima Plus Stentless Porcine Bioprosthesis – Subcoronary = B29
Carpentier-Edwards Prima Plus Stentless Porcine Bioprosthesis – Root = B30
Carpentier-Edwards PERIMOUNT Pericardial Bioprosthesis = B6
Carpentier-Edwards Standard Porcine Bioprosthesis = B7
Carpentier-Edwards Supra-Annular Aortic Porcine Bioprosthesis = B8
Cryolife O'Brien Stentless Porcine Bioprosthesis – Subcoronary = B31
Cryolife O'Brien Stentless Porcine Bioprosthesis – Root = B32
Hancock Standard Porcine Bioprosthesis = B10
Hancock II Porcine Bioprosthesis = B11
Hancock Modified Orifice Porcine Bioprosthesis = B12
Ionescu-Shiley Pericardial Bioprosthesis = B13
Labcor Stented Porcine Bioprosthesis = B14
Labcor Stentless Porcine Bioprosthesis – Subcoronary = B33
Labcor Stentless Porcine Bioprosthesis – Root = B34
Medtronic Freestyle Stentless Porcine Bioprosthesis – Subcoronary = B35
Medtronic Freestyle Stentless Porcine Bioprosthesis – Root = B36
Medtronic Intact Porcine Bioprosthesis = B17
Medtronic Mosaic Porcine Bioprosthesis = B18
Medtronic Contegra Bovine Jugular Bioprosthesis = B37
Mitroflow Pericardial Bioprosthesis = B19
St. Jude Medical - Toronto SPV Stentless Porcine Bioprosthesis or SJM Toronto SPV® Valve = B21
St. Jude Medical-Bioimplant Porcine Bioprosthesis = B22
SJM Biocor™ Valve = B38
SJM Epic™ Valve = B39
SJM Toronto Root™ Bioprosthesis = B40
Sorin Pericarbon Stentless Pericardial Bioprosthesis = B20

Homograft
CryoLife Aortic Homograft = H6
CryoLife Pulmonary Homograft = H7
CryoLife CryoValve SG(Decellularized)Aortic Homograft = H8
CryoLife CryoValve SG Pulmonary Homograft = H9
Homograft Aortic – Subcoronary = H1
Homograft Aortic Root = H2
Homograft Mitral = H3
Homograft Pulmonic Root = H4
LifeNet CV Allografts = H10

Autograft
Pulmonary Autograft to aortic root (Ross Procedure) = A1

Ring - Annuloplasty
CarboMedics AnnuloFlo Ring = R8
CarboMedics AnnuloFlex Ring = R9
CarboMedics CardioFix Bovine Pericardium with PhotoFix Technology = R10
Carpentier-Edwards Classic Annuloplasty Ring = R1
Carpentier-Edwards Physio Annuloplasty System Ring = R2
Cosgrove-Edwards Annuloplasty System Ring = R3
Edwards MC³ Tricuspid Annuloplasty System G Future Band = R11
Genesee Sculptor Annuloplasty Ring = R12
Medtronic Sculptor Ring = R4
Medtronic-Duran AnCore Ring = R5
Sorin-Puig-Messana Ring = R6
St. Jude Medical Sequin Ring or SJM® Séguin Annuloplasty Ring = R7
SJM Tailor™ Annuloplasty Ring = R13

Band – Annuloplasty
Medtronic Colvin Galloway Future Band = Ba1
Medtronic Duran Band = Ba2
Medtronic Duran – Ancore Band = Ba3

Other = 777

L. **VAD**

Previous VAD: Yes No
Please note that future references to "initial VAD" refer to the initial VAD for this hospitalization, not a VAD placed during a previous hospitalization.

Current Circulatory Support: For Initial VAD only

Indication for VAD: (Bridge to Transplant) (Bridge to Recovery) (Destination) (Separation from CPB) (Device Malfunction)

Intubated Pre VAD: Yes No

Hemodynamics Pre VAD: May be obtained Prior to induction in the OR, or in an ICU immediately prior to OR

PCWP: _____mm/Hg CVP: _____mm/Hg PVR: _____woods units CI: _____L/ (min x m2)

RV Function: (Normal) (Mildly Impaired) (Moderately Impaired) (Severely Impaired)

RV Function method: _____ (Pre-op ECHO) (Intra-op pre VAD TEE)

VO2 Measured: Yes No

Peak VO2:_____ml/kg/min

VAD Device Data:

Implant Type: Fill in below: (RVAD) (LVAD) (BiVAD)
Product Type: Fill in below: 1. HeartQuest VAD 2. Lion Heart 3. Novacor LVAS 4. Heartsaver VAD 5. Jarvik 2000 6. Debakey VAD 7. TandemHeart pVAD 8. AB-180 iVAD 9. CardioWest TAH 10. Thoratec IVAD 11. HeartMate VE 12. HeartMate IP LVAS 13. HeartMate SNAP-VE 14. HeartMate XVE 15. HeartMate II 16. HeartMate III 17. BVS5000i 18. AbioCor 19. Incor 20. Excor 21. Other

Explant Reason: Fill in below: 1. Cardiac Transplant 2. Recovery 3. Device Transfer 4. Device Related Infection 5. Device Malfunction

Initial Implant Data

Implant Type	Product Type	Implant Date	Explant	Explant Date	Explant Reason	Cardiac Tx	Tx Date
_____	_____	___ / __ / ___	Y N	___ / ___ / ___	_____	Y N	___ / ___ / ___

Initial VAD Cannulation/Attachment Sites:

LVAD Inflow: (LA) (LV)

RVAD Inflow: (RA) (RV)

Additional Implant(s) Data

Implant(s) Type	Product Type	Implant Date	Explant	Explant Date	Explant Reason	Cardiac Tx	Tx Date
_____	_____	___ / ___ / ___	Y N	___ / ___ / ___	_____	Y N	___ / ___ / ___
_____	_____	___ / ___ / ___	Y N	___ / ___ / ___	_____	Y N	___ / ___ / ___

Primary VAD Complications Data:

Intracranial Bleed: Yes No

Embolic Stroke: Yes No

Driveline/Cannula Infection: Yes No

Pump Pocket Infection: Yes No

VAD Endocarditis: Yes No

Device Malfunction: Yes No

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

VAD Status: Discharged from hospital: (with VAD) (without VAD)

M. **Other Cardiac Procedures**

Yes	No	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	Transmyocard Laser Revasc	Yes	No	Cardiac Trauma	Yes	No	Cardiac Transplant

Arrhythmia Correction Surgery → None
Permanent Pacemaker
Permanent Pacemaker with Cardiac Resynchronization Therapy (CRT)
Implanted Cardioverter Defibrillator (ICD)
ICD with CRT

If "Permanent Pacemaker with CRT" or "ICD with CRT", then answer ↓

Arrhythmia Correction Surgery – Lead Placement → Epicardial Endocardial

Atrial Fibrillation Correction Surgery → None
Standard Surgical Maze Procedure
Other Surgical Ablative Procedure
Combination of Standard and Other If Other or Combo, then answer ↓

Atrial Fibrillation Surgery – Energy Source → Unipolar Radiofrequency
Bipolar Radiofrequency
Microwave
Cryothermia
Other
Combination of above

Yes No Aortic Aneurysm If Yes, → Yes No Ascending Aorta
Yes No Aortic Arch
Yes No Descending Aorta
Yes No Thoracoabdominal Aorta

Yes No Other

N. **Other Non Cardiac Procedures**

Yes No Carotid Endarterectomy Yes No Other Vascular Yes No Other Thoracic Yes No Other

O. **Post Operative**

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 If No, → Initial # Hrs Ventilated Postop: _____

Re-intubated During Hosp Stay: Yes No If Yes, → Addl Hours Ventilated Postop: _____

Total Hours Ventilated Postop: _____

P. **Complications** In Hospital Complications: Yes No

Operative:

Yes No ReOp for Bleeding Tamponade
Yes No ReOp for Valvular Dysfunction
Yes No ReOp for Graft Occlusion
Yes No ReOp for Other Cardiac Problem
Yes No ReOp for Other Non Cardiac Problem
Yes No Perioperative MI

Infection:

Yes No Sternum – Deep
Yes No Thoracotomy
Yes No Leg
Yes No Septicemia

Neurologic:

Yes No Postoperative Stroke for >72 hours

Yes No Transient Neurologic Deficit

Yes No Continuous Coma >=24Hrs

Pulmonary:

Yes No Prolonged Ventilation

Yes No Pulmonary Embolism

Yes No Pneumonia

Renal:

Yes No Renal Failure If Yes, ↓

Yes No Dialysis (Newly Required)

Vascular:

Yes No Illiac/Femoral Dissection

Yes No Acute Limb Ischemia

Other:

Yes No Heart Block

Yes No Cardiac Arrest

Yes No Anticoagulant Complication

Yes No Tamponade

Yes No Gastro-Intestinal Complication

Yes No Multi-System Failure

Yes No Atrial Fibrillation

Yes No Aortic Dissection

Yes No Other

Q. **Mortality**

Mortality: Yes No Discharge Status: Alive Dead Status at 30 days after surgery: Alive Dead Unknown

Operative Death: Yes No Only answered if Mortality = Yes

Mortality - Date __ __/__ __/__ __ __ __ (mm/dd/yyyy) Only answered if Mortality = Yes

Location of Death: OR during initial surgery Hospital Home Other Care Facility OR during reoperation Only answered if Mortality = Yes

Primary Cause of Death (select only one): Only answered if Mortality = Yes

Cardiac Neurologic Renal Vascular Infection Pulmonary Valvular Unknown Other

R. **Discharge** (Note: This section is only answered if Discharge Status is "Alive")

ADP Inhibitors: Yes No

Antiarrhythmics: Yes No If Yes, ↓

Antiarrhythmics – Discharge – Medication Name: Amiodarone Other

Aspirin: Yes No

Ace-Inhibitors: Yes No

Beta Blockers: Yes No

Lipid Lowering: Yes No If Yes, ↓

Lipid Lowering – Discharge – Medication Type: Statin Non statin

Coumadin: Yes No

Discharge Location: Home Extended Care/TCU Other Hospital Nursing Home Other

Cardiac Rehabilitation Referral: Yes No Not Applicable

Smoking Cessation Counseling: Yes No Not Applicable

S. **Readmission** (Note: This section is only answered if Discharge Status is "Alive")

Readmit <=30 Days from Date of Procedure: Yes No ↓ If Yes, select the primary reason and procedure

Readmit Reason:

- Anticoagulation Complication – Valvular
- Anticoagulation Complication - Pharmacological
- Arrhythmias/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 Sternum
- Infection – Conduit Harvest Site
- Renal Failure
- TIA
- Permanent CVA
- Acute Vascular Complication
- Subacute Endocarditis
- VAD Complication
- Other – Related Readmission
- Other – Nonrelated Readmission

Readmit Reason – 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

C Appendix

STS DATA ABSTRACTION TOOL – VERSION 2.61

(Variables considered optional and not harvested by STS are harvested by Mass-DAC)

The Society of Thoracic Surgeons
Adult Cardiac Surgery Database
Data Collection Form
Version 2.61

A. Administrative

Participant ID: |___|___|___|___|___| Cost Link: _____ STS Trial Link Number: _____

B. Demographics

Patient Last Name: _____ Patient First Name: _____ Patient M.I.: ____ Name Fields Optional Harvest

Date of Birth (mm/dd/yyyy): __ __/__ __/__ __ __ __ Patient Age: _____ System Calculation Sex: Male Female

Social Security #: _____ Optional Harvest Medical Record Number: _____ 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

Cerebrovascular Disease: Yes No

If Yes → Coma: Yes No

CVA: Yes No If Yes → CVA-When: Recent (<=2 weeks) Remote (>2 weeks)

CVD RIND: Yes No

CVD TIA: Yes No

CVD NonInvasive >75%: Yes No

CVD Prior Carotid Surgery: Yes No

E. Previous CV Interventions

Previous CV Interventions: Yes No If Yes, complete the remainder of this section ↓

Previous Coronary Artery Bypass: Yes No

Previous Valve: Yes No

Previous Other Cardiac Yes No

Congenital Yes No

AICD (Automatic Implanted Cardioverter / Defibrillator): Yes No

Pacemaker: Yes No

PCI (Percutaneous Cardiac Intervention): Yes No If Yes ↓

PCI Stent: Yes No If Yes → Stent Type: Bare Metal Drug-eluting Unknown

PCI Interval: <= 6 Hours > 6 Hours

Other: Yes No

F. Preoperative Cardiac Status

Previous Myocardial Infarction: Yes No If Yes → When: <= 6 hours > 6 hours but <24 hours 1 - 7 days 8 - 21 days > 21 days

Heart Failure: Yes No

Classification - NYHA: Class I Class II Class III Class IV

Cardiac Presentation on Admission: No Symptoms or Angina

Symptoms Unlikely to be Ischemia

Stable Angina

Unstable Angina

Non-ST Elevation MI (Non-STEMI)

ST-Elevation MI (STEMI)

STS Cardiogenic Shock: Yes No

Resuscitation: Yes No

Arrhythmia: Yes No If Yes → Arrhythmia Type: Vtach / Vfib Yes No

3rd degree HB Yes No

Afib / Aflutter Yes No

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 If Yes → Medication Name: Statin Non-statin Both

ADP Inhibitors Within Five Days: Yes No Contraindicated / Not Indicated If Yes → Discontinuation: _____ (# Days)

Antiplatelets Within 5 Days: Yes No Contraindicated / Not Indicated

Glycoprotein IIbIIIa Inhibitor: Yes No Contraindicated / Not Inidcated

If Yes → Medication Name: Abciximab (ReoPro) Eptifibatied (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 If Yes → Gradient: _____

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

Emergent → Reason: Shock Circ Support Shock No Circ Support Pulmonary Edema AEMI
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

Ventricular Assist Device: Yes No → If Yes, also complete Section L

Other Cardiac Procedure: Yes No → If Yes, also complete Section M

Other Non-Cardiac Procedure: Yes No → If yes, also complete Section N

Enter up to 10 CPT-I 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, 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 _____ (%)

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

Cerebral Oximeter Provided The First Indication: Yes No

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

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

Desmopressin: Yes No

Tranexamic 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: Yes No 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 Thoracoscopy 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	No	No	No
Replacement	Annuloplasty Only	Annuloplasty Only	Replacement
Repair/Reconstruction	Replacement	Replacement	Reconstruction
Root Reconstruction w/ Valve Conduit	Reconstruction w/ Annuloplasty	Reconstruction w/ Annuloplasty	
Replacement + Aortic Graft Conduit	Reconstruction w/o Annuloplasty	Reconstruction w/o Annuloplasty	
Root Reconstruction w/ Valve Sparing	↓	Valvectomy	
Resuspension Aortic Valve w/ Replacement Ascending Aorta	(If Replacement) Mitral Repair Attempt: Yes No		
Resuspension Aortic Valve w/o 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: _____
Mitral 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 Monostrut Mechanical Prosthesis = 4
CarboMedics Mechanical Prosthesis = 6
CarboMedics Carbo-Seal Ascending Aortic Valved Conduit Prosthesis = 57
CarboMedics Carbo-Seal Valsalva Ascending Aortic Valved Conduit Prosthesis = 58
CarboMedics Reduced Cuff Aortic Valve = 59
CarboMedics Standard Aortic Valve = 60
CarboMedics Top-Hat Supra-annular Aortic Valve = 61
CarboMedics OptiForm Mitral Valve = 62
CarboMedics Standard Mitral Valve = 63
CarboMedics Orbis Universal Valve = 64
CarboMedics Small Adult Aortic and Mitral Valves = 65
Edwards Tekna Mechanical Prosthesis = 7
Lillehei-Kaster Mechanical Prosthesis = 53
MCRI On-X Mechanical Prosthesis = 10
Medtronic-Hall/Hall Easy-Fit Mechanical Prosthesis = 8
Medtronic ADVANTAGE Mechanical Prosthesis= 66
OmniCarbon Mechanical Prosthesis = 9
OmniScience Mechanical Prosthesis = 54
Sorin Bicarbon (Baxter Mira) Mechanical Prosthesis = 11
Sorin Monoleaflet Allcarbon Mechanical Prosthesis = 12
St. Jude Medical Mechanical Prosthesis or St. Jude Medical® Mechanical Heart Valve = 13
SJM® Masters Series Mechanical Heart Valve = 67

Medtronic Freestyle Stentless Porcine Bioprosthesis – Subcoronary = 83
Medtronic Freestyle Stentless Porcine Bioprosthesis – Root = 84
Medtronic Intact Porcine Bioprosthesis = 35
Medtronic Mosaic Porcine Bioprosthesis = 36
Medtronic Contegra Bovine Jugular Bioprosthesis = 85
Mitroflow Pericardial Bioprosthesis = 37
St. Jude Medical - Toronto SPV Stentless Porcine Bioprosthesis or SJM Toronto SPV® Valve = 39
St. Jude Medical-Bioimplant Porcine Bioprosthesis = 40
SJM Biocor™ Valve = 86
SJM Epic™ Valve = 87
SJM Toronto Root™ Bioprosthesis = 88
Sorin Pericarbon Stentless Pericardial Bioprosthesis = 38

Homograft

CryoLife Aortic Homograft = 89
CryoLife Pulmonary Homograft = 90
CryoLife CryoValve SG(Decellularized) Aortic Homograft = 91
CryoLife CryoValve SG Pulmonary Homograft = 92
Homograft Aortic – Subcoronary = 41
Homograft Aortic Root = 42
Homograft Mitral = 43
Homograft Pulmonic Root = 44
LifeNet CV Allografts = 93

Autograft

Pulmonary Autograft to aortic root (Ross Procedure) = 45

SJM® Masters Series Aortic Valve Graft Prosthesis = 68
St. Jude Medical® Mechanical Heart Valve Hemodynamic Plus (HP) Series = 69
SJM® Masters Series Hemodynamic Plus Valve with FlexCuff™ Sewing Ring = 70
SJM Regent™ Valve = 71
Starr-Edwards Caged-Ball Prosthesis = 14
Ultracor Mechanical Prosthesis = 15

Bioprosthesis
ATS 3f Aortic Bioprosthesis = 108
Baxter Prima Stentless Porcine Bioprosthesis – Subcoronary = 72
Baxter Prima Stentless Porcine Bioprosthesis – Root = 73
Biocor Porcine Bioprosthesis = 19
Biocor Stentless Porcine Bioprosthesis – Subcoronary = 74
Biocor Stentless Porcine Bioprosthesis – Root = 75
CarboMedics PhotoFix Pericardial Bioprosthesis = 21
Carpentier-Edwards Duraflex Porcine Bioprosthesis = 76
Carpentier-Edwards Prima Plus Stentless Porcine Bioprosthesis – Subcoronary = 77
Carpentier-Edwards Prima Plus Stentless Porcine Bioprosthesis – Root = 78
Carpentier-Edwards PERIMOUNT Pericardial Bioprosthesis = 22
Carpentier-Edwards PERIMOUNT Pericardial Magna Bioprosthesis = 103
Carpentier-Edwards Standard Porcine Bioprosthesis = 23
Carpentier-Edwards Supra-Annular Aortic Porcine Bioprosthesis = 25
Cryolife O'Brien Stentless Porcine Bioprosthesis – Subcoronary = 79
Cryolife O'Brien Stentless Porcine Bioprosthesis – Root = 80
Hancock Standard Porcine Bioprosthesis = 55
Hancock II Porcine Bioprosthesis = 28
Hancock Modified Orifice Porcine Bioprosthesis = 29
Ionescu-Shiley Pericardial Bioprosthesis = 30
Labcor Stented Porcine Bioprosthesis = 31
Labcor Stentless Porcine Bioprosthesis – Subcoronary = 81
Labcor Stentless Porcine Bioprosthesis – Root = 82

Ring / Annuloplasty
ATS Simulus Flex-O Ring = 109
ATS Simulus Flex-C Band = 110
CarboMedics AnnuloFlo Ring = 94
CarboMedics AnnuloFlex Ring = 95
CarboMedics CardioFix Bovine Pericardium with PhotoFix Technology = 96
Carpentier-Edwards Classic Annuloplasty Ring = 46
Carpentier-Edwards Geoform Ring = 104
Carpentier-Edwards IMR Etlogix Ring = 105
Carpentier-Edwards Physio Annuloplasty System Ring = 47
Cosgrove-Edwards Annuloplasty System Ring = 48
Edwards MC³ Tricuspid Annuloplasty System G Future Band = 97
Genesee Sculptor Annuloplasty Ring = 98
Medtronic Sculptor Ring = 49
Medtronic-Duran AnCore Ring = 50
Sorin-Puig-Messana Ring = 51
St. Jude Medical Sequin Ring or SJM® Séguin Annuloplasty Ring = 52
St. Jude RSR (Rigid Saddle Ring) = 106
SJM Tailor™ Annuloplasty Ring = 99

Band / Annuloplasty
Medtronic Colvin Galloway Future Band = 100
Medtronic Duran Band = 101
Medtronic Duran – Ancore Band = 102
St. Jude Tailor Band = 107

Other
Other = 777

L. VAD

Previous VAD: Yes No If Yes → Implanted at another facility: Yes No

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

Current Circulatory Support: For Initial VAD Only

Indication for VAD: Bridge to Transplantation Bridge to Recovery Destination
Postcardiotomy Ventricular Failure (Separation from CPB) Device Malfunction End of Life

Intubated Pre VAD: Yes No

Hemodynamics Pre VAD:

PCWP: _____mm/Hg CVP: _____mm/Hg CI: _____L/ (min x m2)

RV Function: Normal Mildly Impaired Moderately Impaired Severely Impaired

VAD Device Data:

Implant Type: **Fill in below**: Right VAD (RVAD) Left VAD (LVAD) BiVentricular BiVAD (BiVAD) Total Artificial Heart (TAH)

Product Type: **Fill in below**: 1. HeartQuest VAD 2. Lion Heart 3. Novacor LVAS 4. Heartsaver VAD 5. Jarvik 2000 6. DeBakey VAD 7. TandemHeart pVAD 8. AB-180 iVAD 9. CardioWest TAH 10. Thoratec IVAD 11. HeartMate VE 12. HeartMate IP LVAS 13. HeartMate SNAP-VE 14. HeartMate XVE 15. HeartMate II 16. HeartMate III 17. BVS5000i 18. AbioCor 19. Incor 20. Excor 21. Other

Explant Reason: **Fill in below:** 1. Cardiac Transplant 2. Recovery 3. Device Transfer 4. Device Related Infection 5. Device Malfunction 6. End of Life

Initial Implant Data

Implant Type	Product Type	Implant Date	Explant	Explant Date	Explant Reason	Transplant Date
_____	_____	___ / __ / _____ mm dd yyyy	Yes No	___ / ___ / _____ mm dd yyyy	_____	___ / ___ / _____ mm dd yyyy

Initial VAD Cannulation/Attach Site:

LVAD Inflow: Left Atrium Left Ventricle

RVAD Inflow: Right Atrium Right Ventricle

Additional Implant(s) Data

Second Device Implanted: Yes No If Yes ↓

Implant Type #2	Product Type #2	Implant Date #2	Explant #2	Explant Date #2	Explant Reason #2	Transplant Date #2
_____	_____	___ / ___ / ____ mm dd yyyy	Yes No	___ / ___ / ___ mm dd yyyy	_____	___ / ___/____ mm dd yyyy

Implant #2 VAD Cannulation/Attach Site:

LVAD Inflow: Left Atrium Left Ventricle

RVAD Inflow: Right Atrium Right Ventricle

Third Device Implanted: Yes No If Yes ↓

Implant Type #3	Product Type #3	Implant Date #3	Explant #3	Explant Date #3	Explant Reason #3	Transplant Date #3
_____	_____	___ / ___ / ____ mm dd yyyy	Yes No	___ / ___ / ___ mm dd yyyy	_____	___ / ___/____ mm dd yyyy

Implant #3 VAD Cannulation/Attach Site:

LVAD Inflow: Left Atrium Left Ventricle

RVAD Inflow: Right Atrium Right Ventricle

Primary VAD Complications Data:

Intracranial Bleed:	Yes	No
Embolic Stroke:	Yes	No
Driveline and/or Cannula Infection:	Yes	No
Pump Pocket Infection:	Yes	No
VAD Endocarditis:	Yes	No
Device Malfunction:	Yes	No
Bowel Obstruction:	Yes	No

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 If Yes ↓

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

Vascular

Illiac/Femoral Dissection	Yes	No
Acute Limb Ischemia	Yes	No

Other:

Heart Block	Yes	No
Cardiac Arrest	Yes	No
Anticoagulant Event	Yes	No
Tamponade	Yes	No
Gastro-Intestinal Event	Yes	No
Multi-System Failure	Yes	No
Atrial Fibrillation	Yes	No
Aortic Dissection	Yes	No
Other	Yes	No

Q. Mortality

Mortality: Yes No Discharge Status: Alive Dead Status at 30 days After Surgery: Alive Dead Unknown

If Mortality = Yes ↓

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)

ADP Inhibitors: Yes No Contraindicated / Not Indicated

Antiarrhythmics: Yes No Contraindicated / Not Indicated If Yes → Medication Name: Amiodarone Other

Aspirin: Yes No Contraindicated / Not indicated

Ace or ARB Inhibitors: Yes No Contraindicated / Not Indicated

Beta Blockers: Yes No Contraindicated / Not Indicated

Lipid Lowering: Yes No Contraindicated / Not Indicated If Yes → Medication Type: Statin Non-statin Both

Coumadin: Yes No Contraindicated / Not Indicated

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** (Note: This section is only answered if Discharge Status is 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 Sternum
- Infection – Conduit Harvest Site
- Renal Failure
- TIA
- Permanent CVA
- Acute Vascular Complication
- Subacute Endocarditis
- VAD Complication
- Transplant Rejection
- 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

