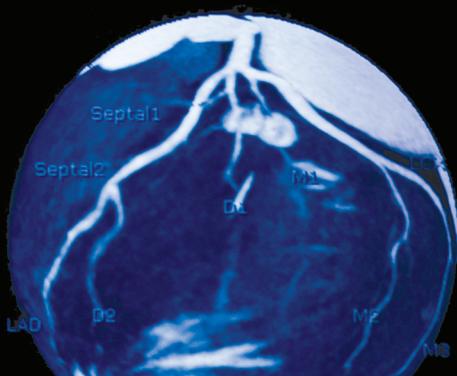
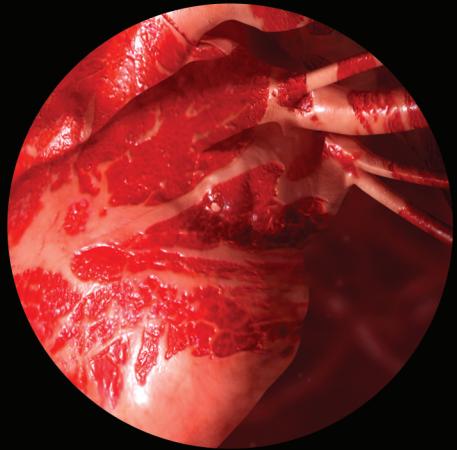
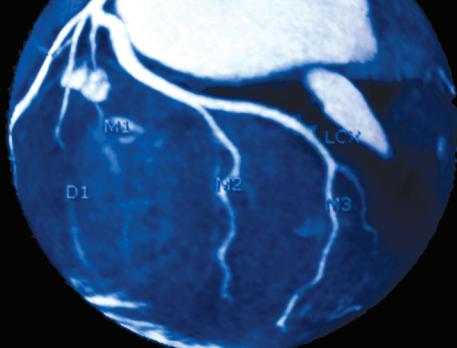


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OCTOBER 2010



The California Report on Coronary Artery Bypass Graft Surgery

2007 Hospital Data
California CABG Outcomes Reporting Program

THE CALIFORNIA REPORT ON

CORONARY ARTERY

BYPASS GRAFT SURGERY

2007 Hospital Data

October 2010

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THE CALIFORNIA REPORT ON CORONARY ARTERY BYPASS GRAFT SURGERY, 2007 HOSPITAL DATA

PREFACE

October 2010

We are pleased to share with you the fifth public release of data from the State's mandatory heart bypass surgery reporting program. This report provides quality ratings for 121 state-licensed hospitals that performed isolated coronary artery bypass graft (CABG) surgery during 2007. The ratings are based on two key outcome measures (operative mortality and post-operative stroke) and an important measure of surgical quality (use of the internal mammary artery during CABG surgery).

Isolated CABG surgery means that no other major procedure, such as valve repair or carotid endarterectomy, was performed at the same time as the bypass surgery. In 2007, the statewide operative mortality rate was 2.4%, a slight increase from the 2.2% rate in 2006, but a 19% reduction from the 2.9% rate in 2003, the first year of mandatory reporting.

Post-operative stroke is a devastating event with lasting consequences for both the patient and the family. This report, for the first time in the program's history, provides hospital ratings based on their risk-adjusted post-operative stroke rates for years 2006-2007 in response to a recommendation from the Office of Statewide Health Planning and Development's Clinical Advisory Panel.

This information is intended for cardiac patients and their families who are developing treatment plans with their doctors. It is also intended for hospitals and surgeons who are developing quality improvement activities and for organizations that purchase health coverage for their members. The clinical data collected and used to generate these findings are accurate and valid, and the analytical methods are rigorous. However, cardiac surgeon or hospital practices may have changed since the 2007 data were collected by OSHPD.

We commend the hospitals and cardiac surgeons in California and the Clinical Advisory Panel that oversees the program for their hard work and dedication in completing this public report. The Office of Statewide Health Planning and Development continues to work with hospitals, physicians, and professional surgical societies to ensure that our reports are accurate, fair, and contribute to improved cardiac surgical care for all residents of the Golden State.



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EXECUTIVE SUMMARY

The California Coronary Artery Bypass Graft (CABG) Outcomes Reporting Program is the largest public reporting program on CABG surgery outcomes in the United States.

The *California Report on Coronary Artery Bypass Graft Surgery, 2007 Hospital Data* presents findings from analyses of data collected from California's 121 state-licensed hospitals that performed adult isolated coronary artery bypass graft surgery¹ during 2007.

The report uses 2007 risk-adjusted operative mortality data and 2006 and 2007 risk-adjusted post-operative stroke data to evaluate hospital performance. Risk adjustment is a statistical technique that allows for fair comparison of hospital outcomes even though some hospitals have sicker patients than average. Operative mortality includes all deaths that occur during the hospitalization in which the CABG surgery was performed (regardless of length of stay) and any deaths within 30 days after the surgery, no matter where they occur. Post-operative stroke is defined as a central neurologic deficit persisting for more than 72 hours in the operating hospital after surgery.

Hospital post-operative stroke rates appear as a new measure of CABG quality in this report for the first time based on a recommendation made by the California CABG Outcomes Reporting Program's Clinical Advisory Panel.

This report also provides hospital-level information on internal mammary artery (IMA)² usage for 2007, an additional measure of surgical quality, and examines the relationship between the number of surgeries that hospitals perform and their mortality rates.

Key findings from this report are:

2007 Mortality Findings:

- There were 347 operative deaths among 14,756 isolated CABG surgeries.
- The operative mortality rate for isolated CABG surgery in California was 2.35%, compared to 2.2% for 2006. The rates for 2005, 2004, and 2003 were 3.1%, 3.3%, and 2.9% respectively. Although the rate is up slightly from 2006, there has been a 19% reduction in the rate since 2003, the first year of mandated public reporting.

¹ Isolated CABG surgery refers to heart bypass surgery without other major surgery, such as heart or lung transplantation, valve repair, etc., performed concurrently with the bypass procedure. For a complete definition of isolated CABG, see http://www.oshpd.ca.gov/HID/SubmitData/CCORP_CABG/2006AbstractTrain.pdf.

² The internal mammary artery (IMA) is an artery that supplies blood to the front chest wall and the breasts. It is a paired artery, with one running on each side of the inner chest. Evidence shows that the IMA, when grafted to a coronary artery, is less susceptible to obstruction over time and remains fully open longer than vein grafts.

- There was significant variation, from 0% to 17.7%, in hospital operative mortality rates after adjusting for patients' pre-operative health. Despite such variation, 117 of 121 hospitals (96.7%) performed at a rate that did not differ significantly from the statewide average.
- No hospital performed significantly "Better" than the state average in terms of risk-adjusted operative mortality, but four hospitals performed significantly "Worse" than the state average (shown in the following table alphabetically):

Hospitals with "Worse" Performance Ratings Based on Risk-adjusted Operative Mortality Rates, 2007	
Hospital	Region
Enloe Medical Center	Sacramento Valley & Northern California Region
Los Angeles Co. Harbor - UCLA Medical Center	Greater Los Angeles
St. Joseph's Medical Center of Stockton	Central California
Valley Presbyterian Hospital	San Fernando Valley, Antelope Valley, Ventura & Santa Barbara

2006-2007 Stroke Findings:

- 405 of the 30,379 patients (1.33%) who underwent isolated CABG surgery experienced a post-operative stroke, similar to the national rate of 1.4% reported by the Society of Thoracic Surgeons.³
- There is wide variation in post-operative stroke rates among hospitals after adjusting for patients' pre-operative conditions. Hospital risk-adjusted post-operative stroke rates ranged from 0% to 5.6%, and 115 of 121 hospitals (95%) performed at a rate that did not differ significantly from the statewide average.
- One hospital performed significantly "Better" than the state average on post-operative stroke, and five hospitals performed significantly "Worse" than the state average (shown in the following table alphabetically):

³ Shahian DM, O'Brien SM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 1—coronary artery bypass grafting surgery. Ann Thorac Surg 2009; 88:S2-22.

Hospitals with “Better” Performance Ratings Based on Risk-adjusted Post-operative Stroke Rates, 2006-2007	
Hospital	Region
Alta Bates Summit Medical Center - Summit Campus	San Francisco Bay Area & San Jose
Hospitals with “Worse” Performance Ratings Based on Risk-adjusted Post-operative Stroke Rates, 2006-2007	
Hospital	Region
Los Angeles Co. Harbor - UCLA Medical Center	Greater Los Angeles
Memorial Medical Center of Modesto	Central California
Sharp Memorial Hospital	Greater San Diego
Sutter Memorial Hospital	Sacramento Valley & Northern California Region
Tri-City Medical Center	Greater San Diego

2007 Internal Mammary Artery Usage Findings:

- California had a 93.7% IMA usage rate in 2007, a 4% increase and improvement since 2003.
- Five California hospitals (listed in the following table alphabetically) had lower than average IMA performance ratings:

Hospitals with “Low” Performance Ratings for IMA Usage, 2007	
Hospital	Region
Citrus Valley Medical Center - IC Campus	Greater Los Angeles
Dameron Hospital	Central California
Lakewood Regional Medical Center	Greater Los Angeles
Sutter Medical Center of Santa Rosa	San Francisco Bay Area & San Jose
Tri-City Medical Center	Greater San Diego

Effect of Hospital Volume on CABG Outcomes

- A small, but significant association was found between hospitals' isolated CABG surgery volume and their risk-adjusted operative mortality rates.
- No significant association was found between hospitals' CABG surgery volume (either isolated or total CABG surgery) and their risk-adjusted post-operative stroke rates.

Percutaneous Coronary Intervention vs. CABG Utilization and Outcomes Findings

- In California, utilization of percutaneous coronary interventions (PCIs) such as angioplasty with stent insertion increased by 20% from 1997 to 2008, peaking in 2005 when total PCI volume reached 60,709. During the same period, the number of isolated CABG surgeries dropped by 50%. The observed in-hospital mortality rate for isolated CABG surgeries decreased from 3.1% in 1997 to 1.9% in 2008 while the in-hospital mortality rate for PCIs increased slightly from 1.7% in 1997 1.8% in 2008.

ACKNOWLEDGEMENTS

The California Coronary Artery Bypass Graft (CABG) Outcomes Reporting Program is funded by the Office of Statewide Health Planning and Development's California Health Data and Planning Fund.

Many people contributed to this report. Hospital staff dedicated time and resources to collect, report, and review the data for analysis. Hospitals provided ongoing feedback on the design of the program, vital to its success. Members of the California CABG Outcomes Reporting Program (CCORP) Clinical Advisory Panel provided oversight and policy guidance for data collection and analysis as well as presentation of results. The Healthcare Information Division and the Healthcare Information Resource Center within the division provided expertise in report concept, editing and design. The California Department of Public Health provided Vital Statistics files needed for identifying post-surgery deaths after discharge. CCORP also benefited from collaboration with the Society of Thoracic Surgeons and its California Chapter to coordinate and improve data collection efforts.

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Additional copies of this report can be obtained through the OSHPD Web site (www.oshpd.ca.gov).

TABLE OF CONTENTS

Preface	iii
Executive Summary	iv
Acknowledgements	viii
California CABG Outcomes Reporting Program (CCORP) Clinical Advisory Panel	ix
Table of Contents.....	x
Tables and Figures	xi

REPORT

I. Introduction.....	1
II. Coronary Artery Disease and Bypass Surgery	2
Study Population	2
III. Data.....	3
Data Quality Review and Verification.....	3
Hospital Medical Chart Audit.....	4
IV. Risk Model for Adjusting Hospital Operative Mortality Rates, 2007	6
Discrimination.....	8
Calibration	9
V. Risk-adjusted Operative Mortality Results and Hospital Performance Ratings	10
2007 Hospital Risk-adjusted Operative Mortality Results.....	12
VI. Risk Model for Adjusting Hospital Post-operative Stroke Rates, 2006-2007	22
Discrimination.....	24
Calibration	25
VII. Risk-adjusted Post-operative Stroke Results and Hospital Performance Ratings.....	26
2006-2007 Hospital Risk-adjusted Post-operative Stroke Results.....	28
VIII. 2007 Internal Mammary Artery Usage by Hospital: A Process Measure of Quality.....	40
IX. The Relationship between Coronary Artery Bypass Graft Surgery Volume and Outcomes	49
2007 Hospital Volume-Outcome Analyses.....	50
Results	50
X. Use of Cardiac Intervention Procedures and Observed In-hospital Mortality	55
Appendix A: Hospital Statements.....	58

TABLES AND FIGURES

TABLES

Table 1:	Logistic Regression Risk Model for Operative Mortality, 2007	8
Table 2:	Calibration of 2007 Risk Model for Operative Mortality, 2007.....	9
Table 3:	Hospital Risk-adjusted Operative Mortality Results by Region, 2007	13
Table 4:	Logistic Regression Risk Model for Post-operative Stroke, 2006-2007	24
Table 5:	Calibration of Risk Model for Post-operative Stroke, 2006-2007	25
Table 6:	Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007.....	29
Table 7:	Hospital Results for Usage of the Internal Mammary Artery by Region, 2007	42
Table 8:	Hospital Isolated CABG Volume Groups and Predicted Mortality Outcomes, 2007	51
Table 9:	Hospital Total CABG Volume Groups and Predicted Mortality Outcomes, 2007	52
Table 10:	Hospital Isolated CABG Volume Groups and Predicted Post-operative Stroke Outcomes, 2006-2007.....	53
Table 11:	Hospital Total CABG Volume Groups and Predicted Post-operative Stroke Outcomes, 2006-2007.....	54

FIGURES

Figure 1:	Volume of Isolated CABG, Non-isolated CABG, and PCI Surgery in California, 1997-2008	56
Figure 2:	In-hospital Mortality Rates for Isolated CABG, Non-isolated CABG, and PCI Surgery in California, 1997-2008	57

I. INTRODUCTION

This report is a public disclosure of the quality of care provided by hospitals performing coronary artery bypass graft (CABG) surgery in California in 2007. It is the fifth heart bypass surgery report developed by the Office of Statewide Health Planning and Development (OSHPD) in compliance with California Health and Safety Code Sections 128745-128750. This report covers all of California's 121 state-licensed hospitals where this procedure is performed.

Risk-adjusted operative mortality and post-operative stroke are the key outcome measures reported. Operative mortality is defined as patient death occurring in the hospital after CABG surgery, regardless of the length of stay, or death occurring anywhere after hospital discharge but within 30 days of the CABG surgery. Use of operative mortality, instead of in-hospital mortality, avoids potential manipulation of outcomes through discharge practices and holds hospitals accountable for patients who died at home shortly after discharge or who were transferred and died in other facilities. The National Quality Forum (NQF), which serves as the national body for vetting quality measures, has endorsed the national Society of Thoracic Surgeons (STS) operative mortality measure for CABG surgery.⁴ STS uses operative mortality as its primary outcome measure for CABG surgery quality reporting, though they do not verify deaths following patient discharge as California CABG Outcomes Reporting Program (CCORP) does. Post-operative stroke is defined as a central neurologic deficit persisting for more than 72 hours in the operating hospital after surgery.

In this report, both the operative mortality rate and post-operative stroke rate are adjusted statistically to account for variation in the health condition of patients before CABG surgery.

This report is intended to encourage hospitals and surgeons to examine their surgical practices and make any changes necessary to improve their quality of care. Patients, their families, and healthcare purchasers may use this information when making decisions about CABG surgery.

OSHPD provided all hospitals listed in this report an opportunity to review their results prior to publication and to submit a comment letter for inclusion in this report. Four hospitals submitted letters, and they are included in Appendix A. These statements may help readers understand the concerns of some healthcare providers regarding the information released about them.

⁴ National Quality Forum. National voluntary consensus standards for cardiac surgery, Washington, DC: National Quality Forum, January 2005.

II. CORONARY ARTERY DISEASE AND BYPASS SURGERY

In 2007 coronary artery disease was the leading cause of adult non-maternal admissions.⁵ This represents 100,116 Californians or 6.5% of all adult non-maternal admissions.

Coronary artery disease is a chronic condition in which cholesterol and fat solidify and form plaque along the linings of the coronary arteries. This process is called atherosclerosis or hardening of the arteries. If plaque continues to accumulate, blood vessels may become partially or completely blocked, preventing the heart from receiving enough oxygen and leading to angina (chest pain) or even myocardial infarction (heart attack).

The two most common procedures for treatment of coronary artery disease are percutaneous coronary intervention (PCI), which includes angioplasty and insertion of stents, and CABG surgery. Despite recent increases in the number of PCIs performed, CABG surgery is more frequently recommended for patients with extensive coronary disease, reduced left ventricular function, and disease involving the left main coronary artery.

During CABG surgery, the surgeon uses arteries or veins from another part of the body (e.g., the internal mammary artery or the saphenous vein from the leg) to reroute blood around a blockage in the coronary arteries. This allows oxygen-rich blood to flow freely to nourish the heart muscle. Surgeons may create single or multiple grafts for patients, depending on how many blood vessels and main branches are blocked. In most patients, the preferred initial graft for CABG surgery is the internal mammary artery, since it maintains better blood flow over time and is associated with better long-term patient survival.

Study Population

Under State law, California-licensed hospitals are required to report all isolated and non-isolated CABG surgeries to the California CABG Outcomes Reporting Program (CCORP). Isolated CABG surgery is defined as CABG surgery performed without other major procedures, such as valve repair or carotid endarterectomy, during the same surgery. CCORP definition of isolated CABG surgery can be found at:

http://www.oshpd.ca.gov/HID/SubmitData/CCORP_CABG/2006AbstractTrain.pdf.

In 2007, there were 18,889 adult CABG surgeries performed in California. Of these, 14,756 (78.1%) were isolated CABG surgeries and 4,133 (21.9%) were non-isolated CABG surgeries. The study population for this report consists of all adult patients who underwent isolated CABG surgery and were discharged in 2007. Isolated CABG surgery cases were selected as the study population because uniformity of the surgical process allows adequate pre-operative risk adjustment for patient conditions. Non-isolated CABG cases were not used to determine hospital performance ratings in this report.

⁵ Data source: OSHPD, Patient Discharge Data, 2007. Patients were identified with Coronary Artery Disease if the principal diagnosis was coded as ICD-9-CM 410.0 - 414.9.

III. DATA

The primary data source for this report is the 2007 clinical data registry collected by CCORP from reporting hospitals. These data are linked to death records from the California Department of Public Health to identify patients who died at home or at facilities other than the operating hospital within 30 days following CABG surgery.

The CCORP clinical registry data draws on a subset of data elements collected by the Society of Thoracic Surgeons (STS) for their National Database of Cardiac Surgery. However, some data elements are exclusive to CCORP. The STS and CCORP data definitions are generally identical and CCORP provides additional clarifications to assist hospitals with coding. The data elements collected by CCORP in 2007 and their definitions can be found at the OSHPD Web site:

http://www.oshpd.ca.gov/HID/SubmitData/CCORP_CABG/Format-FileSpecs2.0.pdf.

Data Quality Review and Verification

CCORP reviews the data submitted by each hospital for completeness and errors. Using a three-step data quality review and verification process, CCORP asks hospitals to check data quality, data discrepancies, and potential risk-factor coding problems.

Step 1: Data Quality Reports

Data quality reports compare individual hospital rates for each pre-operative risk factor to the state average and list individual cases for hospital review and correction (e.g., checks for invalid, missing, and abnormally high or low risk factor values).

Step 2: Data Discrepancy Reports

Data discrepancy reports compare the CCORP clinical data to OSHPD's hospital administrative data source, the Patient Discharge Data (PDD). Hospitals are asked to review and account for discrepancies between the two data sources via patient medical chart review to verify that: 1) all CABG surgeries discharged in 2007 were reported; 2) all *Isolated CABG* surgery in-hospital deaths were reported; 3) coding of *Discharge Status* was consistent; 4) coding of *Cardiogenic Shock* was consistent; 5) coding of *Status of the Procedure*-“Emergent/Salvage” was consistent; and 6) coding of *post-operative complications* (including strokes) was consistent.

Step 3: Risk-Factor Coding Reports

Risk-factor coding reports compare each hospital's data to prior years of data and to the PDD and medical chart audit findings to identify possible under-reporting and over-reporting of risk factors. CCORP requests that hospitals review and, when necessary, correct poorly coded data elements.

Hospital Medical Chart Audit

After completing the quality review and verification process, CCORP developed a preliminary risk model for operative mortality to help identify candidate hospitals for a medical chart audit. Candidate selection for the 2007 audit was based on results of the preliminary model which identified "Better" or "Worse" hospital performers and in data quality reports which identified problems in over- and under-reporting. A small number of hospitals were also randomly selected for the on-site audit.

The 2007 audit included 18 hospitals and a total of 1,286 patient records (15% of all hospitals and 9% of all isolated CABG surgery cases in 2007). On-site medical chart reviews were conducted by trained, independent auditors under contract to OSHPD. All isolated CABG deaths at selected hospitals were audited and high-risk patients were sampled at a higher rate. The number of patient records selected within a hospital was proportional to the isolated CABG volume of the hospital, but generally fell within a range of 40 to 160 cases. If a selected hospital performed less than 40 isolated CABG surgeries per year, all surgeries were audited. An audit summary was sent to each hospital for review and comment and/or correction.

Key findings from the 2007 hospital medical chart audit include:

- The audit found that 99.9% of all reported isolated CABG cases were correctly coded as isolated. Auditors found 20 isolated CABG cases that should have been coded as non-isolated.
- In 2007, 7.4% of the comparisons between audited and CCORP data (39 categorical data elements) resulted in a data correction. Over-coding (hospital coded risk factor as more severe than auditor) of categorical risk factors increased slightly from 3.7% in 2006 to 3.9% in 2007. Under-coding (hospital coded risk factor as less severe than auditor) of categorical risk factors also increased slightly from 3.4% to 3.5%.
- For all hospitals audited, only 0.32% of risk factors were reported as missing. A missing value of a risk factor is replaced by the lowest risk category for that variable in the risk-adjustment process.
- Percent agreement is a simple method to determine agreement between hospital abstractors and auditors. In 2007, percent agreement for the 39 audited categorical data elements ranged from 66.8% to 100.0%. Thirty-five variables exceeded 80% agreement and 30 variables exceeded 90% agreement.
- Percent agreement for *Arrhythmia Type*, *Cardiogenic Shock*, *Cerebrovascular Accident Timing*, *Immunosuppressive Treatment* and all *Complications* was more than 90%. However, for these rare risk factors and events, high percent agreement may simply be due to the absence of the risk factor or event in most patients. In these cases, the Kappa statistic is a better measure of agreement. The Kappa value for *Cardiogenic Shock* was 0.48 and for *Arrhythmia Type: Afib/Flutter* was 0.46, showing moderate agreement between hospital abstractors and auditors.
- Percent agreement was below 80% for *NYHA Class IV* (66.8%), *Mitral Insufficiency* (75%), *Myocardial Infarction Timing* (73.7%), and *Status of Procedure* (78.8%). The Kappa values for these elements ranged from 0.36 to 0.63 (poor to moderate agreement). Of these elements, *NYHA Class IV* and *Mitral Insufficiency* had a greater amount of under-coding. This means that hospital coding of these two risk factors, on average, incorrectly

characterized patients as being at lower risk, resulting in a less favorable hospital outcome score. *Status of Procedure* had a higher percentage of over-coded values. This means that hospital coding of this element, on average, incorrectly characterized patients as being at higher risk, resulting in a more favorable hospital outcome score. The coding of these elements will continue to be monitored over time.

- The percent agreement statistics for post-operative complications were all above 90%, but as these are relatively rare events, percent agreement does not adequately capture quality of coding. The Kappa values for these outcomes range from moderate to excellent (0.41-0.90).

An audit summary report was sent to hospitals for review. The audited data replaced hospital-submitted data in generating the final results for this report. All outlier hospitals identified in 2007, except one, were audited either in 2007 or in previous years.

IV. RISK MODEL FOR ADJUSTING HOSPITAL OPERATIVE MORTALITY RATES, 2007

Whether patients recover quickly, have complications, or die following CABG surgery is in part a result of the medical care they receive. However, it is difficult to compare outcomes and assess surgical performance because patients treated at different hospitals often vary in the severity of their pre-operative clinical conditions. This section explains development and validation of CCORP's risk model that accounts for these variations.

To make fair comparisons among different healthcare providers, it is necessary to adjust for the differences in severity of illness (case mix) of patients across providers. CCORP "levels the playing field" by considering the pre-operative condition of each patient. Providers that handle more complex cases receive a larger risk-adjustment weight in the risk model, while providers that handle less complex cases receive a smaller weight. Thus, hospitals treating sicker patients are not at a disadvantage when their performance is compared with other hospitals.

CCORP used a multivariable logistic regression model to determine the relationship between each of the demographic and pre-operative risk factors and the probability of operative mortality. Multivariable logistic regression models relate the probability of death to the risk factor (e.g., *Patient Age*) while controlling for all other risk factors in the model.

To develop the risk model, the 14,756 isolated CABG surgery cases were evaluated for missing data (14,130 cases had no missing data in any field and were used for the risk model parameter estimation). The 626 (4.2%) isolated CABG cases with missing data fields were removed to ensure that the effects of risk factors were estimated based on the most complete data available. To generate the hospital-specific results shown in this report, missing values for these 626 records were imputed (after risk model parameter estimation) by replacing them with the lowest risk category of the same variable (e.g., *Chronic Lung Disease=None*). CCORP assigned the lowest risk value based on the following rationale: 1) some hospitals leave data fields blank by design when the risk factor is absent or the value is normal; 2) to maintain consistency with other major cardiac reporting programs that replace missing data with the lowest-risk or normal value; and 3) assigning values for missing data in this way creates an incentive for more complete reporting by hospitals. After imputing the missing values, the parameters of the risk model were applied to all cases to estimate each patient's probability of death. These probabilities were then summed to estimate the expected mortality for each hospital. The risk model based on the 2007 data is presented in Table 1.

**GUIDE TO INTERPRETING TABLE 1: LOGISTIC REGRESSION RISK MODEL
FOR OPERATIVE MORTALITY, 2007**

Coefficient	The coefficient for each risk factor represents the effect that factor has on a patient's likelihood of dying (in the hospital or within 30 days) following bypass surgery. If the value is positive, it means that the risk factor is associated with an increased risk of death compared to not having that factor, while controlling for the effect of all other factors. If the coefficient is negative, having that risk factor is associated with a lower risk of death compared with not having it. The larger the value (whether positive or negative), the greater the effect or weight this factor has on the risk of dying. For example, note that the coefficient for "Cardiogenic Shock" is 0.910 and statistically significant at the p<.001 level. This value is positive and indicates that CABG patients with cardiogenic shock are at an increased risk of dying compared to patients who do not have this condition.
Standard Error	The standard error is a measure of the variation or dispersion of the standard deviation of the sampling distribution of an estimate. It measures the statistical reliability of that estimate.
p-value	The p-value is a measure of the statistical significance of the coefficient estimate compared to a null value or reference category. Commonly, p-values of less than 0.05 are considered statistically significant. The smaller the p-value, the more likely the effect of a risk factor is real, rather than due to chance.
Significance	When the p-value of a coefficient is less than 0.05, it is deemed statistically significant at the 0.05 level and is denoted with one asterisk (*) in the significance column. Two asterisks (**) indicate statistical significance at the 0.01 level and three asterisks (***) indicate statistical significance at the 0.001 level. All statistical tests are two-tailed tests.
Odds Ratio	An odds ratio is another way of characterizing the impact of each risk factor on operative mortality. Mathematically, the odds ratio is the antilogarithm of the coefficient value. The larger the odds ratio, the greater the impact that risk factor has on the risk of dying. An odds ratio of 1.0 means the risk factor has no effect. For example, the odds ratio for cardiogenic shock is 2.48. This means that for patients with cardiogenic shock, the odds of dying are about 148% higher compared to patients without cardiogenic shock, assuming all other risk factors are the same.

Table 1: Logistic Regression Risk Model for Operative Mortality, 2007

Risk Factor		Coefficient	Standard Error	p-value	Significance	Odds Ratio
Intercept		-9.280	0.640	0.0001		
Patient Age (Years)		0.051	0.006	0.0001	***	1.053
Gender	Male	Reference				
	Female	0.316	0.127	0.0128	*	1.372
Race	White	Reference				
	Non-White	0.022	0.127	0.8617		1.022
Body Mass Index	18.5-39.9	Reference				
	< 18.5	0.077	0.486	0.8749		1.080
	>=40	0.793	0.246	0.0012	**	2.210
Status of the Procedure	1: Elective	Reference				
	2: Urgent	0.289	0.167	0.0839		1.335
	3: Emergent	0.929	0.279	0.0009	**	2.532
Creatinine PreOp (mg/dl)		1.005	0.259	0.0001	***	2.732
Hypertension		-0.060	0.177	0.7346		0.942
Peripheral Vascular Disease		0.127	0.144	0.3792		1.135
Cerebrovascular Disease		0.354	0.143	0.0133	*	1.425
Diabetes		0.012	0.124	0.9215		1.012
Chronic Lung Disease	None/Mild	Reference				
	Moderate	0.290	0.209	0.1645		1.336
	Severe	0.834	0.196	0.0001	***	2.303
Immunosuppressive Treatment	Yes	0.063	0.366	0.8626		1.065
Dialysis	Yes	0.504	0.307	0.1010		1.655
Arrhythmia Type	None	Reference				
	Afib/Flutter	0.596	0.168	0.0004	***	1.814
	Heart Block	0.315	0.374	0.4000		1.370
	Sust VT/VF	0.103	0.288	0.7212		1.108
Timing of Myocardial Infarction	No MI	Reference				
	21+ days ago	0.187	0.182	0.3034		1.206
	8-21 days ago	0.048	0.263	0.8545		1.049
	1-7 days ago	0.457	0.159	0.0039	**	1.580
	<24 Hours	0.548	0.253	0.0300	*	1.730
Cardiogenic Shock		0.910	0.256	0.0004	***	2.483
Congestive Heart Failure		0.214	0.140	0.1278		1.238
NYHA Class IV		0.171	0.134	0.2032		1.186
Prior Cardiac Surgery	None	Reference				
	One or more	0.492	0.230	0.0324	*	1.636
Interval from Prior PCI to Surgery	No prior PCIs	Reference				
	Prior PCI > 6 HRS	0.139	0.144	0.3359		1.149
	Prior PCI <= 6 HRS	0.258	0.354	0.4672		1.294
Ejection Fraction		-0.019	0.004	0.0001	***	0.981
Left Main Stenosis (%)		0.005	0.004	0.2102		1.005
Number of Diseased Coronary	None, One, or Two	Reference				
	3 or more	0.305	0.161	0.0588		1.357
Mitral Insufficiency	None, Trivial, Mild	Reference				
	Moderate	0.040	0.207	0.8473		1.041
	Severe	1.193	0.461	0.0097	**	3.298

Notes: Creatinine PreOp, Ejection Fraction, and Left Main Disease % Stenosis were all modeled using piecewise linear transformations.

* significant at the 0.05 level (two-tailed test)

** significant at the 0.01 level (two-tailed test)

*** significant at the 0.001 level (two-tailed test)

Discrimination

Risk models that distinguish well between patients who die and those who survive are said to have good discrimination. A commonly used measure of discrimination is the C-statistic, also known as the area under the Receiver Operating Characteristic (ROC) curve. For all possible pairs of patients, where one dies and the other survives surgery, the C-statistic describes the proportion of pairs where the patient who died had a higher predicted risk of death than the patient who lived. C-statistics range from 0.5 to 1, with higher values indicating better discrimination. For the 2007 risk model, the C-statistic was 0.806. In recently published state CABG surgery mortality reports (New Jersey, New York, and Pennsylvania), the C-statistic ranged from 0.791 to 0.816, which is similar to the 2007 CCORP model.

Calibration

Calibration refers to the ability of a risk model to match predicted and observed mortality across the entire spectrum of the data. A model in which the number of observed deaths matches closely with the number of deaths predicted by the model demonstrates good calibration. Good calibration is essential for accurate risk adjustment. A common measure of calibration is the Hosmer-Lemeshow χ^2 test, which compares observed and predicted outcomes over deciles of risk. The p-value of the Hosmer-Lemeshow test statistic for this 2007 risk model is 0.147, indicating a nonsignificant likelihood of poor calibration. That is, the predicted mortality was consistent with actual mortality in the data.

Another way to test model calibration is to partition the data and compare observed deaths with predicted deaths in each of 10 risk groups. The 10 risk groups are created by sorting all observations by the predicted risk of death and then dividing the sorted observations into deciles of approximately equal size. As presented in Table 2, Risk Group 1 shows the patients in the lowest risk group (i.e., their mean predicted mortality was less than 0.3%). Among the 1,412 patients in this group, 6 patients died, but the model predicted 4 patient deaths. Assuming a Poisson distribution for a binary outcome, the predicted range of deaths for Risk Group 1 is 0.1 to 7.9. The observed number of 6 deaths falls within the range of predicted deaths. In fact, only one of ten risk groups has either significantly fewer or significantly more deaths than were predicted by the model. Overall, the risk model shows no systematic underestimation or overestimation of mortality at the extremes.

Table 2: Calibration of 2007 Risk Model for Operative Mortality, 2007

Risk Group	Predicted Mortality	Isolated CABG Cases	Observed Deaths	Predicted Deaths	Difference	95% CI of Predicted Deaths
1	0.0028	1,412	6	3.97	-2.0	(0.1, 7.9)
2	0.0046	1,414	7	6.56	-0.4	(1.5, 11.6)
3	0.0063	1,414	7	8.97	2.0	(3.1, 14.8)
4	0.0084	1,413	9	11.82	2.8	(5.1, 18.6)
5	0.0107	1,413	10	15.09	5.1	(7.5, 22.7)
6	0.0137	1,413	10	19.3	9.3	(10.7, 27.9)
7	0.0180	1,413	30	25.4	-4.6	(15.5, 35.3)
8	0.0250	1,413	45	35.34	-9.7	(23.7, 47.0)
9	0.0387	1,413	57	54.73	-2.3	(40.2, 69.2)
10	0.1111	1,412	157	156.81	-0.2	(132.3, 181.4)
Total	14,130	338	338	0		

V. RISK-ADJUSTED OPERATIVE MORTALITY RESULTS AND HOSPITAL PERFORMANCE RATINGS

The risk-adjusted mortality rate (RAMR) represents the best estimate of what a healthcare provider's mortality rate would have been if the provider had a patient case mix identical to the statewide average. Thus, this rate is comparable among providers because it accounts for the differences in patient severity-of-illness.

The RAMR is computed, first by dividing the provider's observed mortality by the provider's expected mortality rate (obtained from the risk model calculation) to get the observed/expected (O/E) ratio. If the O/E ratio is greater than one, the provider has a higher mortality than expected based on patient mix. If the O/E ratio is less than one, the provider has a lower mortality rate than expected. The O/E ratio is then multiplied by the overall state mortality rate (2.35% for 2007) to obtain the provider's risk-adjusted mortality rate.

The performance rating is based on a comparison of the 95% confidence interval (CI) of each hospital's RAMR to the California average mortality rate.⁶ Thus, OSHPD treated 2007 data as a sample, from which it inferred the range within which each provider's true performance was likely to fall. As shown in Table 3, if the entire 95% CI of a provider's risk-adjusted mortality is below the state average mortality rate, indicating the provider's RAMR is significantly lower than the state average, the performance rating is "**Better**." If the entire 95% CI of a provider's RAMR is above the state average mortality rate, indicating the provider's risk-adjusted mortality is significantly higher than the state average, the performance rating is "**Worse**." If the state average mortality rate is within the 95% CI of a provider's RAMR, the performance rating is "**Not Different**" and left blank.

⁶ The Poisson Exact Probability method is used for computing the 95% confidence interval for the risk-adjusted mortality rate. (Buchan Iain, *Calculating Poisson Confidence Interval in Excel*, January 2004)

GUIDE TO INTERPRETING TABLE 3: HOSPITAL RISK-ADJUSTED OPERATIVE MORTALITY RESULTS, 2007	
All CABG Cases	The total number of isolated and non-isolated CABG cases submitted to CCORP for 2007. Non-isolated CABG cases are not used in calculating performance ratings.
Isolated CABG Cases	The number of isolated CABG cases submitted to CCORP during the time period indicated. Patients with operative status of "salvage" are excluded from this count and not used in calculating hospital performance ratings.
Isolated CABG Deaths	The actual number of operative deaths for isolated CABG cases for the time period indicated. The number of deaths includes: (1) all deaths that occur during the hospitalization in which the CABG surgery was performed, regardless of length of stay, and (2) all deaths occurring anywhere after hospital discharge, but within 30 days after the CABG surgery.
Observed Mortality Rate	The ratio of the number of isolated CABG deaths and the number of isolated CABG cases multiplied by 100: Observed Mortality Rate = Number of Isolated CABG Deaths/Isolated CABG Cases X 100.
Expected Mortality Rate	The ratio of the expected number of operative deaths predicted for a provider (after adjusting for its patient population) and the number of Isolated CABG cases multiplied by 100: Expected Mortality Rate = Number of Expected Deaths/Number of Isolated CABG Cases X 100.
Risk-Adjusted Mortality Rate (RAMR) and 95% Confidence Interval (CI)	The Risk-Adjusted Mortality Rate (RAMR) is obtained by multiplying the California average mortality rate (CAMR) by a hospital's Observed Mortality Rate/Expected Mortality Rate (O/E ratio): RAMR = (CAMR X O/E ratio). The 95% confidence interval (CI) represents the confidence we have in the estimate for the RAMR. The CI is calculated using Poisson Exact Probability 95% CI calculations.
Performance Rating	The performance rating is based on a comparison of the 95% CI of each provider's RAMR and the California observed mortality rate. This is a test of statistical significance. A hospital is classified as " Better " if the entire 95% CI of the RAMR falls below the California observed mortality rate (2.35% for 2007). A hospital is classified as " Worse " if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital is classified as " Not Different " (performance rating is left blank) if the California mortality rate falls within the 95% CI of the hospital's risk-adjusted mortality rate.

2007 Hospital Risk-adjusted Operative Mortality Results

Table 3 presents the risk-adjusted operative mortality results for each hospital for 2007. The table is sorted by geographic region and contains, for each hospital, total number of CABG surgeries performed (isolated and non-isolated combined), number of isolated CABG surgeries (excluding salvage patients), number of observed isolated CABG deaths, observed mortality rate, expected mortality rate predicted by the risk model, RAMR and 95% CI of the RAMR, and the associated hospital performance rating.

Among the 14,756 isolated CABG surgeries performed in 2007, 347 patients died either in-hospital or within 30 days of the surgery date, reflecting an overall operative mortality rate of 2.35%. The observed mortality rates among hospitals ranges from 0% to 12.9%. The expected mortality rates, which are generated by the risk model and account for patient severity of illness, range between 1.3% and 11.1%. The risk-adjusted mortality rates, which measure hospital performance, range from 0% to 17.7%.

Based on the 95% confidence intervals for risk-adjusted mortality rates, 117 of 121 hospitals (97%) performed within the expected range compared to the state's overall mortality rate (denoted by a blank space in the performance rating column of Table 3), no hospital performed significantly “**Better**” than the state average, and four hospitals performed significantly “**Worse**” than the state average. Hospitals marked with two asterisks (**) in Table 3 submitted statements regarding this report (presented in Appendix A).

Table 3: Hospital Risk-adjusted Operative Mortality Results by Region, 2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
Sacramento Valley & Northern California Region	Enloe Medical Center**	190	152	11	7.24	2.90	5.87	(2.94, 10.53)	Worse
	Mercy General Hospital	935	618	6	0.97	1.86	1.23	(0.45, 2.68)	
	Mercy Medical Center - Redding	190	136	2	1.47	3.22	1.07	(0.13, 3.90)	
	Mercy San Juan Hospital	119	81	2	2.47	2.11	2.75	(0.34, 10.00)	
	Rideout Memorial Hospital	161	126	3	2.38	3.16	1.77	(0.37, 5.20)	
	Shasta Regional Medical Center	86	73	2	2.74	2.56	2.52	(0.31, 9.12)	
	St. Joseph Hospital - Eureka	72	61	1	1.64	2.83	1.36	(0.03, 7.63)	
	Sutter Memorial Hospital	434	298	6	2.01	2.68	1.76	(0.65, 3.85)	
	UC Davis Medical Center	199	132	2	1.52	1.61	2.22	(0.27, 8.02)	
San Francisco Bay Area & San Jose	Alta Bates Summit Medical Center - Summit Campus	699	554	5	0.90	1.87	1.13	(0.37, 2.66)	
	California Pacific Medical Center - Pacific Campus	132	88	6	6.82	2.51	6.39	(2.35, 13.94)	
	Community Hospital Monterey Peninsula	67	48	0	0.00	1.46	0.00	(0.00, 12.41)	

* A hospital is classified as **"Better"** if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as **"Worse"** if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as **"Not Different"** from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

** Hospitals marked with two asterisks (**) in Table 3 submitted statements regarding this report. See Appendix A for their statements.

Table 3: Hospital Risk-adjusted Operative Mortality Results by Region, 2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (% RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
San Francisco Bay Area & San Jose (continued)	Dominican Hospital	88	67	1	1.49	1.90	1.84	(0.05, 10.35)	
	El Camino Hospital	80	64	1	1.56	1.72	2.13	(0.05, 11.92)	
	Good Samaritan Hospital - San Jose	164	131	1	0.76	2.18	0.82	(0.02, 4.60)	
	John Muir Medical Center - Concord Campus	253	231	5	2.16	2.62	1.94	(0.63, 4.54)	
	John Muir Medical Center - Walnut Creek Campus	1	1	0	0.00	5.29	0.00	(0.00, 100.0)	
	Kaiser Foundation Hospital (Geary San Francisco)	656	524	10	1.91	1.82	2.47	(1.19, 4.56)	
	Marin General Hospital	50	44	1	2.27	2.79	1.91	(0.05, 10.71)	
	O'Connor Hospital	96	86	4	4.65	2.23	4.90	(1.34, 12.59)	
	Peninsula Medical Center	12	11	0	0.00	1.65	0.00	(0.00, 48.09)	
	Queen of the Valley Hospital	196	171	4	2.34	2.80	1.96	(0.54, 5.04)	
	Regional Medical of San Jose	37	33	1	3.03	2.83	2.52	(0.06, 14.06)	
	Salinas Valley Memorial Hospital	104	96	1	1.04	1.76	1.39	(0.04, 7.80)	

* A hospital is classified as **"Better"** if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as **"Worse"** if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as **"Not Different"** from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (% RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
San Francisco Bay Area & San Jose (continued)	San Ramon Regional Medical Center	65	55	1	1.82	1.46	2.93	(0.07, 16.40)	
	Santa Clara Valley Medical Center	78	65	1	1.54	1.44	2.51	(0.06, 14.09)	
	Santa Rosa Memorial Hospital	86	70	3	4.29	2.90	3.48	(0.72, 10.20)	
	Sequoia Hospital	207	107	1	0.93	2.65	0.82	(0.02, 4.65)	
	Seton Medical Center	167	144	5	3.47	3.18	2.56	(0.84, 6.01)	
	St. Helena Hospital	89	86	5	5.81	3.70	3.69	(1.20, 8.65)	
	St. Mary's Medical Center, San Francisco	33	30	2	6.67	2.90	5.41	(0.66, 19.59)	
	Stanford University Hospital	143	91	2	2.20	1.63	3.17	(0.38, 11.46)	
	Sutter Medical Center of Santa Rosa	115	87	2	2.30	1.67	3.24	(0.39, 11.77)	
	UCSF Medical Center	109	82	2	2.44	1.97	2.91	(0.35, 10.56)	
	Valleycare Medical Center	50	40	0	0.00	4.35	0.00	(0.00, 5.01)	
	Washington Hospital - Fremont	139	135	4	2.96	2.10	3.31	(0.91, 8.51)	

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Table 3: Hospital Risk-adjusted Operative Mortality Results by Region, 2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (% RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
Central California	Bakersfield Heart Hospital	209	180	3	1.67	2.04	1.92	(0.40, 5.62)	
	Bakersfield Memorial Hospital	159	143	4	2.80	1.71	3.85	(1.05, 9.89)	
	Community Medical Center - Fresno	197	168	3	1.79	2.61	1.61	(0.33, 4.72)	
	Dameron Hospital	19	16	0	0.00	2.61	0.00	(0.00, 20.85)	
	Doctors Medical Center - Modesto Campus	327	267	4	1.50	2.16	1.63	(0.45, 4.19)	
	Fresno Heart Hospital	177	143	4	2.80	2.82	2.33	(0.64, 5.99)	
	Kaweah Delta Hospital	319	241	4	1.66	2.92	1.34	(0.37, 3.43)	
	Marian Medical Center	99	71	0	0.00	1.88	0.00	(0.00, 6.53)	
	Memorial Medical Center of Modesto	255	204	6	2.94	2.11	3.27	(1.21, 7.17)	
	San Joaquin Community Hospital	77	65	3	4.62	2.10	5.17	(1.07, 15.16)	
	St. Agnes Medical Center	363	314	9	2.87	2.75	2.45	(1.13, 4.67)	
	St. Joseph's Medical Center of Stockton**	236	207	10	4.83	2.11	5.38	(2.59, 9.92)	Worse

* A hospital is classified as **"Better"** if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as **"Worse"** if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as **"Not Different"** from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

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State		18,889	14,756	347	2.35				
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara	Antelope Valley Hospital Medical Center	45	42	3	7.14	2.71	6.19	(1.28, 18.15)	
	Community Memorial Hospital of San Buenaventura	134	108	1	0.93	4.08	0.54	(0.01, 2.99)	
	Encino Tarzana Regional Medical Center - Tarzana	96	72	1	1.39	3.12	1.05	(0.03, 5.85)	
	French Hospital Medical Center	140	109	3	2.75	2.62	2.47	(0.51, 7.24)	
	Glendale Adventist Medical Center - Wilson Terrace	149	119	4	3.36	2.15	3.67	(1.01, 9.46)	
	Glendale Memorial Hospital and Health Center	145	99	2	2.02	1.92	2.47	(0.30, 8.98)	
	Lancaster Community Hospital	17	17	0	0.00	1.86	0.00	(0.00, 27.58)	
	Los Robles Regional Medical Center	121	91	5	5.49	2.88	4.48	(1.46, 10.50)	
	Northridge Hospital Medical Center	85	64	0	0.00	1.98	0.00	(0.00, 6.88)	
	Providence Holy Cross Medical Center	95	62	3	4.84	3.43	3.32	(0.69, 9.72)	
	Providence St. Joseph Medical Center	71	51	0	0.00	2.34	0.00	(0.00, 7.29)	
	Santa Barbara Cottage Hospital	144	109	4	3.67	2.75	3.14	(0.86, 8.06)	
	Sierra Vista Regional Medical Center	16	14	1	7.14	4.27	3.93	(0.10, 22.02)	

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State									
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara (continued)	St. John's Regional Medical Center	94	74	1	1.35	3.16	1.00	(0.03, 5.63)	
	Valley Presbyterian Hospital	33	31	4	12.90	1.73	17.52	(4.80, 45.11)	Worse
	West Hills Regional Medical Center	68	63	2	3.17	2.54	2.93	(0.36, 10.66)	
Greater Los Angeles	Beverly Hospital	35	32	1	3.13	1.53	4.81	(0.12, 26.94)	
	Brotman Medical Center	1	1	0	0.00	11.08	0.00	(0.00, 78.57)	
	Cedars Sinai Medical Center	231	136	3	2.21	1.74	2.98	(0.62, 8.76)	
	Centinela Hospital Medical Center	94	69	2	2.90	2.56	2.66	(0.32, 9.65)	
	Citrus Valley Medical Center - IC Campus	85	69	1	1.45	1.90	1.79	(0.05, 10.03)	
	Downey Regional Medical Center	78	68	3	4.41	1.50	6.91	(1.43, 20.31)	
	Garfield Medical Center	120	106	3	2.83	2.34	2.84	(0.59, 8.34)	
	Good Samaritan Hospital - Los Angeles	157	127	2	1.57	2.96	1.25	(0.15, 4.54)	
	Huntington Memorial Hospital	103	82	0	0.00	2.38	0.00	(0.00, 4.45)	

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (% RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
Greater Los Angeles (continued)	Kaiser Foundation Hospital (Sunset)	798	611	15	2.45	2.14	2.69	(1.52, 4.47)	
	Lakewood Regional Medical Center	89	77	2	2.60	2.49	2.45	(0.30, 8.88)	
	Little Company of Mary Hospital	68	50	3	6.00	2.49	5.66	(1.17, 16.61)	
	Long Beach Memorial Medical Center	286	250	5	2.00	2.03	2.32	(0.75, 5.43)	
	Los Angeles Co. Harbor - UCLA Medical Center**	109	98	6	6.12	2.19	6.57	(2.42, 14.36)	Worse
	Los Angeles Co. USC Medical Center	100	91	3	3.30	1.27	6.11	(1.26, 17.86)	
	Methodist Hospital of Southern California	78	59	1	1.69	4.47	0.89	(0.02, 4.98)	
	Presbyterian Intercommunity Hospital	116	103	2	1.94	2.88	1.58	(0.19, 5.74)	
	Santa Monica - UCLA Medical Center	17	14	0	0.00	2.94	0.00	(0.00, 21.12)	
	St. Francis Medical Center	39	35	0	0.00	1.39	0.00	(0.00, 17.85)	

* A hospital is classified as "Better" if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as "Worse" if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

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State		18,889	14,756	347	2.35				
Greater Los Angeles (continued)	St. Vincent Medical Center	116	98	6	6.12	2.28	6.31	(2.33, 13.82)	
	Torrance Memorial Medical Center	111	57	0	0.00	2.23	0.00	(0.00, 6.86)	
	UCLA Medical Center	190	112	3	2.68	2.51	2.51	(0.52, 7.35)	
	USC University Hospital	148	71	1	1.41	2.84	1.17	(0.03, 6.52)	
	White Memorial Medical Center	66	56	0	0.00	2.24	0.00	(0.00, 6.95)	
Inland Empire, Riverside & San Bernardino	Desert Regional Medical Center	245	185	8	4.32	2.72	3.73	(1.62, 7.39)	
	Eisenhower Memorial Hospital	291	225	4	1.78	2.60	1.61	(0.44, 4.14)	
	Loma Linda University Medical Center	363	270	6	2.22	2.43	2.15	(0.79, 4.69)	
	Pomona Valley Hospital Medical Center	184	162	4	2.47	2.14	2.71	(0.74, 6.98)	
	Riverside Community Hospital	260	212	4	1.89	3.04	1.46	(0.40, 3.75)	
	San Antonio Community Hospital	149	112	1	0.89	3.19	0.66	(0.02, 3.68)	
	St. Bernardine Medical Center	592	517	13	2.51	2.65	2.23	(1.19, 3.83)	
	St. Mary Regional Medical Center	154	137	3	2.19	3.18	1.62	(0.34, 4.75)	

* A hospital is classified as **"Better"** if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as **"Worse"** if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as **"Not Different"** from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

** Hospitals marked with two asterisks (**) in Table 3 submitted statements regarding this report. See Appendix A for their statements.

Table 3: Hospital Risk-adjusted Operative Mortality Results by Region, 2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (% RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
Orange County	Anaheim Memorial Medical Center	234	188	4	2.13	2.37	2.11	(0.58, 5.43)	
	Fountain Valley Regional Hospital	95	89	3	3.37	2.95	2.68	(0.56, 7.88)	
	Hoag Memorial Hospital Presbyterian	236	159	3	1.89	1.64	2.71	(0.56, 7.94)	
	Irvine Regional Hospital and Medical Center	39	35	0	0.00	1.56	0.00	(0.00, 15.90)	
	Mission Hospital Regional Medical Center	147	117	1	0.85	1.64	1.22	(0.03, 6.85)	
	Saddleback Memorial Medical Center	139	117	0	0.00	2.22	0.00	(0.00, 3.35)	
	St. Joseph Hospital - Orange	148	120	0	0.00	1.57	0.00	(0.00, 4.62)	
	St. Jude Medical Center	135	125	3	2.40	2.10	2.69	(0.55, 7.86)	
	UC Irvine Medical Center	59	42	1	2.38	1.67	3.35	(0.09, 18.71)	
	West Anaheim Medical Center	12	12	0	0.00	10.11	0.00	(0.00, 7.17)	
	Western Medical Center - Santa Ana	50	38	0	0.00	1.32	0.00	(0.00, 17.33)	
	Western Medical Center Hospital - Anaheim	96	87	0	0.00	2.81	0.00	(0.00, 3.57)	

* A hospital is classified as **"Better"** if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as **"Worse"** if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as **"Not Different"** from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

** Hospitals marked with two asterisks (**) in Table 3 submitted statements regarding this report. See Appendix A for their statements.

Table 3: Hospital Risk-adjusted Operative Mortality Results by Region, 2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (% RAMR)	95% CI for RAMR	Performance Rating*
State		18,889	14,756	347	2.35				
Greater San Diego	Alvarado Hospital	63	46	2	4.35	2.11	4.84	(0.59, 17.57)	
	Palomar Medical Center	101	87	1	1.15	1.97	1.37	(0.03, 7.65)	
	Scripps Green Hospital	104	71	1	1.41	2.10	1.58	(0.04, 8.80)	
	Scripps Memorial Hospital - La Jolla	375	263	9	3.42	2.89	2.78	(1.28, 5.31)	
	Scripps Mercy Hospital	164	133	3	2.26	2.59	2.05	(0.42, 6.00)	
	Sharp Chula Vista Medical Center	214	181	6	3.31	3.09	2.52	(0.93, 5.50)	
	Sharp Grossmont Hospital	207	161	7	4.35	3.01	3.40	(1.37, 7.01)	
	Sharp Memorial Hospital**	241	152	2	1.32	1.74	1.78	(0.22, 6.46)	
	Tri-City Medical Center	107	88	4	4.55	1.71	6.25	(1.71, 16.04)	
	UCSD Medical Center	35	30	0	0.00	1.83	0.00	(0.00, 15.86)	
	UCSD Medical Center - La Jolla, John M. & Sally B. Thornton Hospital	68	40	0	0.00	1.69	0.00	(0.00, 12.88)	

* A hospital is classified as **"Better"** if the entire 95% CI of the RAMR falls below the California observed operative mortality rate (2.35). A hospital is classified as **"Worse"** if the entire 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is classified as **"Not Different"** from the state average (rating is blank) if the California mortality rate falls within the 95% CI of the hospital's RAMR.

** Hospitals marked with two asterisks (**) in Table 3 submitted statements regarding this report. See Appendix A for their statements.

VI. RISK MODEL FOR ADJUSTING HOSPITAL POST-OPERATIVE STROKE RATES, 2006-2007

Post-operative stroke is a rare adverse event that can occur after CABG surgery. To better assess hospital performance on this serious complication, CCORP combined 2006 and 2007 data to increase the number of cases and reliability of reported data. Similar to the methodology used to assess the operative mortality rate, CCORP used a multivariable logistic regression model to determine the relationship between each of the demographic and pre-operative risk factors and the probability of post-operative stroke.

To develop the risk model, the 30,379 isolated CABG surgery cases (2006-2007) were evaluated for missing data (28,822 cases had no missing data in any field and were used for the risk model parameter estimation). The 1,557 (5.1%) isolated CABG cases with missing data fields were removed to ensure that the effects of risk factors were estimated based on the most complete data available. To generate the hospital-specific results shown in this report, missing values for these 1,557 records were imputed (after risk model parameter estimation) by replacing them with the lowest risk category of the same variable (e.g., *Mitral Insufficiency= None/trivial/mild*). CCORP assigned the lowest risk value based on the following rationale: 1) some hospitals leave data fields blank by design when the risk factor is absent or the value is normal; 2) to maintain consistency with other major cardiac reporting programs that replace missing data with the lowest-risk or normal value; and 3) assigning values for missing data in this way creates an incentive for more complete reporting by hospitals. After imputing the missing values, the parameters of the risk model were applied to all cases to estimate each patient's probability of post-operative stroke. These probabilities were then summed to estimate the expected outcome for each hospital. The risk model based on the 2006-2007 data is presented in Table 4.

GUIDE TO INTERPRETING TABLE 4: THE LOGISTIC REGRESSION RISK MODEL FOR POST-OPERATIVE STROKE, 2006-2007	
Coefficient	The coefficient for each risk factor represents the effect that risk factor has on a patient's likelihood of having post-operative stroke (>72 Hours) following bypass surgery. If the value is positive, it means that the risk factor is associated with an increased risk of post-operative stroke compared to not having that factor, while controlling for all of the other factors. If the coefficient is negative, having that risk factor is associated with a lower risk of post-operative stroke compared to not having it. The larger the value (whether positive or negative), the greater the effect or weight this factor has on the risk of post-operative stroke. For example, the coefficient for "Cerebrovascular Disease" is 0.648 and statistically significant. This value is positive and indicates that CABG patients with cerebrovascular disease are at an increased risk of post-operative stroke compared to patients who do not have the disease.
Standard Error	The standard error is a measure of the variation or dispersion of the standard deviation of the sampling distribution of an estimate. It measures the statistical reliability of that estimate.
p-value	The p-value is a measure of the statistical significance of the coefficient estimate compared to a null value or reference category. Commonly, p-values of less than 0.05 are considered statistically significant. The smaller the p-value, the more likely the effect of a factor is real, rather than due to chance.
Significance	When the p-value of a coefficient is less than 0.05, it is deemed statistically significant at the 0.05 level and is denoted with one asterisk (*) in the significance column. Two asterisks (**) indicate statistical significance at the 0.01 level and three asterisks (***) indicate statistical significance at the 0.001 level. All statistical tests are two-tailed tests.
Odds Ratio	An odds ratio is another way of characterizing the impact of each risk factor on post-operative stroke. Mathematically, the odds ratio is the antilogarithm of the coefficient value. The larger the odds ratio, the greater the impact that risk factor has on the risk of post-operative stroke. An odds ratio close to 1.0 means the risk factor has no effect. For example, the odds ratio for <i>Cerebrovascular Disease</i> is 1.912. This means that for patients with cerebrovascular disease, the odds of post-operative stroke are about 91% higher compared to patients without cerebrovascular disease, assuming all other risk factors are the same.

Table 4: Logistic Regression Risk Model for Post-operative Stroke, 2006-2007

Risk Factor		Coefficient	Standard Error	p-value	Significance	Odds Ratio
Intercept		-7.738	0.508	<.0001		.
Patient Age (Years)		0.033	0.005	<.0001	***	1.034
Gender	Male	Reference				
	Female	0.389	0.110	0.0004	***	1.476
Race	White					
	Non-White	0.065	0.111	0.5575		1.067
Status of the Procedure	Elective	Reference				
	Urgent	-0.007	0.135	0.9607		0.993
	Emergent	0.473	0.252	0.0607		1.605
Creatinine Level PreOp (mg/dl)		0.749	0.172	<.0001	***	2.116
Hypertension		0.233	0.173	0.1763		1.263
Cerebrovascular Disease		0.648	0.155	<.0001	***	1.912
Diabetes		0.273	0.109	0.0124	*	1.314
Timing of Myocardial Infarction	No MI	Reference				
	21+ days ago	-0.255	0.165	0.1223		0.775
	8-21 days ago	-0.035	0.237	0.8825		0.966
	1-7 days ago	0.183	0.143	0.2009		1.201
	Within 24 Hours	0.564	0.237	0.0175	*	1.758
Cardiogenic Shock		0.061	0.290	0.8326		1.063
NYHA Class	I, II, III	Reference				
	IV	0.277	0.123	0.0241	*	1.319
Prior Cardiac Surgery	None	Reference				
	One or more	0.295	0.225	0.1898		1.344
Ejection Fraction (%)		-0.013	0.004	0.0007	***	0.987
Mitral Insufficiency	None/Trivial/Mild	Reference				
	Moderate	0.222	0.198	0.2615		1.249
	Severe	0.707	0.431	0.1010		2.028
Cerebrovascular Accident Timing	No CVA	Reference				
	> 2 weeks	0.126	0.187	0.4988		1.135
	≤ 2 weeks	1.388	0.454	0.0023	**	4.007

Notes: Creatinine PreOp and Ejection Fraction were modeled using piecewise linear transformations.

* significant at the 0.05 level (two-tailed test)

** significant at the 0.01 level (two-tailed test)

*** significant at the 0.001 level (two-tailed test)

Discrimination

Risk models that distinguish well between patients who have an adverse event and those who do not are said to have good discrimination. A commonly used measure of discrimination is the C-statistic, also known as the area under the Receiver Operating Characteristic (ROC) curve. For all possible pairs of patients, where one has post-operative stroke and the other does not, the C-statistic describes the proportion of pairs where the patient with a post-operative stroke had a higher predicted risk of post-operative stroke than the patient with no stroke. C-statistics ranges from 0.5 to 1, with higher values indicating better discrimination. For the 2006-2007 risk

model, the C-statistic was 0.720. The CCORP 2006-2007 risk model compares favorably with the Society of Thoracic Surgeons' recently published post-operative stroke model (C-statistic=0.716 for isolated CABG surgery).⁷

Calibration

Calibration refers to the ability of a risk model to match predicted and observed post-operative stroke cases across the entire spectrum of the data. A model in which the number of observed stroke cases matches closely with the number of stroke cases predicted by the model demonstrates good calibration. Good calibration is essential for accurate risk adjustment. A common measure of calibration is the Hosmer-Lemeshow χ^2 test, which compares observed and predicted outcomes over deciles of risk. The p-value of the Hosmer-Lemeshow test statistic for this post-operative stroke risk model is 0.152, indicating a nonsignificant likelihood of poor calibration. That is, predicted post-operative stroke was consistent with actual post-operative stroke in the data.

Another way to test model calibration is to partition the data and compare observed stroke cases with predicted stroke cases in each of 10 risk groups. The 10 risk groups are created by sorting all observations by the predicted risk of post-operative stroke and then dividing the sorted observations into deciles of approximately equal size. As presented in Table 5, Risk Group 1 shows the patients in the lowest risk group (i.e., their mean predicted probability of stroke was less than 0.4%). Among the 2,881 patients in this group, 4 patients had post-operative strokes, but the model predicted 9.7 cases. Assuming a Poisson distribution for a binary outcome, the predicted range of strokes for this group is 3.6 to 15.8. The observed number of 4 strokes falls within the range of predicted strokes. In fact, only one of ten risk groups has either significantly fewer or significantly more deaths than were predicted by the model. Overall the risk model shows no systematic underestimation or overestimation of stroke cases at the extremes.

Table 5: Calibration of Risk Model for Post-operative Stroke, 2006-2007

Risk Group	Predicted Post-operative Stroke	Isolated CABG Cases	Observed Post-operative Stroke	Predicted Post-operative Stroke	Difference	95% CI of Predicted Strokes
1	0.0034	2,881	4	9.72	5.7	(3.6, 15.8)
2	0.0048	2,883	8	13.97	6.0	(6.6, 21.3)
3	0.0060	2,883	15	17.32	2.3	(9.2, 25.5)
4	0.0072	2,881	32	20.77	-11.2	(11.8, 29.7)
5	0.0086	2,883	20	24.80	4.8	(15.0, 34.6)
6	0.0103	2,881	31	29.69	-1.3	(19.0, 40.4)
7	0.0125	2,882	32	36.15	4.2	(24.4, 47.9)
8	0.0158	2,882	56	45.56	-10.4	(32.3, 58.8)
9	0.0217	2,882	71	62.43	-8.6	(46.9, 77.9)
10	0.0446	2,884	120	128.58	8.6	(106.4, 150.8)
Total	28,822	389	389	0		

⁷ Shahian DM, O'Brien SM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 1—coronary artery bypass grafting surgery. Ann Thorac Surg 2009; 88:S2-22.

VII. RISK-ADJUSTED POST-OPERATIVE STROKE RESULTS AND HOSPITAL PERFORMANCE RATINGS

The risk-adjusted post-operative stroke rate (RASR) represents the best estimate of what a healthcare provider's post-operative stroke rate would have been if the provider had a patient case mix identical to the statewide average. Thus, this rate is comparable among providers because it accounts for the differences in patient severity-of-illness.

The RASR is computed first by dividing the provider's number of strokes by the provider's expected number of strokes based on the risk model to obtain the observed/expected (O/E) ratio. If the O/E ratio is greater than one, the provider has a higher stroke rate than expected based on patient mix. If the O/E ratio is less than one, the provider has a lower stroke rate than expected. The O/E ratio is then multiplied by the overall state mortality rate (1.33% for 2006-2007) to obtain the provider's risk-adjusted stroke rate.

The performance rating is based on a comparison of the 95% confidence interval (CI) of each provider's RASR to the California average post-operative stroke rate. Thus, OSHPD treated 2006-2007 data as a sample, from which it inferred the range within which each provider's true performance was likely to fall. As shown in Table 6, if the entire 95% CI of a provider's risk-adjusted stroke rate is below the state average stroke rate, indicating the provider's RASR is significantly lower than the state average, the performance rating is "**Better**." If the entire 95% CI of a provider's RASR is above the state average stroke rate, indicating the provider's risk-adjusted stroke rate is significantly higher than the state average, the performance rating is "**Worse**." If the state average mortality rate is within the 95% CI of a provider's RASR, the performance rating is "**Not Different**" and left blank.

GUIDE TO INTERPRETING TABLE 6: HOSPITAL RISK-ADJUSTED POST-OPERATIVE STROKE RESULTS, 2006-2007	
All CABG Cases	The total number of isolated and non-isolated CABG cases submitted to CCORP for 2006-2007. Non-isolated CABG cases are not used in calculating performance ratings.
Isolated CABG Cases	The number of isolated CABG cases submitted to CCORP during the time period indicated. Patients with operative status of "salvage" are excluded from this count and not used in calculating hospital performance ratings.
Isolated CABG Post-operative Strokes	The actual number of post-operative strokes (>72 hours) for isolated CABG cases for the time period indicated.
Observed Post-operative Stroke Rate	The ratio of the number of isolated CABG post-operative strokes and the number of isolated CABG cases multiplied by 100: Observed Post-operative Stroke Rate = Number of Isolated CABG Post-operative Strokes/Number of Isolated CABG Cases X 100.
Expected Post-operative Stroke Rate	The ratio of the expected number of post-operative strokes predicted for a provider (after adjusting for its patient population) and number of isolated CABG cases multiplied by 100: Expected Post-operative Stroke Rate = Number of Expected Post-operative Strokes/Isolated CABG Cases X 100.
Risk-adjusted Post-operative Stroke Rate (95% CI)	The RASR is obtained by multiplying the California average post-operative stroke rate by a provider's O/E ratio. The 95% confidence interval represents the confidence we have in the estimate for the RASR. The lower and upper confidence limits are calculated using Poisson exact confidence interval calculations.
Performance Rating	The performance rating is based on a comparison of each provider's risk-adjusted post-operative stroke rate and the California observed post-operative stroke rate. This is a test of statistical significance. A provider is classified as " Better " if the upper 95% confidence limit of its RASR falls below the California observed post-operative stroke rate. A provider is classified as " Worse " if the lower 95% confidence limit of its RASR is higher than the California observed post-operative stroke rate. A provider is classified as " Not Different " (performance rating is left blank) if the California post-operative stroke rate falls within the confidence interval of the provider's RASR.

2006-2007 Hospital Risk-adjusted Post-operative Stroke Results

Table 6 presents the risk-adjusted results for each hospital for 2006-2007. The table is sorted by geographic region and contains, for each hospital, total number of CABG surgeries performed (isolated and non-isolated combined), number of isolated CABG surgeries (excluding salvage cases), number of observed isolated CABG post-operative stroke cases, observed post-operative stroke rate, expected post-operative stroke rate predicted by the risk model, RASR and 95% CI of the RASR, and the associated hospital performance rating.

Among the 30,379 isolated CABG surgeries performed in 2006-2007, 405 patients had a post-operative stroke in-hospital, reflecting an overall rate of 1.33%. The observed stroke rate among hospitals ranged from 0% to 5.9%. The expected stroke rates, which are generated by the model and measure patient severity of illness, were between 0.9% and 7.1%. The risk-adjusted stroke rates, which measure hospital performance, ranged from 0% to 5.6%.

Based on the 95% confidence intervals for risk-adjusted mortality rates, 115 of 121 hospitals (95%) performed within the expected range compared to the state's overall stroke rate (denoted by a blank space in the performance rating column of Table 6), one hospital performed significantly “**Better**” than the state average, and five hospitals performed significantly “**Worse**” than the state average. Hospitals marked with two asterisks (**) in Table 6 submitted statements regarding this report. Those letters are presented in Appendix A.

Table 6: Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (% RASR)	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
Sacramento Valley & Northern California Region	Enloe Medical Center**	423	325	2	0.62	1.57	0.53	(0.06, 1.90)	
	Mercy General Hospital	1,867	1,246	20	1.61	1.13	1.89	(1.16, 2.94)	
	Mercy Medical Center - Redding	396	307	6	1.95	1.52	1.71	(0.63, 3.74)	
	Mercy San Juan Hospital	231	160	2	1.25	1.21	1.37	(0.17, 5.00)	
	Rideout Memorial Hospital	326	242	3	1.24	1.55	1.06	(0.22, 3.13)	
	Shasta Regional Medical Center	175	149	1	0.67	1.17	0.76	(0.02, 4.27)	
	St. Joseph Hospital - Eureka	129	110	1	0.91	1.08	1.12	(0.03, 6.29)	
	Sutter Memorial Hospital	902	636	16	2.52	1.38	2.43	(1.39, 3.96)	Worse
	UC Davis Medical Center	395	257	4	1.56	1.15	1.80	(0.49, 4.65)	
San Francisco Bay Area & San Jose	Alta Bates Summit Medical Center - Summit Campus	1,465	1,158	7	0.60	1.28	0.62	(0.25, 1.30)	Better
	California Pacific Medical Center - Pacific Campus	244	173	4	2.31	1.30	2.36	(0.65, 6.12)	
	Community Hospital Monterey Peninsula	67	48	0	0.00	1.04	0.00	(0.00, 9.89)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

** Hospitals marked with two asterisks (**) in Table 6 submitted statements regarding this report. See Appendix A for their statements.

Table 6: Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (%), RASR	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
San Francisco Bay Area & San Jose (continued)	Doctors Medical Center - San Pablo Campus	19	17	1	5.88	1.41	5.55	(0.14, 31.13)	
	Dominican Hospital	184	145	4	2.76	1.10	3.34	(0.91, 8.59)	
	EI Camino Hospital	163	123	3	2.44	1.18	2.75	(0.57, 8.07)	
	Good Samaritan Hospital - San Jose	347	274	6	2.19	1.36	2.14	(0.79, 4.69)	
	John Muir Medical Center - Concord Campus	492	431	4	0.93	1.40	0.88	(0.24, 2.27)	
	John Muir Medical Center - Walnut Creek Campus	3	2	0	0.00	7.14	0.00	(0.00, 34.61)	
	Kaiser Foundation Hospital (Geary San Francisco)	1,333	1,025	10	0.98	1.18	1.10	(0.53, 2.04)	
	Marin General Hospital	120	101	3	2.97	1.33	2.97	(0.62, 8.73)	
	O'Connor Hospital	182	157	3	1.91	1.29	1.97	(0.41, 5.80)	
	Peninsula Medical Center	39	31	0	0.00	1.08	0.00	(0.00, 14.75)	
	Queen of the Valley Hospital	446	389	4	1.03	1.51	0.91	(0.25, 2.34)	
	Regional Medical of San Jose	55	50	1	2.00	1.55	1.72	(0.04, 9.65)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

** Hospitals marked with two asterisks (**) in Table 6 submitted statements regarding this report. See Appendix A for their statements.

Table 6: Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (%), RASR	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
San Francisco Bay Area & San Jose (continued)	Salinas Valley Memorial Hospital	245	205	3	1.46	1.14	1.70	(0.36, 5.04)	
	San Ramon Regional Medical Center	135	114	0	0.00	0.96	0.00	(0.00, 4.54)	
	Santa Clara Valley Medical Center	127	109	1	0.92	1.21	1.01	(0.03, 5.66)	
	Santa Rosa Memorial Hospital	147	117	2	1.71	1.26	1.81	(0.22, 6.59)	
	Sequoia Hospital	499	274	1	0.36	1.30	0.37	(0.01, 2.09)	
	Seton Medical Center	409	355	8	2.25	1.67	1.79	(0.78, 3.56)	
	St. Helena Hospital	189	177	3	1.69	1.39	1.62	(0.34, 4.76)	
	St. Mary's Medical Center, San Francisco	74	61	3	4.92	1.32	4.96	(1.03, 14.58)	
	Stanford University Hospital	336	222	0	0.00	1.29	0.00	(0.00, 1.72)	
	Sutter Medical Center of Santa Rosa	258	187	0	0.00	0.95	0.00	(0.00, 2.77)	
	UCSF Medical Center	265	214	5	2.34	1.10	2.83	(0.93, 6.66)	
	Valleycare Medical Center	67	53	0	0.00	1.46	0.00	(0.00, 6.39)	
	Washington Hospital - Fremont	278	250	8	3.20	1.41	3.02	(1.31, 5.99)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Table 6: Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (% RASR)	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
Central California	Bakersfield Heart Hospital	430	359	5	1.39	1.28	1.44	(0.47, 3.40)	
	Bakersfield Memorial Hospital	326	283	6	2.12	1.05	2.69	(0.99, 5.87)	
	Community Medical Center - Fresno	371	314	3	0.96	1.61	0.79	(0.16, 2.32)	
	Dameron Hospital	58	51	1	1.96	1.23	2.12	(0.05, 11.88)	
	Doctors Medical Center - Modesto Campus	690	558	4	0.72	1.09	0.88	(0.24, 2.27)	
	Fresno Heart Hospital	386	306	1	0.33	1.34	0.33	(0.01, 1.82)	
	Kaweah Delta Hospital	602	481	6	1.25	1.51	1.10	(0.41, 2.41)	
	Marian Medical Center	208	164	3	1.83	1.50	1.62	(0.34, 4.78)	
	Memorial Medical Center of Modesto	571	456	12	2.63	1.33	2.63	(1.37, 4.63)	Worse
	San Joaquin Community Hospital	148	132	2	1.52	1.35	1.50	(0.18, 5.42)	
	St. Agnes Medical Center	759	659	5	0.76	1.43	0.71	(0.23, 1.66)	
	St. Joseph's Medical Center of Stockton**	481	418	4	0.96	1.25	1.02	(0.28, 2.63)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (%), RASR	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara	Antelope Valley Hospital Medical Center	91	83	1	1.20	1.41	1.13	(0.03, 6.37)	
	Community Memorial Hospital of San Buenaventura	253	208	5	2.40	1.75	1.82	(0.60, 4.29)	
	Encino Tarzana Regional Medical Center - Tarzana	207	162	2	1.23	1.53	1.07	(0.13, 3.91)	
	French Hospital Medical Center	265	196	3	1.53	1.18	1.72	(0.36, 5.07)	
	Glendale Adventist Medical Center - Wilson Terrace	290	241	0	0.00	1.27	0.00	(0.00, 1.62)	
	Glendale Memorial Hospital and Health Center	291	218	0	0.00	1.30	0.00	(0.00, 1.74)	
	Lancaster Community Hospital	23	23	0	0.00	1.04	0.00	(0.00, 20.72)	
	Los Robles Regional Medical Center	251	192	3	1.56	1.50	1.38	(0.29, 4.08)	
	Northridge Hospital Medical Center	203	155	3	1.94	1.35	1.91	(0.40, 5.61)	
	Providence Holy Cross Medical Center	196	140	2	1.43	1.39	1.37	(0.17, 4.96)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (%), RASR	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara (continued)	Providence St. Joseph Medical Center	130	93	3	3.23	1.16	3.70	(0.77, 10.90)	
	Santa Barbara Cottage Hospital	358	264	3	1.14	1.58	0.96	(0.20, 2.81)	
	Sierra Vista Regional Medical Center	52	42	2	4.76	2.26	2.80	(0.34, 10.19)	
	St. John's Regional Medical Center	228	180	3	1.67	1.56	1.42	(0.30, 4.19)	
	Valley Presbyterian Hospital	67	63	0	0.00	1.27	0.00	(0.00, 6.20)	
Greater Los Angeles	West Hills Regional Medical Center	118	107	3	2.80	1.24	3.00	(0.62, 8.84)	
	Beverly Hospital	63	58	0	0.00	1.17	0.00	(0.00, 7.31)	
	Brotman Medical Center	6	5	0	0.00	1.87	0.00	(0.00, 52.89)	
	Cedars Sinai Medical Center	487	297	5	1.68	1.21	1.85	(0.61, 4.36)	
	Centinela Hospital Medical Center	191	151	3	1.99	1.39	1.90	(0.40, 5.61)	
	Citrus Valley Medical Center - IC Campus	172	133	2	1.50	1.44	1.39	(0.17, 5.04)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Table 6: Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (% RASR)	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
Greater Los Angeles (continued)	Downey Regional Medical Center	170	151	1	0.66	1.19	0.74	(0.02, 4.15)	
	Garfield Medical Center	244	199	1	0.50	1.55	0.43	(0.01, 2.41)	
	Good Samaritan Hospital - Los Angeles	338	275	2	0.73	1.61	0.60	(0.07, 2.18)	
	Huntington Memorial Hospital	219	169	2	1.18	1.60	0.98	(0.12, 3.58)	
	Kaiser Foundation Hospital (Sunset)	1,792	1,429	18	1.26	1.38	1.21	(0.72, 1.93)	
	Lakewood Regional Medical Center	193	167	1	0.60	1.50	0.53	(0.01, 2.99)	
	Little Company of Mary Hospital	136	97	0	0.00	1.65	0.00	(0.00, 3.09)	
	Long Beach Memorial Medical Center	599	511	8	1.57	1.20	1.74	(0.75, 3.44)	
	Los Angeles Co. Harbor - UCLA Medical Center**	218	196	8	4.08	1.30	4.17	(1.82, 8.30)	Worse
	Los Angeles Co. USC Medical Center	197	169	0	0.00	0.89	0.00	(0.00, 3.28)	
	Methodist Hospital of Southern California	176	143	2	1.40	1.45	1.28	(0.16, 4.66)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Table 6: Hospital Risk-adjusted Post-operative Stroke Results by Region, 2006-2007

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (%), RASR	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
Greater Los Angeles (continued)	Presbyterian Intercommunity Hospital	244	206	3	1.46	1.38	1.41	(0.29, 4.15)	
	Santa Monica - UCLA Medical Center	44	33	0	0.00	1.20	0.00	(0.00, 12.43)	
	St. Francis Medical Center	87	81	1	1.23	1.35	1.21	(0.03, 6.81)	
	St. John's Hospital and Health Center	204	152	1	0.66	1.18	0.74	(0.02, 4.16)	
	St. Mary Medical Center	127	111	0	0.00	1.97	0.00	(0.00, 2.26)	
	St. Vincent Medical Center	246	214	2	0.93	1.41	0.88	(0.11, 3.21)	
	Torrance Memorial Medical Center	251	138	2	1.45	1.30	1.48	(0.18, 5.38)	
	UCLA Medical Center	337	184	2	1.09	1.34	1.08	(0.13, 3.91)	
	USC University Hospital	311	160	1	0.63	1.51	0.55	(0.01, 3.09)	
	White Memorial Medical Center	150	134	3	2.24	1.52	1.96	(0.41, 5.78)	
Inland Empire, Riverside & San Bernardino	Desert Regional Medical Center	442	351	3	0.85	1.38	0.82	(0.17, 2.43)	
	Eisenhower Memorial Hospital	560	435	3	0.69	1.30	0.71	(0.15, 2.08)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (% RASR)	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
Inland Empire, Riverside & San Bernardino (continued)	Loma Linda University Medical Center	736	556	7	1.26	1.38	1.21	(0.49, 2.52)	
	Pomona Valley Hospital Medical Center	379	346	4	1.16	1.65	0.94	(0.26, 2.40)	
	Riverside Community Hospital	467	392	2	0.51	1.49	0.46	(0.06, 1.65)	
	San Antonio Community Hospital	295	242	1	0.41	1.69	0.32	(0.01, 1.83)	
	St. Bernardine Medical Center	1,068	931	10	1.07	1.43	1.00	(0.48, 1.86)	
	St. Mary Regional Medical Center	339	288	3	1.04	1.51	0.92	(0.19, 2.69)	
Orange County	Anaheim Memorial Medical Center	442	376	10	2.66	1.52	2.33	(1.13, 4.32)	
	Fountain Valley Regional Hospital	193	178	4	2.25	1.40	2.14	(0.59, 5.52)	
	Hoag Memorial Hospital Presbyterian	473	310	3	0.97	1.16	1.11	(0.23, 3.27)	
	Irvine Regional Hospital and Medical Center	72	63	0	0.00	1.05	0.00	(0.00, 7.48)	
	Mission Hospital Regional Medical Center	304	257	3	1.17	1.18	1.32	(0.27, 3.87)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Post-op Strokes	Observed Post-op Stroke Rate (%)	Expected Post-op Stroke Rate (%)	Risk-Adjusted Post-op Stroke Rate (%), RASR	95% CI for RASR	Performance Rating*
State		38,803	30,379	405	1.33				
Orange County (continued)	Saddleback Memorial Medical Center	281	234	2	0.85	1.05	1.08	(0.13, 3.94)	
	St. Joseph Hospital - Orange	309	235	5	2.13	1.14	2.49	(0.81, 5.82)	
	St. Jude Medical Center	308	268	5	1.87	1.08	2.30	(0.75, 5.41)	
	UC Irvine Medical Center	121	95	3	3.16	1.26	3.34	(0.69, 9.81)	
	West Anaheim Medical Center	54	50	0	0.00	2.24	0.00	(0.00, 4.40)	
	Western Medical Center - Santa Ana	126	96	0	0.00	0.96	0.00	(0.00, 5.37)	
	Western Medical Center Hospital - Anaheim	194	176	1	0.57	1.40	0.54	(0.01, 3.03)	
Greater San Diego	Alvarado Hospital	140	111	2	1.80	1.27	1.89	(0.23, 6.86)	
	Palomar Medical Center	201	163	1	0.61	0.94	0.86	(0.02, 4.86)	
	Scripps Green Hospital	234	167	1	0.60	1.12	0.71	(0.02, 3.98)	
	Scripps Memorial Hospital - La Jolla	775	566	8	1.41	1.57	1.19	(0.52, 2.38)	
	Scripps Mercy Hospital	316	257	3	1.17	1.23	1.27	(0.26, 3.71)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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State		38,803	30,379	405	1.33				
Greater San Diego (continued)	Sharp Chula Vista Medical Center	413	336	7	2.08	1.62	1.71	(0.69, 3.55)	
	Sharp Grossmont Hospital	352	278	7	2.52	1.72	1.95	(0.79, 4.04)	
	Sharp Memorial Hospital**	473	284	8	2.82	1.19	3.15	(1.37, 6.27)	Worse
	Tri-City Medical Center	217	175	6	3.43	1.15	3.97	(1.46, 8.67)	Worse
	UCSD Medical Center	80	69	1	1.45	1.20	1.61	(0.04, 9.02)	
	UCSD Medical Center - La Jolla, John M. & Sally B. Thornton Hospital	152	89	0	0.00	1.11	0.00	(0.00, 5.01)	

* A hospital is classified as "Better" if the entire 95% CI of the RASR falls below the California observed post-operative stroke rate (1.33). A hospital is classified as "Worse" if the entire 95% CI of the RASR is higher than the California observed stroke rate. A hospital's performance is classified as "Not Different" from the state average (rating is blank) if the California stroke rate falls within the 95% CI of the hospital's RASR.

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VIII. 2007 INTERNAL MAMMARY ARTERY USAGE BY HOSPITAL: A PROCESS MEASURE OF QUALITY

A widely accepted definition of healthcare quality contains three dimensions: process, structure, and outcomes.⁸ In addition to publishing hospital outcomes (risk-adjusted operative mortality rates and risk-adjusted post-operative stroke rates), this report also assesses a process of care measure by reporting hospital use of the Internal Mammary Artery (IMA) in surgery. Although outcomes measurement permits comparison of provider performance and can be used for investigating internal processes and structures, assessing the processes of care provides a more immediate path to improvement in patient care since it involves measurement of the care patients actually receive. If diagnostic and therapeutic strategies with clear links to outcomes are monitored, some healthcare quality problems can be detected long before demonstrable health outcome differences occur.

In most cases of first-time isolated CABG surgery where the operative status is elective or urgent, the surgeon has the option of using the IMA, also known as the internal thoracic artery. Clinical literature strongly supports use of the IMA to promote long-term graft patency and patient survival, and recent research also suggests a reduction in immediate, operative mortality associated with use of the internal mammary artery as opposed to saphenous vein revascularization.⁹ The IMA and especially the left IMA is considered the preferred conduit for CABG surgery of the left anterior descending (LAD) coronary artery.

Many nationally respected organizations encourage the use of IMA when appropriate. Currently, the Leapfrog Evidence-Based Hospital Referral program endorses 80% hospital adherence to IMA use. The National Quality Forum (NQF) does not endorse a specific rate but states that the goal is to raise the IMA usage rates of hospitals with low utilization. The Society of Thoracic Surgeons (STS) states that IMA use should be given primary consideration in every CABG surgery patient. Furthermore, a number of healthcare quality advocates recommend public reporting of IMA usage rates for CABG surgery.

Table 7 presents hospital results for usage of the IMA by region for 2007. Only first-time isolated CABG surgeries where the operative status is elective or urgent are included for IMA-usage calculations. Five hospitals received a “**Low**” rating for 2007. Hospital IMA usage rates above the statewide rate were not evaluated because there is no consensus on what constitutes an optimal IMA usage rate. Hospitals marked with two asterisks (**) in Table 7 submitted statements regarding this report. Their statements are presented in Appendix A.

Multivariable analyses performed by CCORP also confirm IMA use as an independent predictor of operative survival for first-time isolated CABG surgery patients whose operative status was not emergent. IMA use as an independent variable entered into the 2007 risk model for operative mortality is a significant predictor of operative mortality ($OR=0.589$, 95% CI: 0.397-0.874, $p\text{-value}=0.0085$). IMA use is not significantly associated with increased risk of post-operative stroke ($OR=1.464$, 95% CI: 0.731-2.932, $p\text{-value}=0.282$).

⁸ Donabedian A. Evaluating the Quality of Medical Care. *The Milbank Quarterly*, 2005; 83(4):691-729.

⁹ Ferguson TB Jr., Coombs LP, Peterson ED. Internal thoracic artery grafting in the elderly patient undergoing coronary artery bypass grafting: room for process improvement? *Journal of Thoracic and Cardiovascular Surgery* 2002; 123(5):869-80.

GUIDE TO INTERPRETING TABLE 7: HOSPITAL RESULTS FOR USAGE OF IMA, 2007

Isolated CABG Surgeries	Includes only first-time isolated CABG surgeries where status of procedure was elective or urgent. This number will be smaller than the total isolated CABG cases performed by the hospital.
IMA Usage Rate	The ratio of the number of CABG surgeries with IMA grafts (including left IMA, right IMA and bilateral IMA) and selected first-time isolated CABG cases multiplied by 100: Percent IMA use=(Number of IMA grafts used for first-time isolated CABG surgeries/Number of first-time isolated CABG cases) x 100.
Rating	A blank rating indicates that the IMA Usage Rate is acceptable. A “ Low ” rating indicates that the IMA Usage Rate for a hospital is less than 79.99%, i.e., two standard deviations below the hospital statewide average IMA usage rate (93.65%). Hospital IMA-use rates above the statewide average IMA-use rate were not evaluated because there is no consensus on what constitutes an optimal rate of usage.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
Sacramento Valley & Northern California Region	Enloe Medical Center**	127	89.76%	
	Mercy General Hospital	576	96.88%	
	Mercy Medical Center - Redding	101	98.02%	
	Mercy San Juan Hospital	72	98.61%	
	Rideout Memorial Hospital	103	97.09%	
	Shasta Regional Medical Center	65	92.31%	
	St. Joseph Hospital - Eureka	56	98.21%	
	Sutter Memorial Hospital	271	97.42%	
	UC Davis Medical Center	120	98.33%	
San Francisco Bay Area & San Jose	Alta Bates Summit Medical Center - Summit Campus	506	97.23%	
	California Pacific Medical Center - Pacific Campus	78	100.00%	
	Community Hospital Monterey Peninsula	46	100.00%	
	Dominican Hospital	61	93.44%	
	El Camino Hospital	61	98.36%	
	Good Samaritan Hospital - San Jose	106	99.06%	
	John Muir Medical Center - Concord Campus	200	94.00%	
	John Muir Medical Center - Walnut Creek Campus [†]	1	Not Applicable	
	Kaiser Foundation Hospital (Geary San Francisco)	507	95.66%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

** Hospitals marked with two asterisks (**) in Table 7 submitted statements regarding this report. See Appendix A for their statements.

[#] "Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
San Francisco Bay Area & San Jose (continued)	Marin General Hospital	42	88.10%	
	O'Connor Hospital	78	96.15%	
	Peninsula Medical Center	10	90.00%	
	Queen of the Valley Hospital	147	96.60%	
	Regional Medical of San Jose	26	96.15%	
	Salinas Valley Memorial Hospital	94	91.49%	
	San Ramon Regional Medical Center	44	95.45%	
	Santa Clara Valley Medical Center	63	93.65%	
	Santa Rosa Memorial Hospital	62	98.39%	
	Sequoia Hospital	87	97.70%	
	Seton Medical Center	132	91.67%	
	St. Helena Hospital	77	89.61%	
	St. Mary's Medical Center, San Francisco	26	100.00%	
	Stanford University Hospital	83	96.39%	
	Sutter Medical Center of Santa Rosa	85	45.88%	Low
	UCSF Medical Center	78	97.44%	
	Valleycare Medical Center	37	97.30%	
	Washington Hospital - Fremont	125	96.00%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

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"Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
Central California	Bakersfield Heart Hospital	165	90.91%	
	Bakersfield Memorial Hospital	136	94.12%	
	Community Medical Center - Fresno	153	91.50%	
	Dameron Hospital	13	76.92%	Low
	Doctors Medical Center - Modesto Campus	232	90.95%	
	Fresno Heart Hospital	121	94.21%	
	Kaweah Delta Hospital	232	95.69%	
	Marian Medical Center	66	98.48%	
	Memorial Medical Center of Modesto	191	88.48%	
	San Joaquin Community Hospital	59	96.61%	
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara	St. Agnes Medical Center	272	94.85%	
	St. Joseph's Medical Center of Stockton**	183	97.81%	
	Antelope Valley Hospital Medical Center	39	87.18%	
	Community Memorial Hospital of San Buenaventura	98	98.98%	
	Encino Tarzana Regional Medical Center - Tarzana	59	98.31%	
	French Hospital Medical Center	95	97.89%	
	Glendale Adventist Medical Center - Wilson Terrace	109	98.17%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

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[#] "Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara (continued)	Glendale Memorial Hospital and Health Center	96	98.96%	
	Lancaster Community Hospital	15	80.00%	
	Los Robles Regional Medical Center	79	97.47%	
	Northridge Hospital Medical Center	59	98.31%	
	Providence Holy Cross Medical Center	49	95.92%	
	Providence St. Joseph Medical Center	45	97.78%	
	Santa Barbara Cottage Hospital	104	89.42%	
	Sierra Vista Regional Medical Center	10	100.00%	
	St. John's Regional Medical Center	66	98.48%	
	Valley Presbyterian Hospital	29	96.55%	
Greater Los Angeles	West Hills Regional Medical Center	56	94.64%	
	Beverly Hospital	32	87.50%	
	Brotman Medical Center [†]	1	Not Applicable	
	Cedars Sinai Medical Center	126	99.21%	
	Centinela Hospital Medical Center	61	91.80%	
	Citrus Valley Medical Center – IC Campus	61	78.69%	Low
	Downey Regional Medical Center	68	88.24%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

** Hospitals marked with two asterisks (**) in Table 7 submitted statements regarding this report. See Appendix A for their statements.

[#] "Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
Greater Los Angeles (continued)	Garfield Medical Center	102	88.24%	
	Good Samaritan Hospital - Los Angeles	115	97.39%	
	Huntington Memorial Hospital	67	92.54%	
	Kaiser Foundation Hospital (Sunset)	578	92.73%	
	Lakewood Regional Medical Center	74	78.38%	Low
	Little Company of Mary Hospital	47	97.87%	
	Long Beach Memorial Medical Center	225	92.44%	
	Los Angeles Co. Harbor - UCLA Medical Center**	87	95.40%	
	Los Angeles Co. USC Medical Center	85	83.53%	
	Methodist Hospital of Southern California	52	92.31%	
	Presbyterian Intercommunity Hospital	98	93.88%	
	Santa Monica - UCLA Medical Center	12	91.67%	
	St. Francis Medical Center	35	94.29%	
	St. John's Hospital and Health Center	64	96.88%	
	St. Mary Medical Center	50	96.00%	
	St. Vincent Medical Center	89	93.26%	
	Torrance Memorial Medical Center	45	97.78%	
	UCLA Medical Center	87	93.10%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

** Hospitals marked with two asterisks (**) in Table 7 submitted statements regarding this report. See Appendix A for their statements.

[#] "Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
Greater Los Angeles (continued)	USC University Hospital	61	80.33%	
	White Memorial Medical Center	50	82.00%	
Inland Empire, Riverside & San Bernardino	Desert Regional Medical Center	168	98.21%	
	Eisenhower Memorial Hospital	208	93.27%	
	Loma Linda University Medical Center	240	90.00%	
	Pomona Valley Hospital Medical Center	148	97.30%	
	Riverside Community Hospital	183	93.99%	
	San Antonio Community Hospital	88	90.91%	
	St. Bernardine Medical Center	477	94.76%	
	St. Mary Regional Medical Center	123	91.87%	
Orange County	Anaheim Memorial Medical Center	166	95.18%	
	Fountain Valley Regional Hospital	79	94.94%	
	Hoag Memorial Hospital Presbyterian	141	98.58%	
	Irvine Regional Hospital and Medical Center	32	90.63%	
	Mission Hospital Regional Medical Center	100	98.00%	
	Saddleback Memorial Medical Center	107	95.33%	
	St. Joseph Hospital - Orange	114	97.37%	
	St. Jude Medical Center	117	97.44%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

** Hospitals marked with two asterisks (**) in Table 7 submitted statements regarding this report. See Appendix A for their statements.

[#] "Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

Table 7: Hospital Results for Usage of the Internal Mammary Artery by Region, 2007

Region	Hospital	Isolated CABGs*	Percent IMA Use	Rating [#]
State		13,358	93.65%	
Orange County (continued)	UC Irvine Medical Center	37	94.59%	
	West Anaheim Medical Center	5	80.00%	
	Western Medical Center - Santa Ana	37	97.30%	
	Western Medical Center Hospital - Anaheim	84	89.29%	
Greater San Diego	Alvarado Hospital	41	95.12%	
	Palomar Medical Center	83	97.59%	
	Scripps Green Hospital	64	96.88%	
	Scripps Memorial Hospital - La Jolla	250	98.40%	
	Scripps Mercy Hospital	121	98.35%	
	Sharp Chula Vista Medical Center	168	99.40%	
	Sharp Grossmont Hospital	141	98.58%	
	Sharp Memorial Hospital**	136	91.91%	
	Tri-City Medical Center	78	73.08%	Low
	UCSD Medical Center	30	100.00%	
	UCSD Medical Center - La Jolla, John M. & Sally B. Thornton Hospital	38	100.00%	

* Only include first-time isolated CABGs where the operative status was elective or urgent.

** Hospitals marked with two asterisks (**) in Table 7 submitted statements regarding this report. See Appendix A for their statements.

[#] "Low" rating: IMA usage rate for a hospital is less than 79.99%, i.e., two standard deviations (0.0697×1.96) below the hospital statewide average IMA usage rate (93.65%).

[†] John Muir Medical Center - Walnut Creek Campus and Brotman Medical Center did not have any isolated CABG surgeries in 2007 that met the IMA criteria for inclusion in this report.

IX. THE RELATIONSHIP BETWEEN CORONARY ARTERY BYPASS GRAFT SURGERY VOLUME AND OUTCOMES

The “volume-outcome” association refers to the relationship between the quantity of care that a hospital or physician provides and the quality of care that patients receive. In general, researchers have found that the higher the number of patients a hospital or physician treats with a specific condition, the lower the patients’ complications and better patients’ health outcomes. This volume-outcome relationship has been extensively studied for patients receiving coronary artery bypass graft (CABG) surgery. While most studies have found that hospitals and surgeons performing more CABG surgeries have better outcomes, more recent data and analyses less consistently support a clinically relevant relationship.^{10,11,12,13} In the first three CCORP reports (February 2006, March 2007, and December 2007), no relationship was found between hospital CABG surgery volume and risk-adjusted CABG hospital mortality.^{14,15,16} In the most recent CCORP report (March 2009), a small but significant association was found between a hospital’s CABG surgery volume (both isolated and total CABG surgery) and operative mortality.¹⁷

As mortality rates for CABG surgery have declined and become more consistent between hospitals, there has been increased interest among health policymakers and quality of care experts in examining the relationship between surgical volume and complications of surgery. Most experts suspect that the more surgical procedures a hospital performs, the lower the rate of surgical complications.

In this current report, we have expanded our previous analyses beyond the relationship between hospital volume and mortality, and have conducted additional analyses examining the relationship between hospital volume and a complication of CABG surgery (post-operative stroke). The following section presents data examining the hospital volume-outcome relationship for two clinical outcomes, hospital mortality and hospital post-operative stroke.

¹⁰ Peterson ED, Coombs LP, DeLong ER, Haan CK, Ferguson TB. Procedural volume as a marker of quality for CABG surgery. JAMA 2004; 291(2):195-201.

¹¹ Shahian DM, Normand SL, Torchiana DF, Lewis SM, Pastore JO, Kuntz RE, et al. Cardiac surgery report cards: comprehensive review and statistical critique. Ann Thorac Surg 2001; 72(6):2155-68.

¹² Glance LG, Dick AW, Mukamel DB, Osler TM. Is the hospital volume-mortality relationship in coronary artery bypass surgery the same for low-risk versus high-risk patients? Ann Thorac Surg 2003; 76(4):1155-62.

¹³ Marcin JP, Li Z, Kravitz RL, Dai JJ, Rocke DM, Romano PS. The CABG surgery volume-outcome relationship: temporal trends and selection effects in California, 1998-2004. Health Serv Res. 2008; 43(1):174-92.

¹⁴ California Office of Statewide Health Planning and Development. ***The California Report on Coronary Artery Bypass Graft Surgery 2003 Hospital Data***, Sacramento, CA: California Office of Statewide Health Planning and Development, February 2006.

¹⁵ California Office of Statewide Health Planning and Development. ***The California Report on Coronary Artery Bypass Graft Surgery 2003-04 Hospital and Surgeon Data***, Sacramento, CA: California Office of Statewide Health Planning and Development, March 2007.

¹⁶ California Office of Statewide Health Planning and Development. ***The California Report on Coronary Artery Bypass Graft Surgery 2005 Hospital Data***, Sacramento, CA: California Office of Statewide Health Planning and Development, December 2007.

¹⁷ California Office of Statewide Health Planning and Development. ***The California Report on Coronary Artery Bypass Graft Surgery 2005-2006 Hospital and Surgeon Data***, Sacramento, CA: California Office of Statewide Health Planning and Development, March 2009.

2007 Hospital Volume-Outcome Analyses

The following analyses were conducted to examine the hospital volume-outcome relationship for both mortality and post-operative stroke in CABG surgery. The primary goal of these analyses was to use the most current methodological techniques to determine whether hospitals performing more procedures have lower risk-adjusted operative mortality rates and lower risk-adjusted post-operative stroke rates than hospitals performing fewer procedures in California.

To accomplish this, a patient-level, risk-adjusted mortality prediction model was first developed using a hierarchical or multi-level technique. Hierarchical models are increasingly used in health services research to analyze multi-level data, particularly when analyses are intended to assess the impact of hospitals or surgeon CABG volume on patient-level outcomes. All of the independent variables included in the patient-level risk adjustment model were included in the hospital volume-outcome analyses.

For the volume-outcome analyses examining the association between hospital CABG surgery volume and mortality, CCORP used data from 2007. For the volume-outcome analyses examining the association between hospital CABG surgery volume and post-operative stroke, CCORP used data from 2006 and 2007. Two years of data were analyzed because post-operative stroke is uncommon, and a two-year sample generates a more stable representation of a hospital's performance than a one-year sample.

Two definitions of volume were considered for the volume-outcome analyses of both mortality and post-operative stroke. First, "isolated CABG volume" was analyzed to assess whether there was an association between isolated CABG volume and isolated CABG mortality. Second, "total CABG volume," which includes both isolated and non-isolated CABG surgeries, was analyzed to assess whether there was an association between total CABG volume and isolated CABG mortality.

The first analyses evaluated whether a linear relationship existed between hospital CABG volume and mortality, and whether a linear relationship existed between hospital CABG volume and post-operative stroke. In these analyses, hospital volumes (both isolated and total volume) were separately included as continuous independent variables in the hierarchical logistic regression models. Second, to evaluate whether different threshold volumes or volume categories were associated with higher or lower mortality and higher or lower post-operative stroke, hospitals were grouped into volume categories depending on their number of isolated and total CABG procedures. Then, these hospital volume categories were included as indicator variables in separate analyses.

Results

Hospital Volume-Outcome Relation (Operative Mortality): The 2007 CCORP CABG surgery database contains detailed patient-level clinical data on 14,756 isolated CABG surgery procedures in 121 hospitals. The average annual hospital isolated CABG surgery volume was 122 cases, with a range among individual hospitals of 1 to 619. The overall operative mortality rate was 2.35%, and the average hospital operative mortality rate was 2.51%, with a range among individual hospitals of 0% to 10%.

In the hierarchical model, when hospital isolated CABG volume was entered into the analysis as a continuous variable, there was no significant association with risk-adjusted operative mortality (coefficient = -0.053, standard error = 0.042, p-value = 0.208; OR = 0.964 and 95% C.I = 0.887-1.046 for every additional 100 patients). Similarly, when hospital total CABG volume was

entered into the analysis as a continuous variable, there was no significant association with risk-adjusted operative mortality (coefficient = -0.018, standard error = 0.030, p-value = 0.537, OR = 0.982, and 95% CI = 0.926-1.041 for every additional 100 patients).

Table 8 presents the summary statistics when hospital isolated CABG volume was categorized into quartiles (<200, 200-299, 300-599, >=600) and dichotomized (>=450 and <450; >=250 and <250; and >=100 and <100). The quartiles were chosen because these volumes were used in the previous California volume-outcome reports. The split point of 450 procedures per year was chosen because of the past volume recommendations by The Leapfrog Group (www.leapfroggroup.org), and the split point of 100 was chosen because of the past volume recommendations by the American College of Cardiology and the American Heart Association (ACC/AHA Practical Guidelines).

The data presented in Table 8 suggests a lower CABG surgery mortality among higher volume hospitals, though not strong. The only volume threshold that is significantly associated with lower mortality is 100 or more isolated CABG surgeries per year (OR = 0.770, 95% CI = 0.596 - 0.995).

Table 8: Hospital Isolated CABG Volume Groups and Predicted Mortality Outcomes, 2007

Volume Group	Hospitals (n=121) N (%)	Patients (n=32,586) N (%)	OR (95% CI)
>=600	2 (0)	1,230 (8)	0.798 (0.426, 1.495)
300-599	4 (3)	1,910 (13)	0.825 (0.514, 1.323)
200-299	11 (9)	2,672 (18)	0.886 (0.627, 1.252)
<200	104 (88)	8,968 (61)	Reference
>=450	5 (4)	2,826 (19)	0.806 (0.535, 1.213)
<450	116 (96)	11,954 (81)	Reference
>=250	11 (9)	4,491 (30)	0.839 (0.615, 1.145)
<250	110 (91)	10,289 (70)	Reference
>=100	53 (47)	10,771 (73)	0.770 (0.596, 0.995)
<100	64 (53)	4,009 (27)	Reference

Note: Bolded groups are significantly different from the reference group.

Table 9 presents the summary statistics when total annualized hospital CABG volume was categorized into quartiles (<200, 200-299, 300-599, >=600) and dichotomized (>=450 and <450; >=250 and <250; >=100 and <100). These data also show that patients have a similar risk of dying from a CABG procedure regardless of the hospital's total CABG surgery annualized volume (i.e., no association was found between total annualized hospital CABG volume and mortality).

Table 9: Hospital Total CABG Volume Groups and Predicted Mortality Outcomes, 2007

Volume Group	Hospitals (n=121) N (%)	Patients (n=32,586) N (%)	OR (95% CI)
>=600	4 (3)	3,088 (16)	0.974 (0.628, 1.512)
300-599	7 (6)	2,773 (15)	0.788 (0.542, 1.145)
200-299	15 (12)	3,605 (19)	0.901 (0.672, 1.208)
<200	95 (79)	9,424 (50)	Reference
<hr/>			
>=450	5 (4)	3,680 (19)	1.028 (0.691, 1.530)
<450	116 (96)	15,210 (81)	Reference
<hr/>			
>=250	16 (13)	7,206 (38)	0.814 (0.630, 1.050)
<250	105 (87)	11,684 (62)	Reference
<hr/>			
>=100	70 (58)	15,763 (83)	0.956 (0.743, 1.231)
<100	51 (42)	3,127 (17)	Reference

Hospital Volume-Outcome Relation (Post-operative Stroke): The 2006-2007 CCOPR CABG database contains detailed patient-level clinical data on 30,379 isolated CABG surgery procedures in 121 hospitals. The average annualized hospital isolated CABG surgery volume was 126 cases, with a range among individual hospitals of 1 to 715. The overall post-operative stroke rate was 1.33%, and the average hospital post-operative stroke rate was 1.37%, with a range among individual hospitals of 0% to 5.88%.

In the hierarchical model, when annualized hospital isolated CABG volume was entered into the analysis as a continuous variable, there was no significant association with risk-adjusted post-operative stroke rate (coefficient = 0.036, standard error = 0.041, p-value = 0.390; OR = 1.036 and 95% C.I = 0.956-1.124 for every additional 100 patients). Similarly, when annualized hospital CABG volume was entered into the analysis as a continuous variable, there was no significant association with risk-adjusted post-operative stroke rate (coefficient = 0.027, standard error = 0.027, p-value = 0.325, OR = 1.027, and 95% confidence interval = 0.964-1.083 for every additional 100 patients).

Table 10 presents the summary statistics when annualized hospital isolated CABG volume was categorized into quartiles (<200, 200-299, 300-599, >=600) and dichotomized (>=450 and <450; >=250 and <250; and >=100 and <100).

These data show that patients have a similar risk of post-operative stroke from a CABG procedure regardless of the hospital's isolated CABG surgery volume except for hospitals in the 200-299 volume group, where their odds ratio of post-operative stroke was 12% higher than hospitals with less than 200 isolated CABG surgeries.

Table 10: Hospital Isolated CABG Volume Groups and Predicted Post-operative Stroke Outcomes, 2006-2007

Volume Group	Hospitals (n=121) N (%)	Patients (n=32,586) N (%)	OR (95% CI)
>=600	2	2,676 (9)	0.892 (0.483, 1.647)
300-599	5	4,409 (15)	1.299 (0.828, 1.039)
200-299	9	4,412 (15)	1.120 (1.762, 1.645)
<200	105	18,884 (62)	Reference
>=450	5	5,790 (19)	1.179 (0.890, 1.561)
<450	106	24,591 (81)	Reference
>=250	11	9,276 (31)	1.123 (0.890, 1.417)
<250	110	21,105 (69)	Reference
>=100	58	22,650 (75)	1.120 (0.889, 1.419)
<100	63	7,731 (25)	Reference

Note: Bolded groups are significantly different from the reference group.

Table 11 presents the summary statistics when annualized hospital total CABG volume was categorized into quartiles (<200, 200-299, 300-599, >=600) and dichotomized (>=450 and <450; >=250 and <250; >=100 and <100). These data also show that patients have a similar risk of post-operative stroke from a CABG procedure regardless of the hospital's total CABG surgery annual volume.

Table 11: Hospital Total CABG Volume Groups and Predicted Post-operative Stroke Outcomes, 2006-2007

Volume Group	Hospitals (n=121) N (%)	Patients (n=32,586) N (%)	OR (95% CI)
>=600	4	6,451 (17)	1.160 (0.772, 1.744)
300-599	8	6,121 (16)	1.235 (0.876, 1.741)
200-299	16	7,494 (19)	1.046 (0.796, 1.374)
<200	93	18,670 (48)	Reference
>=450	6	8,417 (22)	1.374 (0.757, 1.485)
<450	115	30,319 (78)	Reference
>=250	15	14,197 (37)	1.125 (0.939, 1.347)
<250	106	24,539 (63)	Reference
>=100	71	33,150 (86)	1.066 (0.822, 1.382)
<100	50	5,586 (14)	Reference

X. USE OF CARDIAC INTERVENTION PROCEDURES AND OBSERVED IN-HOSPITAL MORTALITY

Medical innovations such as the CABG procedure and Percutaneous Coronary Interventions such as Percutaneous Transluminal Coronary Angioplasty (PTCA) and intra-coronary stents, refined during the past 30 years, have contributed to improved survival for heart attack patients. The introduction of the intra-coronary stent insertion procedure (small wire cylinders that hold a narrow artery open) in clogged arteries has largely replaced angioplasty without stents because of its lower rate of re-narrowing opened arteries (restenosis). New technologies and improved adjunctive medical therapy are making percutaneous coronary intervention (PCI) a viable alternative to CABG for many patients. The advantages associated with PCI have been widely noted: PCI involves a shorter hospital stay, is suitable for most patients, and can be repeated and performed without anesthesia by a cardiologist. However, CABG surgery is associated with lower rates of repeat revascularization, less overall angina, and lower long-term mortality. A more comprehensive approach to examining and reporting on the quality of revascularization procedures in California would include PCI and its outcomes. OSHPD hopes to include PCI reporting in the future.

Figure 1 shows change in the use of the two revascularization procedures, CABG and PCI, over time using data from OSHPD's Patient Discharge Data. Despite a decrease in 2007 and 2008, PCI volume increased by 20% between 1997 and 2008 in California. Increased use of drug-eluting stents and related Centers for Medicare and Medicaid Services (CMS) reimbursement policy changes may be partly responsible for this overall growth.¹⁸ During the same timeframe, the number of isolated CABG surgeries decreased 50% between 1997 and 2008.¹⁹ Non-isolated CABG surgery volume remained relatively constant, with a slight decline each year since 2001.

Figure 2 presents the trends in observed in-hospital mortality rates for isolated CABG surgeries, non-isolated CABG surgeries and PCIs in California between 1997 and 2008. During the 12 years between 1997 and 2008, the in-hospital mortality rate for isolated CABG surgeries declined from 3.08%, when the voluntary California CABG Mortality Reporting Program (CCMRP) was launched in 1997, to 1.90% in 2008, the sixth year of the mandatory reporting program. Meanwhile, the observed in-hospital mortality rates for non-isolated CABG surgeries also declined from 9.66% in 1997 to 6.35% in 2008. However, the in-hospital mortality rate for PCIs increased slightly from 1.70% in 1997 to 1.81% in 2008.

¹⁸ Ryan, J and Cohen, DJ. Are drug-eluting stents cost-effective?: It depends on whom you ask. Circulation 2006; 114:1736-1744.

¹⁹ The numbers cited for isolated CABG and PCI volume come from the OSHPD Patient Discharge Data (PDD) and the number of isolated CABGs differs from what is cited earlier in this report for the CCORP registry. Since OSHPD does not maintain a PCI data registry, only the PDD provides a consistent source of numbers for both procedures.

Figure 1: Volume of Isolated CABG, Non-isolated CABG, and PCI Surgery in California, 1997-2008

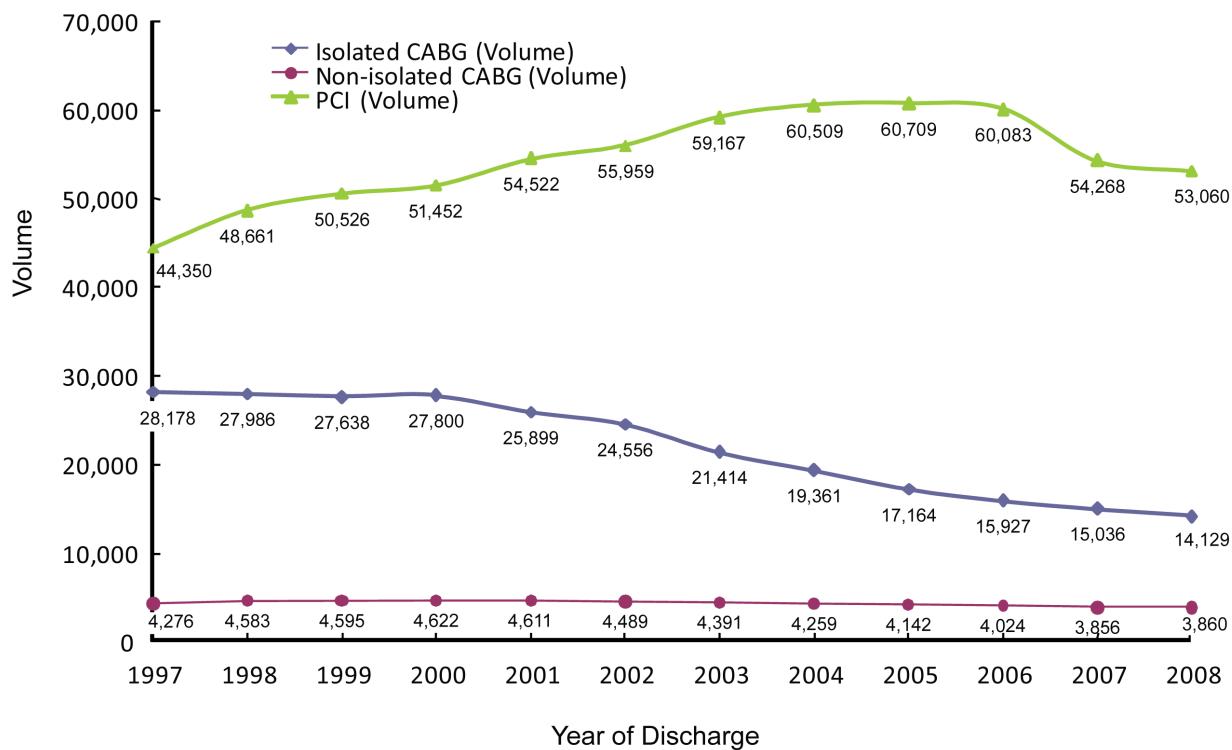
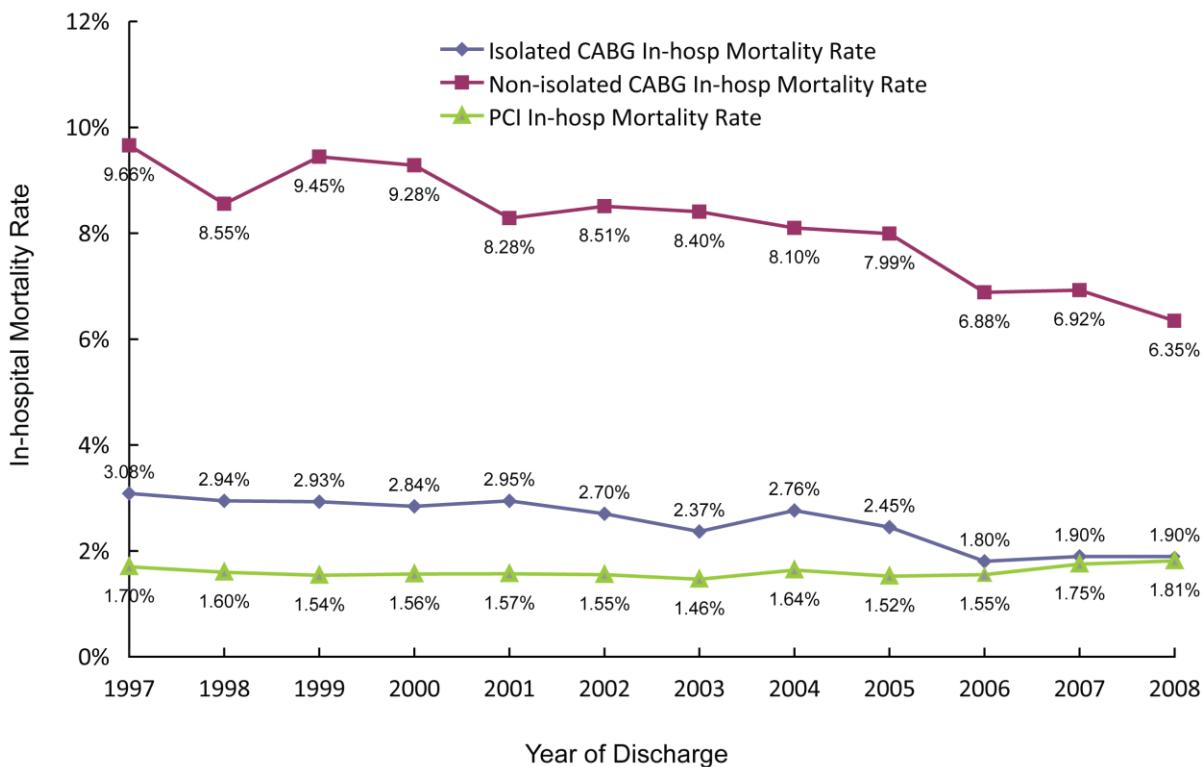


Figure 2: In-hospital Mortality Rates for Isolated CABG, Non-isolated CABG, and PCI Surgery in California, 1997-2008



APPENDIX A: HOSPITAL STATEMENTS

Each hospital included in this report was provided with a preliminary report containing the risk-adjusted models, explanatory materials, and results for all hospitals. Hospitals were given a 60-day review period for submitting statements to OSHPD for inclusion in this report. Four hospitals submitted letters which are included here.



August 12, 2009

Holly Hoegh, Ph.D.
Manager, Clinical Data Programs
Office of Statewide Health Planning and Development
400 R Street, Room 250
Sacramento, CA 95811

Re: 2007 California CABG Outcomes Reporting Program Report

Dear Dr. Hoegh:

Enloe Medical Center appreciates the opportunity to participate in the California CABG Outcomes Reporting Program.

In review of our hospital's risk-adjusted mortality for 2007, we believe that the California CABG Outcomes Reporting Program Report is misleading. While our risk adjusted mortality for 2007 is "worse than expected", we feel that the reporting does not accurately reflect the quality of care provided by our hospital. Out of the cases in 2007 that resulted in mortalities:

- four had previous cardiac intervention
- six were urgent
- four were emergent coming straight from the Cath Lab

In reviewing these cases, we feel that even though they were an isolated CABG, over half of these patients had a mortality risk of greater than 40 percent.

In 2007, Enloe Medical Center's Heart Program received two designations. It was named as a "Blue Distinction Center for Cardiac Care", based on 2003 to 2004 data, by Blue Shield of California and also was one of 20 hospitals in California to be accepted in the Blue Shield of California's Cardiac Quality Initiative program.

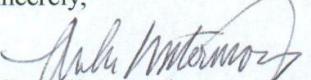
The *Blue Distinction Centers initiative* is a national program designed to create transparency for health care consumers by helping them make more informed decisions and by enabling Blue Cross Blue Shield Association to collaborate with its providers to improve quality outcomes and affordability. Facilities receiving designation met or exceeded specific quality criteria established by expert physician panels and national organizations, demonstrating reliability in delivering cardiac care and better overall outcomes for patients, according to the Blue Cross Blue Shield Association.

The *Blue Shield of California Cardiac Quality Initiative* is a California statewide program to identify and recognize cardiac programs in the Blue Shield of California network that provide high-quality cardiac care to Blue Shield members. The organization evaluated cardiac program data from 2003 to 2006 against criteria developed by an external clinical advisory committee.

Holly Hoegh, Ph.D.
Manager, Clinical Data Programs
Office of Statewide Health Planning and Development
August 12, 2009
Page 2

Enloe Medical Center is dedicated to continually improving the health and quality of our community which is represented by our successful outcomes for 2008 data and 2009 data year to date.

Sincerely,


Mike Wiltermood
President and Chief Executive Office



**Los Angeles County
Board of Supervisors**

Gloria Molina
First District

Mark Ridley-Thomas
Second District

Zev Yaroslavsky
Third District

Don Knabe
Fourth District

Michael D. Antonovich
Fifth District

August 12, 2009

Holly Hoegh, Ph.D.
Manager, Healthcare Outcomes Center
Clinical Data Programs
Office of Statewide Health Planning and Development
400 R. Street, Room 250
Sacramento, CA 95811-6213

Dear Dr. Hoegh,

Miguel Ortiz-Marroquin
Chief Executive Officer

Gail V. Anderson, Jr., MD
Chief Medical Officer

Peggy Nazarey, RN
Chief Nursing Officer

1000 West Carson Street
Torrance, CA 90509

Tel: (310) 222-2747
Fax: (310) 320-2129

*To improve health
through leadership,
service and education*

Upon receiving the preliminary 2007 CCORP (hospital level) report, we were very concerned about our reported outcomes.

On personal review of the medical records, we discovered many discrepancies in our reported cardiac surgery risk factors. There were many important omissions, and these underreported risk factors significantly and adversely affected our expected mortality and morbidity. Once this was discovered, it was too late to correct the discrepancies.

After careful analysis of the situation, we found that a number of technical terms in the data sheet were not clearly defined and were not captured accurately. This accounts for our risk factors being tabulated far below their true level.

Our County facility has several limitations influencing timely patient discharge. Often it is lack of social support and other resources that lengthen hospital stay independent of post-cardiac surgery medical status. Patients requiring postoperative transfers to a skilled nursing facility face prolonged waiting times. One listed death occurred in a patient following prolonged hospitalization due to gastrointestinal disease. She died six months after the cardiac surgery from complications related to her gastrointestinal disease.

We perform surgery on some Jehovah's Witness patients whose beliefs preclude our ability to provide life saving blood transfusions. We respect their wishes, but this increased our mortality and adversely affected our outcomes.

Our review also noted that various preoperative risk factors, including stroke prior to surgery, were not reported. This gave the erroneous impression that the strokes were related to cardiac surgery. We had two patients whose care was withdrawn per their previously expressed wishes and/or those of their families. Though these patients did suffer significant morbidity, provision of continued aggressive and appropriate care may well have prevented the mortalities.



Health Services
www.dhs.lacounty.gov



Holly Hoegh, Ph. D.
Manager Clinical Data Programs
Office of Statewide Heath Planning and Development
400 R Street Room 250
Sacramento CA 95811

Dear Dr Hoegh,

This letter is in response to our receipt of the 2006-2007 California Outcomes Reporting Program (CCORP) report. Sharp Memorial Hospital scored worse than expected on Post-Operative Stroke and we would like to respond to this rating. In 2006 we noted an unusual cluster of 6 strokes. Each case was individually reviewed and no trends or common causes could be identified. Most patients (75%) fully recovered. This unusual cluster strongly influenced our results for the 2 year period. The occurrence of stroke in 2007 was half that of 2006, and in 2008 we had no strokes at all in our isolated CABG patients. In view of this, we feel that the rating, while accurate in number, does not reflect our current performance in this area.

Sharp Memorial Hospital has participated in the California CABG Outcomes Reporting Program since 1998, when it was a voluntary program. The CCORP staff does an excellent job of ensuring accuracy of this data and we wholeheartedly support the program.

Thanks for this opportunity to comment on our results.

A handwritten signature in blue ink. The signature appears to read "Robert Adamson MD" followed by a stylized surname.

Robert Adamson MD
Cardiothoracic Surgeon
Medical Director Cardiac Transplant Program
Sharp Memorial Hospital



St. Joseph's Medical Center

A member of CHW

August 3, 2009

Holly Hoegh, Ph.D.
Manager, Clinical Data Programs
Office of Statewide Health Planning and Development
400 R. Street, Room 250
Sacramento, CA 95811

To Whom It May Concern:

This letter is in response to correspondence received from the Office of Statewide Health Planning and Development dated June 18, 2009 regarding the **2007 California CABG Outcomes Reporting Program (CCORP) Preliminary Report**. We do not feel the published risk adjusted operative mortality rating accurately reflects the quality of care of our program. We appreciate the opportunity to reply, and our response can be categorized as follows:

- In-hospital versus out-of-hospital mortality
- Continuity of care
- Results in aggregate and over time
- Risk adjustment
- Commitment to quality

First and foremost, for the 2007 calendar year, the metric of risk adjusted operative mortality included 4 deaths that occurred within 30 days, but outside of the hospital. This is an extremely unusual and aberrant finding and represents the totality of the difference in the rating of "worse than" as opposed to "no different than expected."

The 2007 CCORP 30-day (operative) mortality rate for our site sits in stark contrast to our 2007 Society of Thoracic Surgeons (STS) isolated CAB risk adjusted in hospital mortality of 2.9%. This is a result well within expected outcomes and compares to the STS like group rate of 2.3% and the STS national rate of 2.2%. Although the risk methodology varies between the ratings systems, both are scientifically data driven and share similar definitions. We encourage OSHPD to add the distinction of "in" versus "out-of-hospital" 30-day mortality to the CCORP report as a more robust measurement system.

While we understand that reporting 30 day "all cause" mortality encourages hospitals to be accountable for post discharge coordination of care, we cannot ultimately be responsible for all follow up within that time frame. Nevertheless, we have conducted a detailed review of the four out of hospital deaths in an effort to identify and correct potential improvement opportunities. Our review revealed that all cases had evidence of stable vital signs, lab values, diagnostic test results, and physical assessment upon discharge. One case was dismissed to another hospital at the hand of the insurance company, one to a community skilled nursing facility, and the other two to home including arrangements for home health care and subsequent outpatient treatments including transportation if needed. This is evidence that every effort was made to ensure continuity of care for safe and optimal outcomes for our patients, a priority at the heart of our mission.

Due to natural variation, any hospital can have a singularly exemplary or less favorable performance result. We believe that for all programs, examination of results over time and in aggregate is a more comprehensive reflection of programmatic strength than evaluation of a single year in isolation. Between 1992 and 2006, a time span representing both voluntary and

mandatory public reporting (CCMRP and CCORP), our results have consistently been within the expected performance range. This is true for individual and combined reporting periods.

Continuing the trend of favorable results over time, we must share that during 2008, there were zero isolated CAB deaths outside of the hospital within 30 days which produces an STS risk adjusted operative mortality rate of 0.8% (CCORP results for 2008 not yet available). St. Joseph's has taken care to validate our 2008 data by cross referencing 100% of cases with the public death index database, a practice not required by STS, nor undertaken by many hospitals.

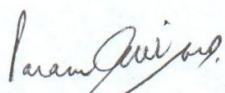
We understand that publishing a single year of data (2007) is an effort to display the most recently available CCORP results and as such is useful. However we assert that to display hospital results in aggregate over a multi-year time frame, including year over year trending in addition to a single year, would be more accurate and helpful to consumers and payers in using the CCORP data. Additionally, we encourage our fellow hospitals to participate in the STS and to validate 30 day STS reportable results as a way to continue to level the playing field for measurement between sites and across measurement systems.

With regard to patient risk, it is common for hospitals and physicians to claim "our patients are sicker". Risk adjustment nullifies this argument in most cases, provided that risk factors are adequately calculated in the predictive modeling. For many California hospitals, including the area in and surrounding Stockton, socioeconomic status (including the potential for undetected underlying chronic conditions) is not a variable accounted for in risk stratification. St. Joseph's philosophy is to provide care to all eligible patients opting for treatment, regardless of payer or socioeconomic factors. For other included risk variables such as peripheral vascular disease and severity of chronic lung disease, we acknowledge that we may have opportunities to more completely document our patients' conditions, such that our predicted risk is more accurately calculated.

Although we consider the most recent ratings to be aberrant, we take the results of this report seriously and remain committed to ongoing measurement and improvement in our cardiovascular services. The provision of excellence in outcomes is accomplished by processes including but not limited to: 1) preoperative risk assessment by a multidisciplinary physician group to ensure optimal planning and coordination of care; 2) a multidisciplinary clinical innovations team dedicated to reducing variation and improving outcomes; 3) robust interdisciplinary peer review including appropriateness screenings; and 4) physician profiles comparing outcomes to peer and national results.

In summary, St. Joseph's Medical Center of Stockton consistently demonstrates favorable isolated CAB mortality results in aggregate, over time, and across a vast array of reporting metrics and agencies. We do not believe the single result displayed in the 2007 California CABG Outcomes Reporting Program report is an accurate reflection of the quality of our program.

Sincerely,



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