III. DATA

Staff reviewed the clinical literature on pre-operative risk factors for bypass surgery and examined variables collected by the leading cardiac reporting programs to inform data collection for the program. Details on variable selection can be found in earlier CCMRP reports [***California Report on Coronary Artery Bypass Graft Surgery: 1997-1998 Hospital Data Technical Report*** (July, 2001) and ***California Report on Coronary Artery Bypass Graft Surgery: 1999 Hospital Data Technical Report*** (August 2003)]. These reports are located on OSHPD's Web site at http://www.oshpd.ca.gov/hqad/outcomes/clinical.htm. With some clarifications, CCMRP drew on a subset of data elements collected by the Society of Thoracic Surgeons (STS) for their National Database of Cardiac Surgery. For each public report, the data elements were reviewed and changes in the risk model were made after consultation with the Clinical Advisory Panel. For the 2000-2002 period, the program began collecting additional risk factors that are part of the STS risk model for CABG mortality, most importantly pre-operative *Cardiogenic Shock* and *Body Mass Index* (*BMI*) (See Table 2). In addition, the definitions and response categories for several STS risk factors (e.g., *Arrhythmia Type, Left Main Disease*) have changed substantially since the last report.

Although the STS and CCMRP data definitions are virtually identical, CCMRP provided guidelines on definitions to assist hospitals with coding. To improve the quality and comparability of data submitted across hospitals, staff encouraged each hospital to receive training prior to beginning data submissions.

Table 2: CCMRP Data Elements, 2000-2002

1. Date of Surgery	2. Gender
3. Date of Birth	4. Patient Age
5. Race/Ethnicity (STS: Race)	6. Insurer-payment source (STS: Payor)
7. Height (cm)	8. Weight (kg)
9. Last Creatinine Level (Pre-operative)	10. Hypertension: (Yes, No)
11. Dialysis: (Yes, No)	12. Diabetes: (Yes, No)
13. Peripheral Vascular Disease: (Yes, No)	14. Cerebrovascular Disease: (Yes, No)
15. Arrhythmia: (Yes, No)	16. Arrhythmia Type: (Sustained VT/VF, Heart Block, Afib/Flutter)
17. Myocardial Infarction (MI): (Yes, No)	18. MI-When: (<=6 hrs, >6hrs but <24 hrs, 1-7 days, 8-20 days, >=21 days)
19. Number of Prior Cardiac Operations Requiring Cardiopulmonary Bypass	20. Number of Prior Cardiac Operations without Cardiopulmonary Bypass
21. PTCA/Atherectomy: (Yes, No)	22. PTCA to Surgery Time Interval: (<=6hrs, >6hrs)
23. Chronic Lung Disease: (No, Mild, Moderate, Severe)	24. Cardiogenic Shock: (Yes, No)
25. Angina: (Yes, No)	26. Angina Type: (Stable, Unstable)
27. Canadian Cardiovascular Society (CCS) Angina Class: (No Angina, I, II, III, IV)	28. Congestive Heart Failure: (Yes, No)
29. New York Heart Association (NYHA) Functional Class: (I, II, III, IV)	30. Ejection Fraction (EF): (%)
31. Method of Measuring EF: (LV Gram, Radionuclide, ECHO, Estimate)	32. Left Main Disease >50%: (Yes, No)

Table 2: CCMRP Data Elements, 2000-2002 (Continued)	
33. Acuity (STS: Status): (Elective, Urgent, Emergent, Salvage)	34. Number of Diseased Vessels: (None, One, Two, Three)
35. Mitral Insufficiency: (None, Trivial, Mild, Moderate, Severe)	36. Minimally Invasive Procedure Attempted: (Yes, No)
37. Internal Mammary Artery (IMA) Used: (Left IMA, Right IMA, Both IMAs, No IMA)	38. Date of Discharge
39. Patient Status at Discharge: (Alive, Dead)	40. Date of Death

Data Quality Review and Verification

The data submitted by each hospital was reviewed for completeness and data errors. However, unlike the two prior reports, an independent medical records audit of selected hospitals was not undertaken for data contained in this report. An audit was not possible due to a reduction in staff resources with implementation of the new mandatory CABG reporting program. However, project staff did verify data submissions by comparing them against the OSHPD Patient Discharge Data (PDD) files and requiring hospitals to account for discrepancies. This included a patient-level cross check of *Discharge Status* and a number of clinical risk factors (e.g., presence of *Cardiogenic Shock*, recent *MI*) that otherwise would have been checked through the audit process. Unlike an audit, this process (Step 2 below) allowed us to verify data of all patients at all hospitals. The key steps involved in data cleaning and verification were:

Step 1: Hospital-Specific Data Summaries
This process is very similar to that summarized in the 1999 CCMRP Technical Report, in which hospital-specific rates for each pre-operative risk factor were compared to the state average, highlighting possible coding issues for hospitals to clean-up. Checks for invalid, missing, and abnormally high or low risk factor values are also included in these summaries.

Step 2: Record-Specific Linkage of CCMRP Data with Patient Discharge Data
Data quality review for the 1999 CCMRP report revealed widespread problems with hospitals' coding of patient *Discharge Status* (e.g., dead or alive) and interpretation of the definition of isolated CABG (e.g., submission of appropriate cases). To identify whether these problems also occurred in the 2000-2002 submissions, staff linked the CCMRP dataset with the PDD in order to maximize the validity of the final results. Specifically, CCMRP records were linked, via a probabilistic matching algorithm,[6] to all PDD records classified as Major Diagnostic Category 5 (MDC 5), Diseases and Disorders of the Circulatory System, as well as any records with the ICD-9-CM code 36.1x (bypass anastomosis). Also, an ICD-9-CM code-based definition of isolated CABG was developed to identify those PDD records that were isolated CABG surgeries.

This matched dataset was used to generate hospital reports when any of the two following conditions applied to patients whose *Discharge Status* was "dead" in either dataset:

1. There was a discrepancy in patient *Discharge Status* between PDD and CCMRP (dead vs. alive).
2. An apparent isolated CABG mortality found in the hospital's PDD was not submitted to CCMRP (unreported death).

[6] A description of the methodology and mechanics of the data linkage are available from CCMRP upon request.

For the first condition, 27 cases were found in which patient *Discharge Status* was recorded as "dead" in the PDD but reported as "alive" in the CCMRP submission. Likewise, 36 cases were found in which *Discharge Status* was recorded as "alive" in the PDD but "dead" in the CCMRP submission. The relevant hospitals were contacted and asked to check the cases by reviewing patient medical charts. As a result, 21 of 27 cases reported to CCMRP as "alive" were appropriately re-coded as "dead," and 21 of 36 cases reported to CCMRP as "dead" were re-coded as "alive."

For the second condition, 103 deaths were identified in the PDD as being isolated CABG mortalities that had not been submitted to CCMRP. As a result of hospitals' chart review, 69 of 103 cases were confirmed as isolated CABG surgery deaths and subsequently submitted to CCMRP. These additions resulted in increased mortality rates for several hospitals, and in one instance a hospital was required to add nine additional deaths, which resulted in a doubling of its mortality rate.

The PDD-CCMRP linkage report also listed all cases identified by the PDD as non-isolated CABGs but reported to CCMRP as isolated CABGs if the discrepancy found in CCMRP submissions exceeded 10% of a hospital's total caseload. The 10% threshold was chosen because of the innate problems in precisely identifying isolated CABG cases with ICD-9 codes. There were 452 cases submitted to CCMRP by eleven hospitals that did not appear to be isolated CABG surgeries according to ICD-9 coding in the PDD. The hospitals were asked to review these cases and ultimately, 433 of 452 records were confirmed by the hospitals to be non-isolated CABGs and removed from the database. In one instance, a hospital was required to remove 115 non-isolated CABG cases from their 2002 data submission. This brought the volume and deaths of isolated CABGs in line with other years of data submissions.

The PDD-CCMRP linkage report was also used to verify a number of risk factors, including the prevalence of *Cardiogenic Shock, PTCA, Dialysis,* and *MI*. As a result of this data cross check, the prevalence of *Cardiogenic Shock* fell from 1,304 (2.3%) to 1,099 (1.9%) cases; *PTCA* fell slightly from 10,936 (19.1%) to 10,899 (19.0%); *Dialysis* increased slightly from 1,290 (2.3%) to 1,325 (2.3%); and *MI* increased from 27,463 (47.9%) to 28,551 (49.7%).

The majority of hospitals actively participated in the multiple steps of data validation and submitted data corrections. However, two hospitals failed to correct their data and eventually withdrew from CCMRP participation. Their data were excluded from data analyses and public reporting and are not included in the total of 83 hospitals who submitted useable data.

As with previous reports, CCMRP assigned the lowest risk value to missing data, based on the following rationale: 1) many hospitals may leave data fields blank by design (e.g., blank means a risk factor was not present or the value was normal); 2) to maintain consistency with other major cardiac reporting programs, missing data are replaced with the lowest-risk or normal value; and 3) assigning values for missing data in this way creates an incentive for more complete coding by hospitals.