

Risk-Adjusted 30-Day Readmission Rates for
Coronary Artery Bypass Graft

CABG 2011

Introduction

For over twenty years, the NYS Cardiac Data Reporting System has been a powerful resource for quality improvement in the areas of cardiac surgery and percutaneous coronary interventions (PCI). Building on this strong foundation, we are pleased to now present for the first time risk-adjusted 30-day readmission rates for coronary artery bypass graft surgery (CABG) patients.

Annual reports on CABG outcomes in NYS, publicly released for many years, have provided valuable information to patients and health care providers concerning mortality outcomes after CABG. This new report serves as a complement to the existing mortality reports. Readmissions data are regarded as an important measure of hospital quality and resource utilization, and are currently being reported by the federal Center for Medicare and Medicaid Services for a few medical conditions for Medicare patients. The data provided here serve as an additional factor that patients and referring providers may consider when developing treatment plans. Patients are encouraged to discuss this information with their health care provider.

This report was developed with clinical guidance from the NYS Cardiac Advisory Committee, an advisory body to the Commissioner of Health consisting of nationally recognized cardiac surgeons, cardiologists and others from related disciplines working both in New York State and elsewhere. The Cardiac Advisory Committee is to be commended for sustained leadership in these efforts.

The data that serve as the basis for these reports is collected by the NYS Department of Health cooperatively with hospitals throughout the state. Careful auditing and rigorous analysis assure that the results contained in these reports represent meaningful outcome assessments. Hospitals and physicians in NYS can take pride in the excellent patient care provided and in their role in contributing to this unique, collaborative, quality improvement system.

Patient Population

This report is based on data for patients discharged between December 1, 2010, and November 30, 2011, provided by all 40 non-federal hospitals in NYS where CABG was performed. CABG surgery is an operation in which a vein or artery from another part of the body is used to create an alternate path for blood to flow to the heart muscle, bypassing the arterial blockage. Isolated CABG means CABG was performed with no other major heart surgery at the same time.

In total there were 8674 Isolated CABG procedures performed during this time period. As more fully described in the mortality report, 47 cases were excluded from all analyses for reasons including pre-procedural risk of shock and out-of-country residence. This left 8627 cases for to be considered for analysis of readmission. For various reasons, some additional cases are excluded from analysis in this report. The reasons for exclusion and number of cases affected are described below.

Records belonging to patients residing outside NYS were excluded because there is no reliable way to track out-of-state readmissions. This accounted for 309 cases. Another 75 patients were excluded because they died in the same admission as their index CABG, so readmission was impossible.

In one case, a patient was readmitted for subsequent CABG within 30 days of the index CABG and therefore, the second admission was considered only as 30-day readmission and was excluded from index CABG count.

In total, the number of exclusions was 432, leaving 8242 cases to be examined for 30-day readmission.

Data Collection, Data Validation and Identifying 30-Day Readmission Rates

As more fully described in the mortality report, approximately 40 risk factors relating to patients' demographic and clinical characteristics are collected by hospitals' cardiac surgery departments. Along with information about the hospital, physician and the patient's status at discharge, these data are entered into the Cardiac Surgery Reporting System (CSRS) database and sent to the Department of Health for analysis. Data are verified through review of unusual reporting frequencies, cross-matching of CSRS data with other Department of Health databases and a review of medical records for a sample of cases.

Data on readmission are obtained from the Department of Health's acute care hospital dataset, the Statewide Planning and Research Cooperative System (SPARCS), which contains data pertaining to all acute care hospital discharges in the state.

Thirty-day readmission is defined as admission to a NYS non-Federal hospital within 30 days of discharge from the index hospitalization. For patients whose index hospitalization ends in transfer to another acute care facility, the 30 day period begins upon discharge from the second hospital.

Assessing Patient Risk and Predicting 30-Day Readmission Rates for Providers

Patient risk of 30-day readmission is assessed using the same methods used for assessing mortality risk. All potential risk factors are considered and those that are independently related to readmission are identified and given weights so as to best predict the risk of 30-day readmission for each patient. These probabilities are used to calculate the expected readmission rate (ERR) for each hospital by adding the predicted probabilities of readmission for each of the provider's patients and dividing by the number of patients. The resulting rate is an estimate of what the provider's readmission rate would have been if the hospital's performance was identical to the state performance. Each hospital's ERR is then contrasted with its observed readmission rate (ORR), which is the number of CABG patients who were readmitted within 30 days divided by the total number of CABG records analyzed.

To calculate the risk-adjusted readmission rate (RARR), the ORR for each provider is first divided by the provider's ERR, and this ratio is then multiplied by the overall statewide readmission rate (14.96 percent in 2011). The RARR represents the best estimate, based on the associated statistical model, of what the provider's 30-day readmission rate would have been if the provider had a mix of patients identical to the statewide mix. Thus, the RARR has, to the extent possible, ironed out differences among providers in patient severity of illness, since it arrives at a readmission rate for each provider based on an identical group of patients.

Interpreting the Risk-Adjusted Readmission Rate

This analysis is based on all-cause readmission not just readmission directly related to the CABG procedure. Not all readmissions represent a poor patient outcome or reflect poor patient care. However, by risk-adjusting and comparing the results across the many hospitals that perform this procedure we are able to look for meaningful differences from the overall statewide experience.

If the RARR is significantly lower than the statewide readmission rate, the hospital has a better performance than the state as a whole; if the RARR is significantly higher than the statewide readmission rate, the hospital has a worse performance than the state as a whole.

The RARR is used in this report as a measure of quality of care provided by hospitals. However, there are reasons that a provider's RARR may not be indicative of its true quality, just as risk-adjusted mortality rates (RAMRs) may not be indicative of true quality. For example, extreme outcome rates may occur due to chance alone. This is particularly true for low-volume providers, for whom very high or very low rates are more likely to occur than for high-volume providers. To prevent

misinterpretation of differences caused by chance variation, expected ranges (confidence intervals) are included in the reported results. Differences in hospital coding of risk factors could be an additional reason that a hospital's RARR may not be reflective of quality of care. The Department of Health monitors the quality of coded data by reviewing patients' medical records to ascertain the presence of key risk factors. When significant coding problems are discovered, hospitals are required to correct these data and are subject to subsequent monitoring.

How This Initiative Contributes to Quality Improvement

One goal of the Department of Health and the Cardiac Advisory Committee is to improve the quality of care in relation to cardiac surgery and angioplasty in NYS. Providing the hospitals, cardiac surgeons (who perform cardiac surgery) and cardiologists (who perform PCI) in NYS with data about their own outcomes for these procedures allows them to examine the quality of their own care and to identify opportunities to improve that care.

The data collected and analyzed in this program are reviewed by the Cardiac Advisory Committee, which assists with interpretation and advises the Department of Health regarding which hospitals and physicians may need special attention. Committee members have also conducted site visits to particular hospitals and have recommended that some hospitals obtain the expertise of outside consultants to design improvements for their programs.

2011 Hospital Risk-Adjusted Readmission for CABG

Table 1 presents the 30-day readmission results for the 40 hospitals performing CABG in NYS in 2011 for which data could be analyzed. The table contains, for each hospital, the number of CABGs resulting in 2011 discharges, the number of in-hospital/30-day readmissions, the ORR, the ERR based on the statistical model presented in Appendix 1, the RARR and a 95 percent confidence interval for the RARR.

The overall in-hospital/30-day ORR for the 8242 CABGs included in this 2011 analysis was 14.96 percent. Observed readmission rates ranged from 8.82 percent to 24.68 percent. The range in ERRs, which measure patient severity of illness, was between 12.88 percent and 18.01 percent. The RARRs, which measure hospital performance, range from 9.52 percent to 24.06 percent. Based on confidence intervals for RARRs, three hospitals (Lenox Hill Hospital in Manhattan, University Hospital Stony Brook, and Winthrop University Hospital in Mineola) had RARRs that were significantly higher than the statewide average. Two hospitals (Maimonides Medical Center in Brooklyn and St. Peter's Hospital in Albany) had RARRs that were significantly lower than the statewide average.

Definitions of key terms are as follows:

The observed readmission rate (ORR) is the observed number of 30-day readmissions divided by the total number of analyzed cases.

The expected readmission rate (ERR) is the sum of the predicted probabilities of readmission for all patients divided by the total number of analyzed cases.

The risk-adjusted readmission rate (RARR) is the best estimate, based on the statistical model, of what the provider's readmission rate would have been if the provider had a mix of patients similar to the statewide mix. It is obtained by first dividing the ORR by the ERR, and then multiplying that quotient by the statewide readmission rate (14.96 percent 30-day readmission rate for all CABG patients discharged in 2011).

Confidence intervals indicate which hospitals had significantly more or fewer readmissions than expected given the risk factors of their patients. Hospitals with significantly higher rates than expected after adjusting for risk are those with confidence intervals entirely above the statewide rate. Hospitals with significantly lower rates than expected, given the severity of illness of their patients before the CABG, have confidence intervals entirely below the statewide rate.

Table 1

Hospital Observed, Expected, and Risk-Adjusted 30-Day Readmission Rates (RARR) for Coronary Artery Bypass Graft Surgery in New York State, 2011 Discharges

Hospital	Cases	Readmissions	ORR	ERR	RARR	95% CI for RARR
Albany Medical Center	220	24	10.91	14.84	11.00	(7.04, 16.36)
Arnot Ogden Med Ctr	68	6	8.82	13.75	9.60	(3.50, 20.89)
Bellevue Hospital Ctr	92	17	18.48	13.52	20.45	(11.9, 32.75)
Beth Israel Med Ctr	159	23	14.47	13.28	16.30	(10.3, 24.46)
Buffalo General Hosp	283	39	13.78	15.50	13.30	(9.46, 1 8.18)
Champ.Valley Phys Hosp	79	8	10.13	13.40	11.31	(4.87, 22.28)
Ellis Hospital	179	16	8.94	14.05	9.52	(5.44, 15.46)
Erie County Med Ctr	80	12	15.00	13.71	16.37	(8.45, 28.60)
Good Sam - Suffern	111	19	17.12	14.49	17.68	(10.6, 27.61)
Lenox Hill Hospital	249	56	22.49	15.68	21.46 *	(16.2, 27.86)
Long Island Jewish MC	128	21	16.41	15.91	15.43	(9.55, 23.58)
M I Bassett Hospital	61	7	11.48	14.54	11.81	(4.73, 24.34)
Maimonides Medical Ctr	267	32	11.99	17.10	10.49 **	(7.17, 14.80)
Mercy Hospital	353	44	12.46	14.57	12.80	(9.30, 17.18)
Millard Fillmore Hosp	209	31	14.83	15.28	14.52	(9.86, 20.61)
Montefiore - Moses	176	27	15.34	14.85	15.46	(10.2, 22.49)
Montefiore - Weiler	204	39	19.12	14.40	19.86	(14.1, 27.16)
Mount Sinai Hospital	286	51	17.83	13.79	19.34	(14.4, 25.43)
NY Hospital - Queens	96	11	11.46	13.42	12.77	(6.37, 22.85)
NY Methodist Hospital	88	20	22.73	15.21	22.36	(13.7, 34.53)
NYP- Columbia Presby.	303	41	13.53	14.66	13.81	(9.91, 18.73)
NYP- Weill Cornell	159	21	13.21	14.53	13.60	(8.41, 20.79)
NYU Hospitals Center	114	16	14.04	12.88	16.31	(9.31, 26.48)
North Shore Univ Hosp	353	60	17.00	15.03	16.92	(12.9, 21.78)
Rochester General Hosp	309	40	12.94	14.83	13.06	(9.33, 17.78)
Southside Hospital	110	21	19.09	16.20	17.63	(10.9, 26.95)
St. Elizabeth Med Ctr	206	28	13.59	15.65	12.99	(8.63, 18.77)
St. Francis Hospital	701	92	13.12	15.13	12.98	(10.5, 15.92)
St. Josephs Hospital	389	51	13.11	16.56	11.85	(8.82, 15.58)
St. Lukes at St. Lukes	94	12	12.77	15.16	12.60	(6.50, 22.01)
St. Peters Hospital	268	28	10.45	15.18	10.29 **	(6.84, 14.88)
Staten Island Univ Hosp	280	39	13.93	13.55	15.38	(10.9, 21.03)
Strong Memorial Hosp	243	41	16.87	14.47	17.45	(12.5, 23.67)
UHS - Wilson Med Ctr	151	24	15.89	15.28	15.56	(9.97, 23.15)
Univ. Hosp-Brooklyn	63	15	23.81	18.01	19.78	(11.1, 32.63)
Univ. Hosp-Stony Brook	231	57	24.68	15.34	24.06 *	(18.2, 31.17)
Univ. Hosp-Upstate	153	24	15.69	16.35	14.36	(9.20, 21.36)
Vassar Bros. Med Ctr	201	20	9.95	13.72	10.85	(6.62, 16.76)
Westchester Med Ctr	245	36	14.69	15.93	13.80	(9.66, 19.10)
Winthrop Univ. Hosp	281	64	22.78	14.66	23.23*	(17.9, 29.67)
Total	8242	1233	14.96			

* Risk-adjusted readmission rate significantly higher than statewide rate based on 95 percent confidence interval.

** Risk-adjusted readmission rate significantly lower than statewide rate based on 95 percent confidence interval.

2011 Risk Factors For CABG 30-Day Readmission

The significant pre-procedural risk factors for 30-day readmissions following CABG in 2011 are presented in the table that follows.

For risk factors that are binary (that is, there are two possibilities – the patient either has the condition or does not have the condition), the odds ratio for the risk factor represents the number of times more likely to be readmitted a patient with that risk factor is than a patient without the risk factor, all other risk factors being the same. For example, the odds ratio for the risk factor “Peripheral Vascular Disease” is 1.546. This means that a patient with peripheral vascular disease is approximately 1.546 times more likely to be readmitted to a hospital within 30 days following discharge after CABG than a patient without peripheral vascular disease who has the same other significant risk factors. The risk factors Female Gender, COPD, and Diabetes are also interpreted in this way.

For age, the odds ratio roughly represents the number of times more likely to be readmitted a patient who is older than 60 is compared to a patient who is one year younger but otherwise has the same significant risk factors. Thus, the chance of 30-day readmission for a patient undergoing CABG who is 61 years old is approximately 1.021 times that of a patient 60 years old undergoing CABG, if all other risk factors are the same. All patients age 60 and younger have roughly the same odds of being readmitted within 30-days if their other risk factors are identical.

Body surface area (BSA) is a function of height and weight and increases for larger heights and weights. This model includes terms for both BSA and BSA-squared, reflecting the complex relationship between BSA and 30-day readmission rate. The quadratic function of BSA (BSA-squared) used in the statistical model reflects the fact that patients with very high and very low BSAs tend to have higher risks of readmissions than patients with intermediate levels of BSA. This functional form is used to improve the model’s ability to predict readmissions, but it means that the odds ratios for these terms do not have a straightforward interpretation.

Ejection Fraction, which is the percentage of blood in the heart’s left ventricle that is expelled when it contracts (with more denoting a healthier heart), is subdivided into four ranges (less than 20 percent, 20 to 29 percent, 30 to 39 percent and 40 percent or more). The last range is referred to as the reference category. This means that the odds ratio that appears for the other Ejection Fraction categories in the table is relative to patients with an ejection fraction of 40 percent or more. Thus, a CABG patient with an ejection fraction of less than 20 percent is about 1.663 times as likely to be readmitted to a hospital within 30 days as a patient with an ejection fraction of 40 percent or higher, all other significant risk factors being the same.

Renal Failure is subdivided into four groups. Two categories represent patients with various levels of elevated creatinine but no dialysis. One category includes patients with renal failure on dialysis. These groups are relative to patients who are not on dialysis and had no pre-CABG creatinine values greater than 1.3 mg/dL.

Appendix Table 1
Multivariable Risk Factor Equation for CABG 30-day Readmission in New York State, 2011

Patient Risk Factor	Prevalence (%)	Logistic Regression		
		Coefficient	P-Value	Odds Ratio
Demographic				
Age: Number of years greater than 60	—	0.0207	<.0001	1.021
Female Gender	25.43	0.4367	<.0001	1.548
Body Surface Area (0.1 m ²)	—	-0.2561	0.0272	—
Body Surface Area – squared (0.01 m ⁴)	—	0.0069	0.0116	—
Ventricular Function				
Ejection Fraction 40% or greater	82.50	— Reference —	—	1.000
Ejection Fraction < 20%	1.37	0.5084	0.0294	1.663
Ejection Fraction 20 – 29%	5.63	0.3489	0.0052	1.417
Ejection Fraction 30 – 39%	10.50	0.2522	0.0090	1.287
Comorbidities				
COPD	25.75	0.1917	0.0057	1.211
Peripheral Vascular Disease	11.20	0.4356	<.0001	1.546
Diabetes	38.34	0.2617	<.0001	1.299
Renal Failure				
No Renal Failure	74.84	— Reference —	—	1.000
Renal Failure, Creatinine 1.3 – 1.5 mg/dl	12.82	0.2589	0.0048	1.296
Renal Failure, Creatinine ≥1.6 mg/dl	9.73	0.4180	<.0001	1.519
Renal Failure, Requiring Dialysis	2.61	0.7926	<.0001	2.209

Intercept = -0.1272

C Statistic = 0.633