

Report on Coronary Artery Bypass Surgery in Ontario, Fiscal Years 2005/06 and 2006/07

In collaboration with the
Cardiac Care Network of Ontario



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The results and conclusions are those of the authors and should not be attributed to ICES, CCN or the MOHLTC.

Executive Summary

The Institute for Clinical Evaluative Sciences (ICES) has worked with the Cardiac Care Network of Ontario (CCN) since 1994 to monitor trends in the case-mix and outcomes of patients receiving coronary artery bypass graft (CABG) surgery in Ontario.

In this current study, the outcomes of patients receiving CABG surgery at each of the 11 cardiac surgery centres in Ontario were examined for 2005/06 and 2006/07. In 2005/06 and 2006/07, the number of isolated CABG surgeries performed in Ontario was 7,277 cases and 6,759 cases, respectively, representing an 8% decline. Decreasing CABG surgery volumes may be due in part to increasing angioplasty volumes in Ontario.

The outcomes of CABG surgery were generally excellent at all surgical centres in Ontario. CABG surgery mortality rates have continued to decline despite the proportion of high-risk CABG surgery patients remaining relatively stable. The crude in-hospital mortality rate has declined from an average of 1.21% during the fiscal period 2002/03–2004/05 (April 1, 2002, to March 31, 2005) to 1.13% during the fiscal period 2005/06–2006/07. In 2006/07, no hospital had significantly higher than expected risk-adjusted in-hospital or 30-day mortality rates, although there was some variation that warranted further investigation and quality improvement. In-hospital mortality rates in Ontario, however, are among the lowest in North America and are much lower than in the early 1990s when bypass mortality rates were 3%. This is likely due to ongoing advances in perioperative CABG care.

Background

The Institute for Clinical Evaluative Sciences (ICES) in collaboration with the Cardiac Care Network of Ontario (CCN) has prepared yearly outcomes reports on coronary artery bypass graft (CABG) surgery since 1994. These reports, which assist institutions in Ontario to monitor their case-mix and patient outcomes, have been released publicly since 1999 to allow for transparency in the quality of care received by patients undergoing CABG surgery in the province.

The following report is based on a data set that included all isolated CABG surgeries performed in fiscal years 2005/06 and 2006/07 in Ontario. The primary outcomes included crude and risk-adjusted in-hospital mortality rates, 30-day mortality rates, postoperative length of stay (LOS), intensive care unit LOS, and transfusion rates for red blood cells and plasma or platelets.

By linking CCN surgical registry data to Ontario hospital discharge data from the Canadian Institute for Health Information (CIHI) discharge abstract database (DAD), outcomes could be analyzed at the cardiac centre level with adjustment for case-mix. Patients who had a valid health card number in the linked CCN/CIHI data set were also linked to the Ontario Registered Persons Database (RPDB) and the Ontario Health Insurance Plan (OHIP) database. Data was provided on other important postoperative endpoints, such as morbidity and evidenced-based processes of care. The intention of this report is to help stimulate quality improvement activity across Ontario hospitals.

Dates of analysis

To evaluate hospital performance for the fiscal 2005/06–2006/07 time period, this report included all patients who had isolated CABG surgery between April 1, 2005, and March 31, 2007, inclusive. All available CCN records of patients undergoing isolated CABG surgery were linked to CIHI discharge records in the DAD. As the CIHI database is based on the discharge date and the CCN database is based on the procedure date, the two data sets were not always completely synchronized. As a result, a small number of CCN records with a procedure date near the end of the analysis period but with a discharge date after March 2007 were unlinkable and were excluded from the analysis.

Cardiac surgery centres

The following 11 cardiac surgery centres were in operation in Ontario during the study period (2005/06 and 2006/07):

- Kingston General Hospital (KGH)
- Sunnybrook Health Sciences Centre (SHSC)
- St. Michael's Hospital (SMH)
- London Health Sciences Centre (LHSC)
- University of Ottawa Heart Institute (OHI)
- Hamilton Health Sciences Corporation (HHSC)
- Hôpital Régional de Sudbury Regional Hospital (SRH)
- University Health Network (UHN)
- Trillium Health Centre (THC)
- Southlake Regional Health Centre (SRHC)
- St. Mary's General Hospital (SGH)

Methods

General issues

This report details the crude and risk-adjusted outcomes of in-hospital and 30-day mortality rates after isolated CABG surgery. Several new outcomes obtained from linkage of CCN data to the CIHI discharge database were also provided, including allogeneic blood transfusion rates, intensive care unit length of stay (LOS), and arterial graft utilization following CABG surgery.

Statistical models to predict in-hospital and 30-day mortality and allogeneic blood transfusion rates were modeled using logistic regression (2005/06 to 2006/07), while postoperative LOS and intensive care unit LOS were modeled using a Poisson regression model (2005/06 to 2006/07). As in previous CABG reports prepared jointly by ICES and CCN, the risk models were derived using the most recent data available. Calibrating the models over the years covered by the report improved their discriminating power.

The exclusion criteria utilized for postoperative LOS were consistent with those previously used. Patients who died in hospital and patients with a postoperative LOS greater than the 99th percentile were excluded.

Model development and analysis

The model development techniques used were similar to those in previous reports.² These models were created to permit statistical adjustment for patient case-mix at each centre prior to the comparison of outcomes. Risk factors with p-values of less than 0.25 at the univariate level were included in the full multivariate model. Class parameter was used in the logistic regression with backward selection at level 0.1 for the model selection. The risk adjustment models are provided in Appendix A, Tables 1a-d.

For the in-hospital mortality model, the model's predictive power was measured with the c statistic, which is equal to the area under the receiver operating characteristic (ROC) curve. The Hosmer-Lemeshow goodness-of-fit statistic was used to assess model fit. The 2005/06–2006/07 in-hospital mortality model had a ROC curve area of 0.76 and a p-value for the Hosmer-Lemeshow statistic of 0.78. The 2005/06–2006/07 30-day mortality model had a ROC curve area of 0.75 and a p-value for the Hosmer-Lemeshow statistic of 0.10. These statistics indicated that the mortality models had a high degree of discrimination and good calibration. The 2005/06–2006/07 blood transfusion rates for red blood cells and plasma or platelets had ROC curve areas of 0.72 and 0.62 respectively and p-values for the Hosmer-Lemeshow statistic of 0.44 and 0.84 respectively.

Yearly risk-adjusted outcomes by cardiac centre were calculated as the observed outcome divided by the expected outcome for an institution multiplied by the observed outcome for the province in that year. Risk factor weights from the appropriate outcome model were used to calculate an individual's expected outcome. The overall expected outcome by institution was calculated as the sum (in-hospital mortality, 30-day mortality, blood product transfusion) or the mean (postoperative LOS, intensive care unit LOS) of the individual expected outcomes for that centre. Risk-adjusted outcomes can be interpreted as the outcome that would be expected if each centre's case mix were identical to the provincial average.

Patients were categorized as low, medium or high risk based on tertiles of predicted risk for the entire province for a given fiscal year. These tertiles were derived from the appropriate model (either in-hospital mortality model or 30-day mortality model), where risk was calculated as a person's predicted probability of mortality.

For the longitudinal trend analysis of in-hospital mortality from 2005/06 to 2006/07, a risk model was derived based on the entire cohort. Yearly risk-adjusted mortality rates were calculated as the observed rate divided by the expected rate based on the statistical model multiplied by the overall provincial observed rate. This analysis allowed for trends in mortality rates across years to be identified.

Data sources

As before, age, sex, in-hospital mortality status, procedure date and discharge date were obtained from the CIHI discharge database. Postoperative LOS was calculated using the procedure date and discharge date.

The following risk factors were taken directly from the CCN database: urgency category, previous CABG, left ventricular function (LVF), CCS class, and creatinine level. Since other risk factors in the CCN database tend to have higher levels of missing data, the information from CCN was combined with data from the linked CIHI record to provide more complete data. These risk factors include: peripheral vascular disease (PVD), cerebrovascular disease (CVD), chronic obstructive pulmonary disease (COPD), diabetes, dialysis, and congestive heart failure (CHF). From the linked CIHI record and its 25 ICD-10 diagnosis codes, CIHI indicators were derived for PVD, CVD, COPD, diabetes, and CHF. For CHF specifically, only pre-surgery diagnoses were included as determined by the diagnosis-type indicator in CIHI. Overall indicators for PVD, CVD, COPD, diabetes, dialysis, and CHF were constructed by combining the CIHI and CCN indicators and assuming a comorbid condition was present when it was indicated by either source.

The amount of missing data for the surgical risk factors in the CCN database is listed in Appendix A, Table 2. The percentage of missing information for each risk factor is reported by institution. In 2005/06 and 2006/07 most centres had very low rates of missing data. The only exceptions were Sudbury Regional Hospital which had a high rate of missing data for urgency rating score for 2005/06, St. Mary's General Hospital which had a high rate of missing data for CCS class in 2005/06 and 2006/07, and the University of Ottawa Heart Institute which had a high rate of missing data for creatinine level in 2006/07. The University of Ottawa Heart Institute also appeared to have a disproportionately high rate of CHF patients. These differences could reflect differences in interpretation of data definitions and are areas for further discussion and potentially data quality audits. CCN will be implementing strategies in the future to minimize the amount of missing data and ensure data completeness (personal communication, Kori Kingsbury). For the analysis, missing data was interpreted as the absence of a risk factor and, as such, could affect the calculation of case-mix for an institution. For example, an unknown LV function was treated as the equivalent of Grade 1 LV function. A high level of missing data could make patients at some centres appear healthier than they actually are. It is therefore in each centre's interest to minimize the amount of missing data submitted to the CCN database.

Data linkage

The data linkage and creation steps followed were similar to those used in previous report cards.² As such, patients who were classified by CCN as isolated CABG but who had other cardiac procedures listed on their linked CIHI record were excluded. Table 1 outlines the data linkage steps and the process used to generate the final data set. Starting with the CCN 2005/06–2006/07 files, only those records for CABG, valve or CABG-plus-valve procedures were retained for data linkage. Multiple records per person were retained unless the record was for a re-operation during the same admission as another record. These re-operations were thought to have occurred in response to an immediate and serious post-operative complication and thus were excluded from the analysis so that any increased chance of mortality or longer length of stay would not be attributed to the first procedure.

Data linkage between CCN records and CIHI discharge abstracts was performed using AutoMatch, a data linkage program. The following variables were used for matching: health card number; chart number; admission, discharge and procedure dates; birth date; gender; and postal code. On first pass, 71% of CCN records were matched with a CIHI record on identical values for institution, health card number, and admission date and similar values for other variables. The second pass allowed for some errors in the admission date and matched a further 23% of CCN records. These steps captured a matching CIHI record for the vast majority of in-province patients.

The third step identified exact matches based on institution and chart number with similar values of the other variables. Further matches were made with CIHI records based on same institution, procedure date, gender and birth date with similar chart number, admission and discharge dates, and postal code.

The last three steps used different combinations of dates and identical institution for matching with similar information in the other fields. The final match rate was approximately 97% for each of the two fiscal years analyzed.

To create the final analysis data set, records not from the CCN 2005–2006 fiscal files were excluded. The analysis data set was further restricted to those cases with truly isolated CABG. For this definition a case had to (a) be identified as isolated CABG in CCN; (b) have a procedure code for CABG in its linked CIHI record; and (c) have no other valve or cardiac procedures performed during the same admission.

The final number of isolated CABG records used in the main analysis was 7,277 in 2005/06 and 6,759 in 2006/07. To capture 30-day mortality, the records were linked by health card number to the Ontario Registered Persons Database (RPDB) to obtain out-of-hospital dates of death. Therefore, the 30-day mortality analysis was restricted to those records that had a valid health card number and could be linked to the RPDB (Table 1). Accordingly, non-Ontario residents who had CABG surgery in Ontario were not included in the 30-day mortality analysis.

Results

Risk-adjusted in-hospital mortality rates remained low in Ontario, ranging from an average of 1.21% in fiscal 2002/03–2004/05 to 1.08% and 1.2% in 2005/06 and 2006/07 respectively (Table 2a). Crude and risk adjusted 30-day mortality rates remained relatively constant (Table 2b) and the mean crude postoperative length of stay has fluctuated slightly (Table 2c) over this period.

During 2002/03 to 2006/07 the prevalence of the following risk factors among patients receiving CABG increased slightly: aged 75+, unknown left ventricular function (LVF), Canadian Cardiovascular Society (CCS) class 1, CCS class 4D, history of dialysis, and creatinine level 121-180. During this same period there was a slight decrease in the prevalence of certain risk factors among patients undergoing CABG: urgency ranking scores of urgent, grade 2 LVF, coronary anatomy 3V/2V+PLAD, and CCS class 3 (Table 3).

In-hospital mortality rates for isolated CABG surgery have remained relatively constant across all surgical risk factors for 2005/06 and 2006/07 (Tables 4a, 4b). There also continued to be higher in-hospital mortality rates and mean length of stays for females versus males.

The distribution of risk factors by hospital is reported in Tables 5a and 5b. Depending on the risk factor the variation could be quite small (e.g., previous CABG) or quite large (e.g., history of COPD) between cardiac centres.

Table 6 provides institution-specific distribution of low-, medium-, and high-risk groups based on predicted in-hospital mortality. In 2005/06, Trillium Health Centre had the highest proportion of high-risk patients, while London Health Sciences Centre had the lowest proportion. In 2006/07, Hamilton Health Sciences Corporation and the University of Ottawa Heart Institute had the highest proportions of high-risk patients, while Sudbury Regional Hospital had the lowest proportions. Variation in the proportion of high-risk patients across centres raises concerns about consistency in the interpretation of data variables and data collection processes. These do not appear to be related to any one variable in particular.

Centre-specific crude and risk-adjusted in-hospital mortality rates are shown in Table 7 for 2005/06 and 2006/07 (also see Figure 1). In 2005/06, two hospitals had risk-adjusted in-hospital mortality rates (2.44% and 1.97%) that were significantly higher than the provincial average of 1.08%. In 2006/07, no cardiac centre had a risk-adjusted in-hospital mortality rate that was significantly different from the provincial average of 1.2%.

For 30-day mortality rates, only patients with a valid health card number who were in the RPDB were included. The cohort was therefore a subset of patients from the in-hospital mortality cohort. In 2005/06, one centre had a mortality rate which was significantly higher than the provincial average of 1.19% (Table 8). In 2006/07, no hospital had a risk-adjusted 30-day mortality rate that was significantly different from the provincial average of 1.14% (also see Figure 2).

There was significant variation in the risk-adjusted mean postoperative LOS in days by centre for 2005/06 and 2006/07 (Table 9). In 2005/06, St. Michael's Hospital had the highest risk-adjusted mean postoperative LOS (8.0 days) and Kingston General Hospital and Trillium Health Centre had the lowest LOS (5.9 days). This trend also continued in 2006/07 with St. Michael's Hospital having the highest LOS (9.6 days) and Kingston General Hospital having the lowest LOS (6.1 days).

Tables 10a and 10b provide provincial outcomes of isolated CABG outcomes by risk category for 2005/06 and 2006/07. These data demonstrate that the higher the patient risk category, the higher the in-hospital and 30-day mortality rates, and the longer the post-operative length of stay.

Stratified centre-specific mortality and LOS by predicted in-hospital mortality rate is presented in Tables 11a and 11b. In 2005/06, St. Mary's General Hospital and the University Health Network had lower than expected in-hospital mortality rates of 0.62% and 1.05% respectively for high-risk patients compared to

the provincial average of 2.5% (Table 11a). St. Mary's also had a lower-than-expected 30-day mortality rate for high-risk patients at 0.63%. In 2006/07, no hospital had risk-stratified in-hospital mortality rates, 30-day mortality rates, or mean post-operative lengths of stay that were significantly different from the Ontario average (Table 11b).

Table 12 shows the crude and risk-adjusted mean intensive care unit LOS by hospital in 2005/06–2006/07. In 2005/06, Sudbury Regional Hospital had the highest risk-adjusted mean ICU LOS (3.8 days) and Southlake Regional Health Centre had the lowest LOS (1.4 days). In 2006/07, Sudbury Regional Hospital once again had the highest intensive care unit LOS (3.8 days), while Trillium Health Centre and Southlake Regional Health Centre had the lowest (1.7 days).

Tables 13 presents the variability in transfusion rates of packed red blood cells by institution. In 2005/06, the University of Ottawa Heart Institute had the highest risk-adjusted transfusion rate of packed red blood cells (59.3%) and St. Mary's General Hospital had the lowest (21.6%). In 2006/07, Sunnybrook Health Sciences Centre had the highest risk-adjusted transfusion rate (68.1%) and St. Mary's once again had the lowest rate (18.0%). This significant amount of variability needs to be addressed with improved blood conservation strategies across hospitals.

The variability in blood transfusion rates for plasma and/or platelets is presented in Table 14. In 2005/06, Hamilton Health Sciences Corporation had the highest risk-adjusted blood transfusion rates of packed plasma or platelets (33.1%) and St. Mary's General Hospital had the lowest (5.3%). In 2006/07 Trillium Health Centre and London Health Sciences Centre had the lowest risk-adjusted rates (10.1% and 10.5% respectively) and Hamilton Health Sciences Corporation and St. Michael's Hospital had the highest blood transfusion rates of plasma and/or platelets (30.7%).

Table 15 shows that the utilization rate of at least one arterial graft in all CABG patients was highest at London Health Sciences Centre in 2005/06 and 2006/07 (97% and 96% respectively) and lowest at Sudbury Regional Hospital (80% and 77% respectively).

Discussion

Ontario cardiac centres continued to show a decline in their crude in-hospital mortality rate from 2002/03–2004/05 (1.21%) to 2005/06–2006/07 (1.13%). These results were likely a reflection of ongoing advances in perioperative CABG care and have been achieved despite the proportion of high-risk CABG surgery patients staying relatively constant. In 2006/07, mortality outcomes were similar across all cardiac centres with no centre having a risk-adjusted in-hospital mortality rate that was statistically significantly different from the provincial average. Crude 30-day mortality rates have remained relatively constant from 2002/03–2004/05 (1.16%) to 2005/06–2006/07 (1.16%). There has been a slight increase in crude post-operative length of stays and mean ICU lengths of stay, however, which may be a reflection of higher patient acuity.

Patient subgroups with lower rates of early survival after CABG continue to be elderly patients (75+), women, patients with high urgency ranking scores, patients who had a previous CABG, patients with poor left ventricular function, and those with a variety of other comorbid illnesses. These patient groups require further attention to determine optimal perioperative practices to help improve their outcomes following CABG. It should be noted that the mortality rates in all these high-risk subgroups have substantially improved in recent years.

The wide variation in rates of red blood cell transfusion across centres highlight potential opportunities for the sharing of ‘best practices’ and the potential adoption of province-wide blood conservation strategies. St. Mary’s General Hospital in Kitchener has the lowest rate of transfusion in the province, and there may be opportunities for other centres to learn from its blood conservation strategies. There are also potential opportunities to further increase the rates of arterial graft usage in Ontario.

The CABG surgery report card process was introduced in Ontario more than a decade ago. Since then a number of hospitals have launched quality improvement initiatives in response to the information contained in these report cards. The information in this report suggests their efforts have had a positive impact, as Ontario’s isolated CABG mortality rates continue to be among the lowest in North America. The relatively low mortality rates raise issues about whether isolated CABG surgery should be the primary focus of province-wide cardiac surgery quality assurance efforts, since there is likely greater outcome variations for other types of surgery, such as valve surgery. In addition, it now takes potentially only a few extra deaths for a hospital to become a ‘statistical outlier’ for CABG surgery. Distinguishing between true outlier hospitals versus statistical outlier hospitals may be an increasing challenge in the future given the relatively low mortality rates.

To facilitate more timely reporting in the future, we recommend that CCN consider collecting outcomes information such as in-hospital mortality rates or perhaps other outcomes indicators (e.g., postoperative strokes, deep sternal infection, myocardial infarction) on a prospective basis. This would permit the identification of quality of care issues in a timelier manner than is currently possible with the retrospective linkage of CCN data to the CIHI-DAD. The current process involves some time delay, as the CIHI database is assembled from data provided by hospitals across the province several months after the end of the fiscal year.

The new Ontario Health Quality Council has identified the need for monitoring and reporting of health system outcomes in order to support continuous quality improvement. CCN and ICES have been leaders in this process for over a decade. We look forward to continuing to work together to ensure that all Ontarians have access to the highest possible quality of CABG surgery.

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Table 1. Summary of steps to link the CCN and CIHI databases

	2005/06	2006/07
Total number of records	82,276	81,880
Exclude records for which patient was removed from the CCN list for reasons other than an ACB, valve, or ACB+valve procedure	-71,262	-71,484
Exclude records for a re-operation on the same person during the same admission as another record	-31	-17
Total records from each fiscal year	10,983	10,379
Addition of CABG and valve records left unmatched from previous report card with discharge date in or after March	279	259
Overall number of potential matches	11,262	10,638
1. Identical institution, health care number and admission date; similar chart number, procedure date, discharge date, date of birth, gender and postal code	7,962	7,512
2. Identical institution and health care number; similar chart number, admission date, procedure date, discharge date, date of birth, gender and postal code	2,639	2,475
3. Identical institution and chart number; similar health care number, admission date, procedure date, discharge date, date of birth, gender and postal code	336	310
4. Identical institution, procedure date, gender and date of birth; similar chart number, admission date, discharge date and postal code	4	11
5. Identical institution, date of birth and admission date; similar chart number, discharge date, procedure date, gender and postal code	0	0
6. Identical institution and procedure date; similar chart number, admission date, discharge date, date of birth, gender and postal code	0	0
7. Identical institution, date of birth and discharge date; similar chart number, admission date, procedure date, gender and postal code	1	0
Total number of matched records	10,942	10,308
Matched records as a % of potential matches	97.2%	96.9%
Post-linkage steps		
Keep only records from CCN for each fiscal year	-271	-251
Keep only records isolated CABG (according to CCN)	-2,987	-2,883
Keep only records with a CABG procedure code in the linked CIHI record	0	-2
Keep only records which were "isolated CABG" based on the linked CIHI record	-407	-413
Total number of records used in main analysis	7,277	6,759
Exclude records for people without a valid health care number and who are not in the Registered Persons Database (for linking out-of-hospital dates of death)	-198	-180
Total number of records for 30-day mortality analysis	7,079	6,579

Table 2(a) Crude and risk-adjusted in-hospital mortality in Ontario, 2005/06–2006/07

Fiscal Year	Observed Rate	Expected Rate	Adjusted Rate*	Lower 95% CI	Upper 95% CI	Volume
2005/06	1.1	1.16	1.08	0.84	1.31	7,277
2006/07	1.17	1.11	1.2	0.94	1.45	6,759
2005/06–2006/07	1.13					14,036

*Adjusted rate is based on the logistic regression model defined for fiscal year 2005/06.

Table 2(b) Crude and risk-adjusted 30-day mortality in Ontario, 2005/06–2006/07*

Fiscal Year	Observed Rate	Expected Rate	Adjusted Rate**	Lower 95% CI	Upper 95% CI	Volume
2005/06	1.21	1.19	1.19	0.94	1.43	7,079
2006/07	1.11	1.14	1.14	0.88	1.4	6,579
2005/06–2006/07	1.16					13,658

*Only those with valid health card numbers are included.

**Adjusted rate is based on the logistic regression model defined for fiscal year 2005/06.

Table 2(c) Crude postoperative length of stay (LOS) in Ontario, 2005/06–2006/07*

Fiscal Year	Number of Patients	Mean LOS
2005/06	7,127	7.0
2006/07	6,614	7.3

*Patients who died in hospital and whose postoperative length of stay exceeded the 99th percentile were excluded.

Table 3. Prevalence of risk factors of CABG surgery, 2002/03–2006/07

Description	Risk Factor	Fiscal 2002	Fiscal 2003	Fiscal 2004	Fiscal 2005	Fiscal 2006
Age (in years)	<65	49	49	46	47	46
	65-74	35	35	35	34	35
	75+	16	16	18	19	19
Sex	Female	22	21	21	22	22
Urgency Ranking Score	Emergency	6	8	7	7	8
	Urgent	51	50	51	49	49
	Elective	43	42	41	43	43
Previous CABG	Re-operation	2	2	2	2	2
Left Ventricular Function	Grade 1	49	50	50	50	52
	Grade 2	31	31	30	28	28
	Grade 3	15	15	14	14	12
	Grade 4	2	3	2	2	2
	Unkown	3	2	4	5	6
Coronary Anatomy	Left Main Disease	26	27	29	30	29
	3V/2V+PLAD	55	58	56	53	54
	1V/2V-PLAD	19	15	15	16	16
CCS (Canadian Cardiovascular Society) Classification of Angina/ACS Class	Class 1	7	8	8	9	10
	Class2	16	17	18	17	17
	Class 3	33	31	28	27	25
	Class 4					3
	Class 4A	27	27	29	30	22
	Class 4B	12	11	11	11	15
	Class 4C	5	5	5	5	6
	Class 4D	0	0	0	1	1
History of Peripheral Vascular Disease (PVD)		16	15	15	15	14
History of Cerebrovascular Disease (CVD)		11	11	12	11	10
History of Chronic Obstructive Pulmonary Disease (COPD)		11	11	11	11	12
History of Diabetes Mellitus		35	34	37	37	39
History of Dialysis		1	1	1	2	2
History of Chronic Heart Failure (CHF)		12	12	13	13	14
Creatinine	≤120	89	89	88	87	88
	121-180	9	9	9	10	10
	>180	3	2	3	3	3

Table 4(a) Isolated CABG surgery outcomes by surgical risk factor, 2005/06

Risk Factor	Category	No. of Cases	Percentage	In-Hospital Mortality	Mean Length of Stay	Median Length of Stay
Age	<65	3,453	47	0.6	6.2	5
	65-74	2,463	34	1.3	7.3	6
	75+	1,361	19	1.8	8.7	7
Sex	Female	1,569	22	1.7	7.9	6
	Male	5,708	78	1.0	6.8	6
URS	Emergency	537	7	3.9	8.2	7
	Urgent	3,581	49	1.0	7.3	6
	Elective	3,159	43	0.7	6.5	6
Previous CABG	No	7,136	98	1.0	7.0	6
	Yes	141	2	5.0	8.0	7
LV	1	3,670	50	0.6	6.7	6
	2	2,065	28	1.0	7.0	6
	3	992	14	2.2	7.6	6
	4	159	2	3.8	9.1	7
	Unknown	391	5	2.8	7.3	6
Anatomy	Left Main	2,212	30	1.7	7.5	6
	3V/2V+PLAD	3,880	53	0.8	6.9	6
	1V/2V-PLAD	1,185	16	0.8	6.5	6
CCS	1	621	9	1.6	6.5	6
	2	1,256	17	0.3	6.4	6
	3	1,992	27	1.0	6.8	6
	4A	2,163	30	1.0	7.3	6
	4B	814	11	0.9	7.5	6
	4C	363	5	2.8	7.7	6
	4D	68	1	10.3	9.9	8
PVD	No	6,218	85	0.9	6.8	6
	Yes	1,059	15	2.2	8.3	7
CVD	No	6,471	89	1.0	6.9	6
	Yes	806	11	1.9	8.3	7
COPD	No	6,472	89	1.0	6.9	6
	Yes	805	11	1.7	8.2	7
DM	No	4,560	63	0.8	6.7	6
	Yes	2,717	37	1.6	7.5	6
Dialysis	No	7,167	98	1.0	7.0	6
	Yes	110	2	6.4	10.2	8
CHF	No	6,317	87	0.6	6.6	6
	Yes	960	13	4.2	9.6	7
Creatinine	≤120	6,354	87	0.9	6.8	6
	121-180	704	10	2.0	8.2	7
	>180	219	3	5.5	9.7	8.5

Table 4(b) Isolated CABG surgery outcomes by surgical risk factor, 2006/07

Risk Factor	Category	No. of Cases	Percentage	In-Hospital Mortality	Mean Length of Stay	Median Length of Stay
Age	<65	3141	46	0.5	6.4	6
	65-74	2338	35	1.2	7.5	6
	75+	1280	19	2.8	9.1	7
Sex	Female	1463	22	1.6	8.0	7
	Male	5296	78	1.1	7.1	6
URS	Emergency	540	8	3.9	8.7	7
	Urgent	3322	49	1.0	7.5	6
	Elective	2897	43	0.8	6.8	6
Previous CABG	No	6636	98	1.1	7.3	6
	Yes	123	2	3.3	7.8	6
LV	1	3531	52	0.9	7.0	6
	2	1897	28	1.1	7.4	6
	3	783	12	2.2	8.3	7
	4	134	2	3.7	9.3	7
	Unknown	414	6	1.0	7.3	6
Anatomy	Left Main	1969	29	1.6	7.8	6
	3V/2V+PLAD	3681	54	1.0	7.2	6
	1V/2V-PLAD	1109	16	1.0	6.9	6
CCS	1	704	10	0.9	6.9	6
	2	1145	17	0.6	6.7	6
	3	1683	25	1.1	7.2	6
	4	233	3	0.4	7.0	6
	4A	1461	22	1.2	7.6	6
	4B	1024	15	1.0	7.7	6
	4C	438	6	2.3	8.0	7
	4D	71	1	12.7	10.0	7
PVD	No	5821	86	1.1	7.1	6
	Yes	938	14	1.8	8.5	7
CVD	No	6050	90	1.0	7.2	6
	Yes	709	10	2.5	8.6	7
COPD	No	5967	88	1.1	7.2	6
	Yes	792	12	1.8	8.1	7
Diabetes	No	4091	61	1.1	7.0	6
	Yes	2668	39	1.2	7.8	6
Dialysis	No	6653	98	1.1	7.3	6
	Yes	106	2	3.8	9.2	7
CHF	No	5807	86	0.7	7.0	6
	Yes	952	14	3.9	9.5	7
Creatinine	≤120	5939	88	1.0	7.1	6
	121-180	643	10	2.0	8.8	7
	>180	177	3	4.5	9.6	8

Table 5(a) Distribution of surgical risk factors in isolated CABG patients by hospital, 2005/06

Risk Factor	Category	Hamilton HHSC	Sudbury SRH	Kingston KGH	London LHSC	Southlake SRHC	St. Mary's SGH	St. Michael's SMH	Sunnybrook SHSC	Trillium THC	UHN	Ottawa OHI	Total
Age	<65	44	47	46	48	51	45	49	47	47	46	50	47
	65-74	31	35	37	34	32	37	35	37	32	35	31	34
	75+	25	18	18	18	18	18	16	16	20	19	19	19
Sex	Female	23	22	23	21	26	23	18	22	20	22	18	22
	Male	77	78	77	79	74	77	82	78	80	78	82	78
URS	Emergency	8	5	7	9	6	5	2	6	14	8	7	7
	Urgent	46	40	48	50	46	47	55	56	47	51	50	49
	Elective	46	55	45	41	49	48	43	38	39	41	43	43
Prev CABG	No	98	96	98	99	99	99	99	99	95	98	97	98
	Yes	2	4	2	1	1	1	1	1	5	2	3	2
LV	1	69	39	42	55	44	33	47	47	43	57	54	50
	2	20	25	20	35	35	26	31	33	34	27	21	28
	3	10	13	13	10	12	16	20	16	19	15	8	14
	4	1	3	2	1	2	4	2	3	4	1	2	2
	Unknown	0	20	22	0	6	21	1	1	1	0	0	14
Anatomy	Left Main	30	35	33	28	25	34	31	32	24	30	38	30
	3V/2V+PLAD	54	37	55	55	52	52	52	56	63	52	49	53
	1V/2V-PLAD	16	28	12	17	23	14	17	12	13	18	13	16
CCS	1	8	23	15	1	7	19	8	10	4	6	12	9
	2	9	28	25	15	15	18	24	20	10	18	21	17
	3	33	33	28	35	20	32	27	18	19	26	32	27
	4A	33	8	19	32	47	19	38	23	44	18	24	30
	4B	10	3	8	12	6	9	1	27	9	25	5	11
	4C	5	4	4	6	5	2	2	2	11	6	4	5
	4D	3	1	2	0	0	0	0	0	2	0	2	1
PVD	No	85	89	83	86	91	83	87	87	86	81	83	85
	Yes	15	11	17	14	9	17	13	13	14	19	17	15
CVD	No	88	93	82	88	93	89	90	92	90	88	87	89
	Yes	12	7	18	12	7	11	10	8	10	12	13	11
COPD	No	90	95	69	88	92	93	85	90	90	94	88	89
	Yes	10	5	31	12	8	7	15	10	10	6	12	11
Diabetes	No	66	59	63	66	67	63	62	63	57	59	63	63
	Yes	34	41	37	34	33	37	38	37	43	41	37	37
Dialysis	No	97	98	99	99	99	99	97	98	99	99	99	98
	Yes	3	2	1	1	1	1	3	2	1	1	1	2
CHF	No	88	91	83	92	97	85	86	89	88	88	67	87
	Yes	12	9	17	8	3	15	14	11	12	12	33	13
Creatinine	≤120	86	93	93	87	92	82	87	91	88	82	86	87
	121-180	10	5	5	10	6	15	9	7	10	15	10	10
	>180	4	2	2	3	2	3	4	2	2	3	4	3

Table 5(b) Distribution of surgical risk factors in isolated CABG patients by hospital, 2006/07

Risk Factor	Category	Hamilton HHSC	Sudbury SRH	Kingston KGH	London LHSC	Southlake SRHC	St. Mary's SGH	St. Michael's SMH	Sunnybrook SHSC	Trillium THC	UHN	Ottawa OHI	Total
Age	<65	43	48	45	47	48	43	50	46	51	44	46	46
	65-74	35	38	38	34	33	39	34	36	30	36	33	35
	75+	21	14	18	19	20	18	16	17	19	20	21	19
Sex	F	22	23	24	21	21	23	22	17	21	22	23	22
	M	78	77	76	79	79	77	78	83	79	78	78	78
URS	Emergency	8	9	14	7	13	5	2	7	8	7	10	8
	Urgent	44	46	49	52	48	45	56	54	49	46	51	49
	Elective	47	45	37	41	39	50	42	40	43	46	39	43
Prev CABG	No	97	98	98	99	99	98	99	99	97	99	98	98
	Yes	3	2	2	1	1	2	1	1	3	1	2	2
LV	1	68	47	41	55	41	38	49	53	47	60	56	52
	2	23	27	16	34	33	27	33	32	34	28	18	28
	3	7	13	8	9	16	14	17	13	15	10	9	12
	4	1	3	1	1	1	4	1	2	4	2	2	2
	Unknown	0	11	34	0	9	17	0	1	1	0	14	6
Anatomy	Left Main	29	28	32	27	26	33	30	29	22	28	39	29
	3V/2V+PLAD	54	51	52	58	53	52	52	55	64	54	49	54
	1V/2V-PLAD	18	22	16	15	20	15	18	16	15	18	12	16
CCS	1	7	13	10	7	10	17	10	11	9	13	14	10
	2	9	25	18	17	15	21	20	19	14	18	21	17
	3	27	23	23	31	19	25	27	17	25	23	26	25
	4	9	1	2	0	3	6	0	5	3	1	5	3
	4A	31	12	12	27	18	8	37	23	23	16	14	22
	4B	9	18	20	13	24	12	4	21	22	22	9	15
	4C	4	7	13	5	9	10	2	5	6	5	9	6
	4D	2	1	1	0	2	0	0	0	0	0	3	1
PVD	No	85	89	81	87	91	86	91	88	89	79	83	86
	Yes	15	11	19	13	9	14	9	12	11	21	17	14
CVD	No	88	93	89	89	94	91	91	90	89	88	87	90
	Yes	12	7	11	11	6	9	9	10	11	12	13	10
COPD	No	89	94	72	87	92	94	88	89	91	90	85	88
	Yes	11	6	28	13	8	6	12	11	9	10	15	12
Diabetes	No	62	64	64	64	64	64	53	62	58	57	58	61
	Yes	38	36	36	36	36	36	47	38	42	43	42	39
Dialysis	No	97	99	99	100	98	100	98	98	97	98	99	98
	Yes	3	1	1	0	2	0	2	2	3	2	1	2
CHF	No	84	89	91	90	92	85	85	89	91	87	67	86
	Yes	16	11	9	10	8	15	15	11	9	13	33	14
Creatinine	≤120	85	94	91	87	88	90	86	91	88	88	85	88
	121-180	10	4	7	10	10	9	12	7	10	9	12	10
	>180	5	1	2	2	2	1	3	2	3	2	3	3

Table 6(a) Distribution of low-, medium- and high-risk isolated CABG patients by hospital, 2005/06*

Hospital	Low-risk (%)	Medium-risk (%)	High-risk (%)
Hamilton Health Sciences Corp (HHSC)	31	36	33
Sudbury Regional Hospital (SRH)	37	28	36
Kingston General Hospital (KGH)	35	31	34
London Health Sciences Centre (LHSC)	32	39	29
Southlake Regional Health Centre (SRHC)	34	34	32
St. Mary's General Hospital (SGH)	26	36	38
St. Michael's Hospital (SMH)	30	38	32
Sunnybrook Health Science Centre (SHSC)	37	32	31
Trillium Health Centre (THC)	30	29	41
University Health Network (UHN)	32	35	32
University of Ottawa Heart Institute (OHI)	32	35	33

* Based on in-hospital mortality.

Table 6(b) Distribution of low-, medium- and high-risk isolated CABG patients by hospital, 2006/07*

Hospital	Low-risk (%)	Medium-risk (%)	High-risk (%)
Hamilton Health Sciences Corp (HHSC)	31	32	38
Sudbury Regional Hospital (SRH)	35	36	30
Kingston General Hospital (KGH)	31	35	33
London Health Sciences Centre (LHSC)	34	34	32
Southlake Regional Health Centre (SRHC)	31	31	37
St. Mary's General Hospital (SGH)	28	38	33
St. Michael's Hospital (SMH)	34	33	33
Sunnybrook Health Science Centre (SHSC)	36	34	31
Trillium Health Centre (THC)	36	31	33
University Health Network (UHN)	31	36	33
University of Ottawa Heart Institute (OHI)	30	32	38

* Low-, medium-, and high-risk groups are based on in-hospital mortality.

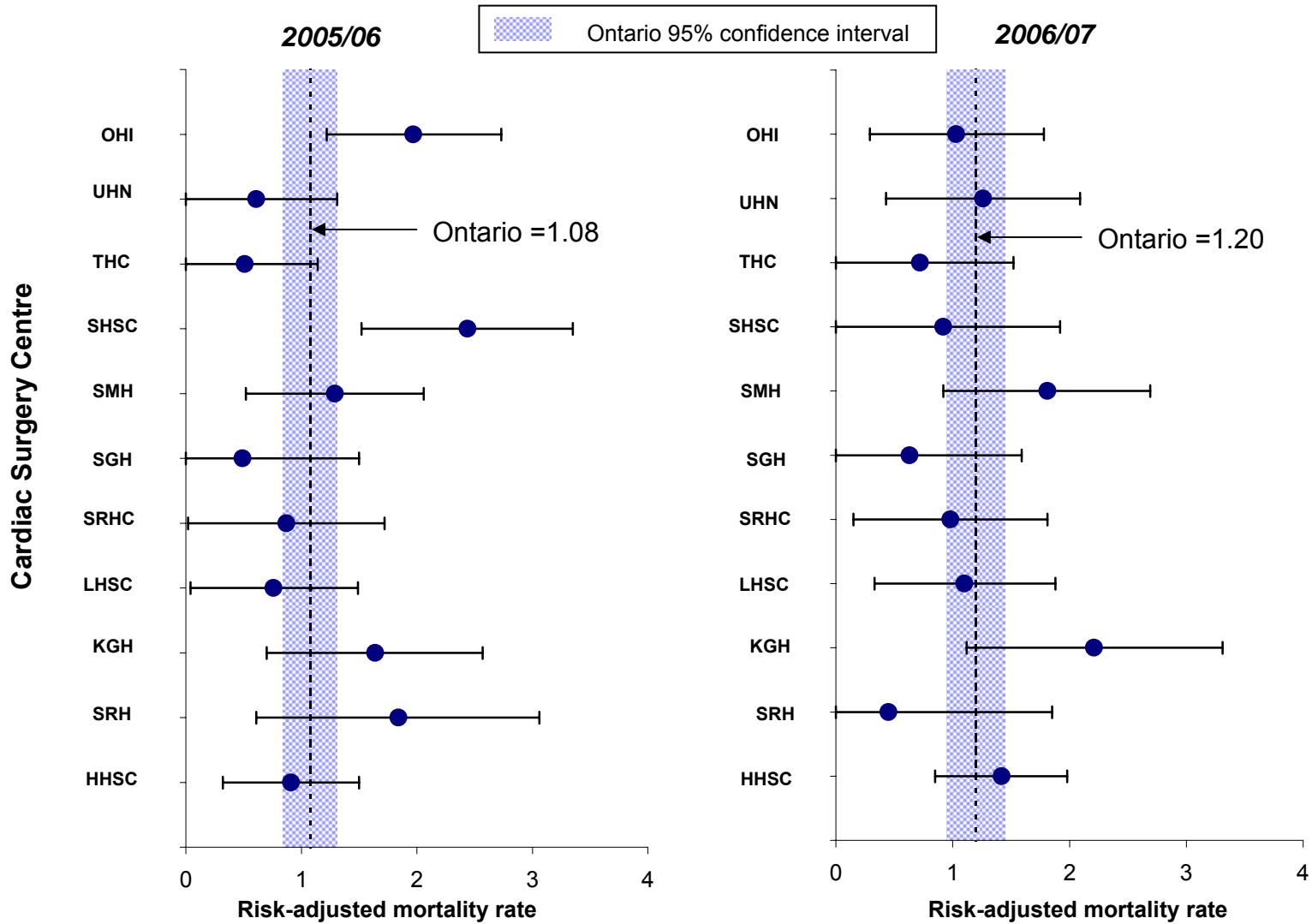
Table 7(a) Crude and risk-adjusted in-hospital mortality rates by hospital for 2005/06

Hospital	Institutional Volume	Observed Rate	Expected Rate	Adjusted Rate	Lower 95% CI	Upper 95% CI	Institution vs. Overall
Hamilton Health Sciences Corp (HHSC)	879	1.14	1.38	0.91	0.32	1.5	
Sudbury Regional Hospital (SRH)	275	1.82	1.09	1.84	0.61	3.06	
Kingston General Hospital (KGH)	416	1.68	1.13	1.64	0.7	2.57	
London Health Sciences Centre (LHSC)	895	0.67	0.97	0.76	0.04	1.49	
Southlake Regional Health Centre (SRHC)	695	0.72	0.91	0.87	0.02	1.72	
St. Mary's General Hospital (SGH)	421	0.48	1.06	0.49	0	1.5	
St. Michael's Hospital (SMH)	743	1.21	1.03	1.29	0.52	2.06	
Sunnybrook Health Science Centre (SHSC)	604	1.99	0.9	2.44	1.52	3.35	High
Trillium Health Centre (THC)	769	0.65	1.41	0.51	0	1.14	
University Health Network (UHN)	883	0.57	1.03	0.61	0	1.31	
University of Ottawa Heart Institute (OHI)	697	2.01	1.12	1.97	1.22	2.73	High
Overall	7,277	1.1					

Table 7(b) Crude and risk-adjusted in-hospital mortality rates by hospital for 2006/07

Hospital	Institutional Volume	Observed Rate	Expected Rate	Adjusted Rate	Lower 95% CI	Upper 95% CI	Institution vs. Overall
Hamilton Health Sciences Corp (HHSC)	931	1.93	1.6	1.42	0.85	1.98	
Sudbury Regional Hospital (SRH)	271	0.37	0.96	0.45	0.00	1.85	
Kingston General Hospital (KGH)	395	2.03	1.07	2.21	1.12	3.31	
London Health Sciences Centre (LHSC)	816	0.98	1.04	1.10	0.33	1.88	
Southlake Regional Health Centre (SRHC)	582	1.03	1.23	0.98	0.15	1.81	
St. Mary's General Hospital (SGH)	499	0.6	1.11	0.63	0.00	1.59	
St. Michael's Hospital (SMH)	605	1.65	1.07	1.81	0.92	2.69	
Sunnybrook Health Science Centre (SHSC)	491	0.81	1.03	0.92	0.00	1.92	
Trillium Health Centre (THC)	730	0.68	1.11	0.72	0.00	1.52	
University Health Network (UHN)	750	1.07	0.99	1.26	0.43	2.09	
University of Ottawa Heart Institute (OHI)	689	1.16	1.31	1.03	0.29	1.78	
Overall	6,759	1.17					

Figure 1. Risk-adjusted in-hospital mortality rate in Ontario by cardiac surgery centre, 2005/06 and 2006/07



* Adjusted rate is based on the logistic regression model defined in Appendix A Table 1a.

Table 8(a) Crude and risk-adjusted 30-day mortality rates by hospital, 2005/06

Hospital	Hospital Volume	Observed Rate	Expected Rate	Adjusted Rate*	Upper 95% CI	Lower 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	875	1.49	1.47	1.22	0.59	1.86	
Sudbury Regional Hospital (SRH)	273	2.56	1.09	2.85	1.49	4.21	High
Kingston General Hospital (KGH)	413	1.69	1.26	1.63	0.65	2.61	
London Health Sciences Centre (LHSC)	893	0.9	1.1	0.99	0.24	1.74	
Southlake Regional Health Centre (SRHC)	687	1.16	0.98	1.45	0.54	2.36	
St. Mary's General Hospital (SGH)	418	0.48	1.11	0.52	0	1.62	
St. Michael's Hospital (SMH)	735	1.09	1.07	1.24	0.4	2.08	
Sunnybrook Health Science Centre (SHSC)	599	1.67	0.96	2.11	1.13	3.1	
Trillium Health Centre (THC)	763	0.92	1.53	0.73	0.05	1.41	
University Health Network (UHN)	872	0.8	1.12	0.87	0.12	1.63	
University of Ottawa Heart Institute (OHI)	551	1.63	1.28	1.55	0.68	2.43	
Overall	7,079	1.21					

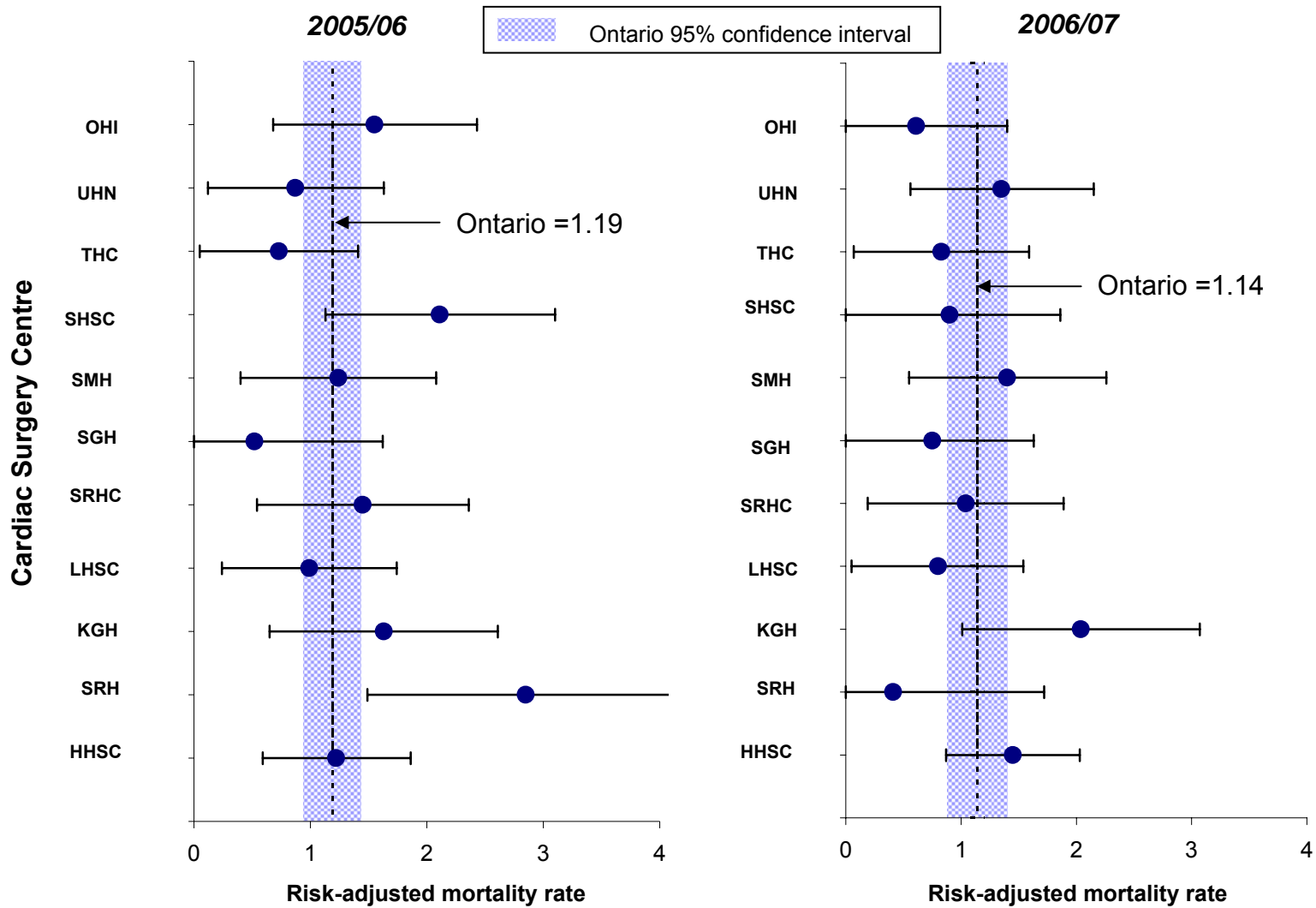
*Adjusted rate is based on the logistic regression model in Appendix A, Table 1a.

Table 8(b) Crude and risk-adjusted 30-day mortality rates by hospital, 2006/07

Hospital	Hospital Volume	Observed Rate	Expected Rate	Adjusted Rate*	Upper 95% CI	Lower 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	926	1.84	1.41	1.45	0.87	2.03	
Sudbury Regional Hospital (SRH)	271	0.37	1	0.41	0	1.72	
Kingston General Hospital (KGH)	389	2.06	1.12	2.04	1.01	3.07	
London Health Sciences Centre (LHSC)	813	0.74	1.03	0.8	0.05	1.54	
Southlake Regional Health Centre (SRHC)	574	1.05	1.11	1.04	0.19	1.89	
St. Mary's General Hospital (SGH)	497	0.8	1.19	0.75	0	1.63	
St. Michael's Hospital (SMH)	598	1.34	1.06	1.4	0.55	2.26	
Sunnybrook Health Science Centre (SHSC)	486	0.82	1.02	0.9	0	1.86	
Trillium Health Centre (THC)	719	0.83	1.11	0.83	0.07	1.59	
University Health Network (UHN)	738	1.22	1	1.35	0.56	2.15	
University of Ottawa Heart Institute (OHI)	568	0.7	1.29	0.61	0	1.4	
Overall	6,579	1.11					

*Adjusted rate is based on the logistic regression model in Appendix A, Table 1a.

Figure 2. Risk-adjusted 30-day mortality rate in Ontario by cardiac surgery centre, 2005/06 and 2006/07



* Adjusted rate is based on the logistic regression model defined in Appendix A Table 1a.

Table 9(a) Crude and risk-adjusted mean postoperative length of stay (LOS) for CABG patients by hospital, 2005/06*

Hospital	Observed LOS	Expected LOS	Adjusted LOS	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	7.5	7.3	7.2	7.1	7.3	High
Sudbury Regional Hospital (SRH)	7.6	6.9	7.7	7.6	7.9	High
Kingston General Hospital (KGH)	6.0	7.2	5.9	5.7	6.0	Low
London Health Sciences Centre (LHSC)	7.0	7.1	6.9	6.8	7.0	
Southlake Regional Health Centre (SRHC)	6.0	7.0	6.0	5.9	6.1	Low
St. Mary's General Hospital (SGH)	6.7	7.2	6.6	6.5	6.7	Low
St. Michael's Hospital (SMH)	8.0	7.1	8.0	7.9	8.1	High
Sunnybrook Health Science Centre (SHSC)	7.5	7.1	7.4	7.2	7.5	High
Trillium Health Centre (THC)	6.3	7.4	5.9	5.8	6.1	Low
University Health Network (UHN)	6.6	7.2	6.4	6.3	6.5	Low
University of Ottawa Heart Institute (OHI)	7.9	7.1	7.8	7.7	7.9	High
Overall	7.0					

*Adjusted rate is based on the poisson regression model defined in Appendix A, Table 1b.

Table 9(b) Crude and risk-adjusted mean postoperative length of stay (LOS) for CABG patients by hospital, 2006/07*

Hospital	Observed LOS	Expected LOS	Adjusted LOS	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	7.3	7.2	7.4	7.3	7.5	
Sudbury Regional Hospital (SRH)	7.2	6.9	7.6	7.4	7.7	High
Kingston General Hospital (KGH)	6.0	7.2	6.1	5.9	6.2	Low
London Health Sciences Centre (LHSC)	7.3	7.1	7.5	7.4	7.6	High
Southlake Regional Health Centre (SRHC)	6.4	7.1	6.5	6.4	6.7	Low
St. Mary's General Hospital (SGH)	6.9	7.1	7.1	7.0	7.3	Low
St. Michael's Hospital (SMH)	9.2	7.1	9.6	9.4	9.7	High
Sunnybrook Health Science Centre (SHSC)	8.2	7.1	8.4	8.3	8.6	High
Trillium Health Centre (THC)	6.4	7.2	6.5	6.4	6.6	Low
University Health Network (UHN)	7.2	7.2	7.3	7.2	7.4	
University of Ottawa Heart Institute (OHI)	8.0	7.2	8.1	8.0	8.2	High
Overall	7.3					

*Adjusted rate is based on the poisson regression model defined in Appendix A, Table 1b.

Table 10(a) Summary of isolated CABG outcomes by risk category, 2005/06

Risk Category	In-Hospital Mortality		Mean Postoperative Length of Stay		30-Day Mortality	
	%	Rate	%	Days	%	Rate
Low	32.0	0.2	31.8	5.9	31.8	0.3
Medium	34.6	0.6	34.2	6.8	34.7	0.7
High	33.4	2.5	31.9	8.3	33.5	2.6
Provincial Total	N=7277	1.1	N=7127*	7	N=7079**	1.2

* Excluded those who died in hospital and whose post-operative length of stay exceeded the 99th percentile.

** Only included patients with valid health card numbers.

Table 10(b) Summary of isolated CABG outcomes by risk category, 2006/07

Risk Category	In-Hospital Mortality		Mean Postoperative Length of Stay		30-Day Mortality	
	%	Rate	%	Days	%	Rate
Low	32.5	0.2	32.2	6.1	32.5	0.3
Medium	33.5	0.7	33.1	6.9	33.5	0.6
High	34.1	2.6	32.5	8.8	34.0	2.3
Provincial Total	N=6759	1.17	N=6614*	7.3	N=6579**	1.1

* Excluded those who died in hospital and whose postoperative length of stay exceeded the 99th percentile.

** Only included patients with valid health card numbers.

Table 11(a) Risk-stratified surgical outcomes for isolated CABG patients by hospital, 2005/06

Hospital	In-Hospital Mortality (%)			30-Day Mortality (%)			Mean Postoperative LOS (Days)		
	Low Risk	Medium Risk	High Risk	Low Risk	Medium Risk	High Risk	Low Risk	Medium Risk	High Risk
Hamilton Health Sciences Corp (HHSC)	0.0	0.3	3.1	0.0	1.0	3.4	6.3	7.1	9.2
Sudbury Regional Hospital (SRH)	1.0	0.0	4.1	1.0	1.3	5.1	6.7	7.2	9.0
Kingston General Hospital (KGH)	0.0	1.5	3.6	0.0	1.6	3.6	5.4	5.8	6.9
London Health Sciences Centre (LHSC)	0.0	0.3	1.9	0.4	0.6	1.9	6.1	6.7	8.4
Southlake Regional Health Centre (SRHC)	0.0	0.4	1.8	0.0	0.9	2.7	5.1	5.9	7.1
St. Mary's General Hospital (SGH)	0.9	0.0	0.62*	0.9	0.0	0.63*	5.8	6.8	7.3
St. Michael's Hospital (SMH)	0.5	0.7	2.5	0.5	0.7	2.1	6.6	7.4	10.3
Sunnybrook Health Science Centre (SHSC)	0.5	1.6	4.3	0.5	1.0	3.7	6.3	7.3	9.1
Trillium Health Centre (THC)	0.0	0.0	1.6	0.0	0.0	2.2	5.1	6.2	7.2
University Health Network (UHN)	0.0	0.6	1.05*	0.4	0.7	1.4	5.8	6.6	7.5
University of Ottawa Heart Institute (OHI)	0.4	0.8	4.8	0.6	0.5	3.7	6.3	7.5	9.9
Overall	0.2	0.6	2.5	0.3	0.7	2.6	5.9	6.8	8.3

*Significantly lower than provincial risk-stratified average in 2005 (p < 0.05).

Table 11(b) Risk-stratified surgical outcomes for isolated CABG patients by hospital, 2006/07

Hospital	In-Hospital Mortality (%)			30-Day Mortality (%)			Mean Postoperative LOS (Days)		
	Low Risk	Medium Risk	High Risk	Low Risk	Medium Risk	High Risk	Low Risk	Medium Risk	High Risk
Hamilton Health Sciences Corp (HHSC)	0.4	0.7	4.3	0.7	0.3	4.0	6.0	6.9	8.9
Sudbury Regional Hospital (SRH)	1.1	0.0	0.0	1.1	0.0	0.0	6.5	7.3	7.9
Kingston General Hospital (KGH)	0.0	0.7	5.3	0.8	0.0	5.3	5.3	5.5	7.1
London Health Sciences Centre (LHSC)	0.0	1.5	1.5	0.0	1.1	1.1	6.1	6.9	8.8
Southlake Regional Health Centre (SRHC)	0.0	0.6	2.3	0.0	0.6	2.3	5.5	6.1	7.4
St. Mary's General Hospital (SGH)	0.0	0.5	1.2	0.0	1.1	1.2	5.8	6.7	8.2
St. Michael's Hospital (SMH)	0.5	0.5	4.1	0.5	0.5	3.1	7.8	8.7	11.5
Sunnybrook Health Science Centre (SHSC)	0.0	0.0	2.7	0.0	0.0	2.7	7.1	7.6	10.2
Trillium Health Centre (THC)	0.0	0.9	1.3	0.0	1.3	1.3	5.3	6.3	7.8
University Health Network (UHN)	0.9	0.7	1.6	0.9	1.1	1.7	6.1	6.8	8.7
University of Ottawa Heart Institute (OHI)	0.0	0.5	2.7	0.0	0.0	1.9	6.3	7.7	9.9
Overall	0.2	0.7	2.6	0.3	0.6	2.3	6.1	6.9	8.8

Table 12(a) Crude and risk-adjusted mean ICU length of stay (LOS), 2005/06*

Hospital	Observed LOS	Expected LOS	Adjusted LOS	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	2.1	1.9	2.1	2.03	2.10	High
Sudbury Regional Hospital (SRH)	3.7	1.8	3.8	3.70	3.81	High
Kingston General Hospital (KGH)	1.6	1.9	1.6	1.52	1.61	Low
London Health Sciences Centre (LHSC)	1.9	1.9	1.8	1.81	1.87	Low
Southlake Regional Health Centre (SRHC)	1.4	1.9	1.4	1.36	1.42	Low
St. Mary's General Hospital (SGH)	1.6	1.9	1.6	1.57	1.65	Low
St. Michael's Hospital (SMH)	1.7	1.9	1.7	1.70	1.76	Low
Sunnybrook Health Science Centre (SHSC)	2.1	1.9	2.0	1.99	2.06	High
Trillium Health Centre (THC)	1.7	2.0	1.5	1.48	1.56	Low
University Health Network (UHN)	1.8	2.0	1.7	1.64	1.71	Low
University of Ottawa Heart Institute (OHI)	2.0	1.9	1.9	1.90	1.97	High
Overall	1.9					

*Adjusted rate is based on the poisson regression model defined in Appendix A, Table 1c.

Table 12(b) Crude and risk-adjusted mean ICU length of stay (LOS), 2006/07*

Hospital	Observed LOS	Expected LOS	Adjusted LOS	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	2.0	1.9	2.1	2.05	2.11	High
Sudbury Regional Hospital (SRH)	3.6	1.9	3.8	3.78	3.90	High
Kingston General Hospital (KGH)	2.0	2.0	2.0	1.96	2.06	
London Health Sciences Centre (LHSC)	1.8	1.9	1.9	1.88	1.94	Low
Southlake Regional Health Centre (SRHC)	1.7	1.9	1.7	1.69	1.76	Low
St. Mary's General Hospital (SGH)	2.1	1.9	2.1	2.07	2.17	High
St. Michael's Hospital (SMH)	2.1	1.9	2.2	2.20	2.27	High
Sunnybrook Health Science Centre (SHSC)	2.2	1.9	2.3	2.22	2.30	High
Trillium Health Centre (THC)	1.7	2.0	1.7	1.66	1.74	Low
University Health Network (UHN)	1.9	2.0	1.9	1.86	1.93	Low
University of Ottawa Heart Institute (OHI)	2.0	2.0	2.0	1.96	2.04	
Overall	2.0					

*Adjusted rate is based on the poisson regression model defined in Appendix A, Table 1c.

Table 13(a) Crude and risk-adjusted rates for blood transfusion – red blood cells, 2005/06

Hospital	No. of Patients Transfused	No. of Patients/ Hospital	Observed Rate	Expected Rate	Adjusted Rate*	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	532	879	60.5	47.4	57.0	54.1	59.8	High
Sudbury Regional Hospital (SRH)	97	275	35.3	41.7	37.7	31.9	43.4	Low
Kingston General Hospital (KGH)	187	416	45.0	44.9	44.6	40.2	49.0	
London Health Sciences Centre (LHSC)	314	895	35.1	44.4	35.3	32.3	38.3	Low
Southlake Regional Health Centre (SRHC)	236	695	34.0	44.4	34.1	30.6	37.5	Low
St. Mary's General Hospital (SGH)	91	421	21.6	44.6	21.6	17.2	26.0	Low
St. Michael's Hospital (SMH)	390	743	52.5	42.6	54.9	51.5	58.4	High
Sunnybrook Health Science Centre (SHSC)	338	604	56.0	44.7	55.9	52.2	59.5	High
Trillium Health Centre (THC)	209	769	27.2	46.3	26.2	23.1	29.3	Low
University Health Network (UHN)	446	883	50.5	46.5	48.4	45.5	51.3	High
University of Ottawa Heart Institute (OHI)	404	697	58.0	43.6	59.3	55.8	62.7	High
Overall		7277	44.6					

*Adjusted rate is based on the logistic regression model defined in Appendix A, Table 1a.

Table 13(b) Crude and risk-adjusted rates for blood transfusion – red blood cells, 2006/07

Hospital	No. of Patients Transfused	No. of Patients/ Hospital	Observed Rate	Expected Rate	Adjusted Rate*	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	508	931	54.6	47.7	52.3	49.4	55.1	High
Sudbury Regional Hospital (SRH)	72	271	26.6	42.4	28.6	22.7	34.5	Low
Kingston General Hospital (KGH)	188	395	47.6	46.6	46.6	42.1	51.1	
London Health Sciences Centre (LHSC)	271	816	33.2	44.2	34.3	31.1	37.6	Low
Southlake Regional Health Centre (SRHC)	229	582	39.4	45.2	39.7	35.9	43.5	Low
St. Mary's General Hospital (SGH)	87	499	17.4	44.3	18.0	13.8	22.1	Low
St. Michael's Hospital (SMH)	336	605	55.5	44.0	57.6	53.8	61.4	High
Sunnybrook Health Science Centre (SHSC)	319	491	65.0	43.5	68.1	63.8	72.4	High
Trillium Health Centre (THC)	226	730	31.0	44.7	31.6	28.2	35.0	Low
University Health Network (UHN)	450	750	60.0	46.0	59.6	56.3	62.9	High
University of Ottawa Heart Institute (OHI)	398	689	57.8	46.7	56.4	53.1	59.8	High
Overall		6759	45.6					

*Adjusted rate is based on the logistic regression model defined in Appendix A, Table 1a.

Table 14(a) Crude and risk-adjusted rates for blood transfusion – plasma or platelet, 2005/06*

Hospital	No. of Patients Transfused	No. of Patients/ Hospital	Observed Rate	Expected Rate	Adjusted Rate	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	314	879	35.7	21.8	33.1	30.6	35.6	High
Sudbury Regional Hospital (SRH)	42	275	15.3	18.9	16.3	11.4	21.2	
Kingston General Hospital (KGH)	99	416	23.8	20.0	24.0	20.2	27.8	High
London Health Sciences Centre (LHSC)	119	895	13.3	19.7	13.6	11.0	16.2	Low
Southlake Regional Health Centre (SRHC)	93	695	13.4	19.7	13.7	10.7	16.7	Low
St. Mary's General Hospital (SGH)	21	421	5.0	19.2	5.3	1.3	9.2	Low
St. Michael's Hospital (SMH)	233	743	31.4	19.3	32.7	29.8	35.7	High
Sunnybrook Health Science Centre (SHSC)	134	604	22.2	19.6	22.9	19.7	26.1	
Trillium Health Centre (THC)	92	769	12.0	21.9	11.1	8.4	13.7	Low
University Health Network (UHN)	169	883	19.1	19.9	19.5	16.8	22.1	
University of Ottawa Heart Institute (OHI)	152	697	21.8	20.3	21.6	18.7	24.5	
Overall		7277	20.2					

*Adjusted rate is based on the logistic regression model defined in Appendix A, Table 1a.

Table 14(b) Crude and risk-adjusted rates for blood transfusion – plasma or platelet, 2006/07*

Hospital	No. of Patients Transfused	No. of Patients/ Hospital	Observed Rate	Expected Rate	Adjusted Rate	Lower 95% CI	Upper 95% CI	Hospital vs. Overall
Hamilton Health Sciences Corp (HHSC)	309	931	33.2	21.8	30.7	28.3	33.1	High
Sudbury Regional Hospital (SRH)	33	271	12.2	19.2	12.8	8.0	17.7	Low
Kingston General Hospital (KGH)	102	395	25.8	20.7	25.1	21.3	29.0	High
London Health Sciences Centre (LHSC)	82	816	10.1	19.3	10.5	7.7	13.3	Low
Southlake Regional Health Centre (SRHC)	82	582	14.1	20.5	13.9	10.7	17.0	Low
St. Mary's General Hospital (SGH)	33	499	6.6	19.9	6.7	3.2	10.2	Low
St. Michael's Hospital (SMH)	175	605	28.9	19.0	30.7	27.4	33.9	High
Sunnybrook Health Science Centre (SHSC)	135	491	27.5	19.9	27.9	24.4	31.4	High
Trillium Health Centre (THC)	71	730	9.7	19.5	10.1	7.1	13.0	Low
University Health Network (UHN)	171	750	22.8	19.7	23.3	20.5	26.2	High
University of Ottawa Heart Institute (OHI)	168	689	24.4	21.3	23.1	20.3	25.9	High
Overall		6759	20.1					

*Adjusted rate is based on the logistic regression model defined in Appendix A, Table 1a.

Table 15. Arterial graft use for isolated CABG patients by hospital for 2005/06–2006/07*

Quality Indicator	Fiscal Year	Hamilton HHSC	Sudbury SRH	Kingston KGH	London LHSC	Southlake SRHC	St. Mary's SGH	St. Michael's SMH	Sunnybrook SHSC	Trillium THC	University UHN	Ottawa OHI
E652 Arterial Graft	2005/06	94	80	N/A	97	92	94	93	95	96	89	92
	2006/07	95	77	N/A	96	91	90	87	92	94	90	92

*Only includes patients in the OHIP database. Kingston General Hospital is excluded.

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Table 1(a) Logistic regression models for predicting the probability of in-hospital and 30-day mortality of CABG patients, 2005/06–2006/07

In-Hospital Mortality				30-Day Mortality			
Risk Factor		Odds Ratio	P-value	Risk Factor		Odds Ratio	P-value
Age	65–74	1.922	0.0021	Age	65–74	1.84	0.003
	≥75	3.085	<.0001		≥75	2.426	<.0001
Sex	Female	1.532	0.0183	Sex	Female	1.462	0.036
Previous CABG	Yes	3.448	0.0002	Previous CABG	Yes	3.418	0.0002
LVF	Grade 2	1.171	0.436	LVF	Grade 2	1.197	0.3631
	Grade 3	2.14	0.0003		Grade 3	1.76	0.01
	Grade 4	3.417	0.0004		Grade 4	3.424	0.0003
Left Main	Yes	1.41	0.0417	Left Main	Yes	1.371	0.061
CCS Class	Class 3	1.272	0.3469	CCS Class	Class 3	1.323	0.2703
	Class 4/4A	1.172	0.5304		Class 4/4A	1.275	0.3316
	Class 4B	0.904	0.7506		Class 4B	0.884	0.7024
	Class 4C	2.469	0.003		Class 4C	2.735	0.0008
	Class 4D	9.493	<.0001		Class 4D	8.024	<.0001
				CVD	Yes	1.671	0.0105
Creatinine	121–180	1.573	0.0449	Creatinine	121–180	1.523	0.0651
	>180	4.46	<.0001		>180	3.664	<.0001
Constant coefficient		-5.945	<0.0001	Constant coefficient		-5.849	<0.0001
Hosmser-Lemeshow			0.7769	Hosmser-Lemeshow			0.1009
ROC		0.76		ROC		0.75	

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Table 1(b) Poisson regression model for predicting postoperative length of stay in CABG patients, 2005/06–2006/07

Risk Factor	Coefficient	P-value	
Age	65-74	0.1363	<.0001
	≥75	0.2875	<.0001
Sex	Female	0.0894	<.0001
Previous CABG	Yes	0.0689	0.0026
LVF	Grade 2	0.0365	<.0001
	Grade 3	0.1013	<.0001
	Grade 4	0.2363	<.0001
Left Main	Yes	0.0504	<.0001
CCS Class	Class 3	0.0295	0.0011
	Class 4/4a	0.0742	<.0001
	Class 4b	0.0814	<.0001
	Class 4c	0.1062	<.0001
	Class 4d	0.3222	<.0001
PVD	Yes	0.082	<.0001
CVD	Yes	0.0597	<.0001
COPD	Yes	0.0925	<.0001
Diabetes	Yes	0.0834	<.0001
Dialysis	Yes	0.1426	<.0001
Creatinine	121-180	0.1039	<.0001
	>180	0.1774	<.0001
Constant		1.6642	<.0001

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Table 1(c) Poisson regression model for predicting postoperative ICU length of stay in CABG patients, 2005/06–2006/07

Risk Factor	Coefficient	P-value	
Age	65-74	0.0405	0.0046
	≥75	0.2239	<.0001
Sex	Female	0.1302	<.0001
Previous CABG	Yes	0.3073	<.0001
LVF	Grade 2	0.0462	0.0012
	Grade 3	0.1169	<.0001
	Grade 4	0.3431	<.0001
Left Main	Yes	0.0571	<.0001
CCS Class	Class 3	-0.0007	0.9676
	Class 4/4a	0.0982	<.0001
	Class 4b	0.1977	<.0001
	Class 4c	0.3476	<.0001
	Class 4d	0.3608	<.0001
PVD	Yes	0.1008	<.0001
CVD	Yes	0.0849	<.0001
COPD	Yes	0.073	<.0001
Diabetes	Yes	0.0545	<.0001
Dialysis	Yes	0.1167	0.019
Creatinine	121-180	0.1139	<.0001
	>180	0.3765	<.0001
Constant		0.341	<.0001

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Table 1(d) Logistic regression models for predicting the probability of blood transfusion of CABG patients, 2005/06–2006/07

Blood Transfusion: Red Blood Cell				Blood Transfusion: Plasma or Platelet			
Risk Factor		Odds Ratio	P-value	Risk Factor		Odds Ratio	P-value
Age	65-74	1.689	<.0001	Age	65-74	1.34	<.0001
	≥75	2.701	<.0001		≥75	1.812	<.0001
Sex	Female	3.536	<.0001				
Previous CABG	Yes	1.785	<.0001	Previous CABG	Yes	2.074	<.0001
				LVF	Grade 2	0.931	0.1571
					Grade 3	1.013	0.8413
					Grade 4	1.366	0.024
Left Main	Yes	1.232	<.0001	Left Main	Yes	1.309	<.0001
CCS Class	Class 3	0.976	0.6345	CCS Class	Class 3	1.019	0.758
	Class 4/4A	1.39	<.0001		Class 4/4A	1.388	<.0001
	Class 4B	1.567	<.0001		Class 4B	1.208	0.0102
	Class 4C	1.634	<.0001		Class 4C	1.787	<.0001
	Class 4D	4.98	<.0001		Class 4D	6.487	<.0001
PVD	Yes	1.261	<.0001	PVD	Yes	1.177	0.0057
CVD	Yes	1.304	<.0001				
COPD	Yes	1.114	0.0639				
Diabetes	Yes	1.21	<.0001	Diabetes	Yes	0.858	0.0006
Dialysis	Yes	2.31	<.0001	Dialysis	Yes	2.204	<.0001
Creatinine	121-180	1.631	<.0001				
	>180	3.237	<.0001				
Constant coefficient		-1.336	<0.0001	Constant coefficient		-1.8682	<0.0001
Hosmer-Lemeshow			0.4445	Hosmer-Lemeshow			0.8438
ROC		0.72		ROC		0.62	

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Table 2. Missing information on surgical risk factors by hospital for 2005/06–2006/07

Risk Factor	Hamilton HHSC	Sudbury SRH	Kingston KGH	London LHSC	Southlake SRHC	St. Mary's SGH	St. Michael's SMH	Sunnybrook SHSC	Trillium THC	University UHN	Ottawa OHI	Total
2005/06												
Age	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.17	0.00	0.00	0.00	0.03
Sex	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
URS	0.57	9.45	0.00	0.00	1.58	1.90	0.81	2.98	1.17	1.59	1.58	1.48
Prev CABG	0.00	0.36	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.03
LV	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.05
Anatomy	0.57	1.09	0.00	0.00	1.58	0.00	0.27	2.65	1.04	1.59	1.58	0.96
CCS	0.00	0.00	0.00	0.00	0.00	9.03	0.13	0.00	0.00	0.00	0.00	0.54
Creatinine	0.00	0.00	0.24	0.00	0.29	0.00	1.48	0.17	0.00	0.23	1.15	0.34
CHF	0.00	0.00	0.00	0.00	0.14	0.00	1.88	0.00	0.00	0.00	0.00	0.21
COPD	0.00	0.00	0.00	0.00	0.00	0.00	3.50	0.00	0.00	0.00	0.00	0.36
CVD	0.00	0.00	0.00	0.00	0.00	0.00	2.15	0.00	0.00	0.00	0.00	0.22
PVD	0.00	0.00	0.00	0.00	0.14	0.00	2.15	0.00	0.00	0.00	0.00	0.23
Diabetes	0.00	0.00	0.00	0.00	0.00	0.00	2.15	0.00	0.00	0.00	0.00	0.22
Dialysis	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.07
2006/07												
Age	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Sex	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
URS	0.00	1.85	0.51	0.00	1.03	2.40	1.16	1.02	0.68	0.40	0.15	0.68
Prev CABG	0.00	0.37	0.00	0.74	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.16
LV	0.00	1.48	0.00	0.00	0.00	0.60	0.33	0.00	0.00	0.00	0.00	0.13
Anatomy	0.00	0.37	0.25	0.00	1.03	0.40	0.66	1.02	0.68	0.40	0.00	0.40
CCS	0.00	0.00	0.00	0.00	0.00	10.02	0.17	0.00	0.00	0.00	0.00	0.75
Creatinine	0.00	0.00	0.00	0.25	0.00	0.20	0.33	0.20	0.00	0.27	9.72	1.11
CHF	0.00	0.00	0.00	0.12	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.09
COPD	0.00	0.00	0.00	0.00	0.00	0.00	1.49	0.00	0.00	0.00	0.00	0.13
CVD	0.00	0.00	0.00	0.25	0.34	0.00	0.83	0.00	0.00	0.00	0.00	0.13
PVD	0.00	0.00	0.00	0.00	0.34	0.20	1.16	0.00	0.00	0.00	0.00	0.15
Diabetes	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Dialysis	0.00	0.37	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.15	0.04