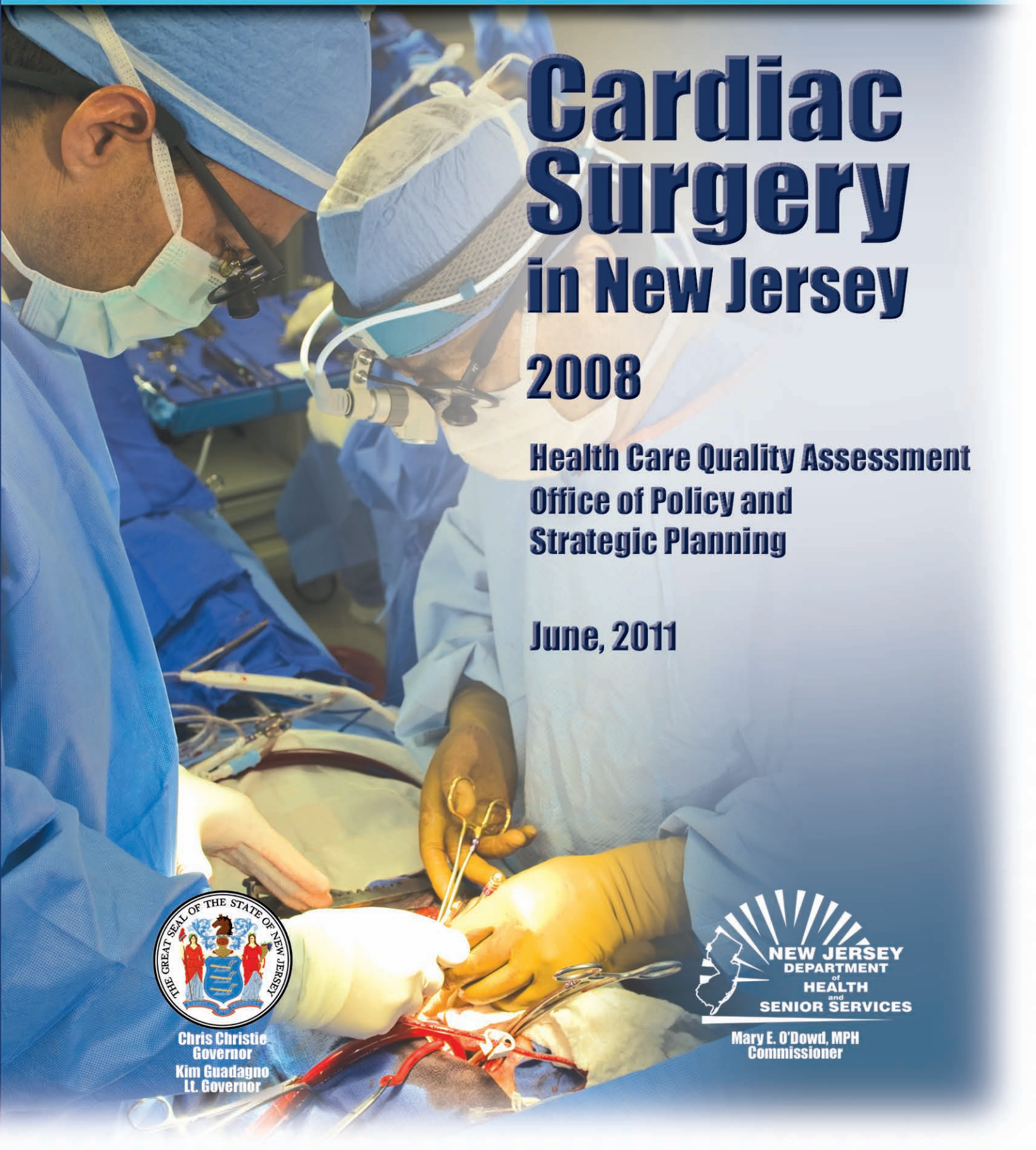
HCQA Health Care Quality Assessment



Cardiac Surgery in New Jersey 2008

Health Care Quality Assessment
Office of Policy and Strategic Planning

June, 2011

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NEW JERSEY DEPARTMENT of HEALTH and SENIOR SERVICES

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Table of Contents

Executive Summary . . . iii
Introduction . . . 1
Cardiovascular Health Advisory Panel . . . 2
Heart Disease and Cardiac Surgery in New Jersey . . . 2
Treatment Options . . . 2
Definition of Operative Mortality . . . 2
Performance Data . . . 3
Risk-Adjusted Mortality . . . 3
Performance Reports Lead to Improvement . . . 4
Hospitals . . . 4
Surgeons . . . 4
Volume Affects Quality . . . 4
Isolated CABG Surgery Volume at New Jersey Hospitals in 2008 . . . 4
Hospital Risk-Adjusted Mortality . . . 5
Statewide CABG Surgery Related Infections . . . 8
Length of Stay by Hospital . . . 9
Individual Surgeon Performance . . . 10
Statewide Trends in Risk-Adjusted CABG Surgery Mortality Rates: Pooled Estimates . . . 18

Figure 1: Number of Isolated Coronary Artery Bypass Graft Surgeries vs. Other Cardiac Surgeries (2008) . . . 6
Figure 2: Risk-Adjusted Operative Mortality Rate by Hospital (2008) . . . 7
Figure 3: Risk-Adjusted Operative Mortality and Length of Stay by Hospital, 2008 . . . 9
Figure 4: Surgeon Risk-Adjusted Operative Mortality Rate (2007-2008) . . . 11
Figure 5: Trends in Statewide CABG Surgery Mortality Rates . . . 18

Table 1: Statewide In-hospital Infection Rate and Operative Mortality Rate by Infection Type, 2008 . . . 8
Table 2: Risk-Adjusted Mortality Rate and Post-Surgery Length of Stay by Surgeon (2007-2008) . . . 15

Appendix A: Questions and Answers . . . 19
Appendix B: New Jersey's Cardiovascular Health Advisory Panel Members and NJDHSS Cardiac Surgery Report Team . . . 20
Appendix C: Statewide Observed In-hospital and Operative Mortality Rates . . . 21
Appendix D: Summary of Methods Used in this Report . . . 22

References . . . 31

Executive Summary

The Department of Health and Senior Services (Department) collected data on 8,329 patients undergoing open heart surgery at 18 hospitals in 2008. Of these patients, 4,620 had coronary artery bypass graft (CABG) surgery with no other major surgery during the same admission, i.e., isolated CABG.

One important goal of this report is to provide New Jersey hospitals and surgeons with data they can use in assessing quality of care related to bypass surgery. More importantly, this report presents patients and families of patients with important information they can use in discussing questions and issues related to bypass surgery with their physicians.

After subjecting the CABG surgery data to extensive error checks and consulting with the clinical panel of the Cardiovascular Health Advisory Panel (CHAP), the Department analyzed the isolated CABG surgery data using a statistical method to assess hospital and surgeon performance. The statistical analysis took into account the patient's health status before surgery as well as demographic factors. This process is commonly known as "risk-adjustment" and allows for fair comparisons among hospitals and surgeons treating diverse patient populations. Some key findings of the 2008 data analysis are as follows:

- In 2008, only 55.5% (4,620) of the 8,329 total open heart surgeries performed in New Jersey were isolated CABG surgeries.
- Of the 4,620 isolated CABG surgery patients, 68 died while in the hospital or within 30 days after surgery.
- The statewide observed operative mortality rate for isolated CABG surgery patients in 2008 was 1.47 percent. When comparing 2007 and 2008 on a risk-adjusted basis, mortality rate declined 26.0 percent. However, the decline was not statistically significant.
- A review of 15 years of pooled data suggests that the risk-adjusted CABG mortality rate in New Jersey has declined 68.0 percent between 1994 and 2008.
- In 2008, no hospital had statistically significantly different risk-adjusted mortality rate than the statewide rate. Although their rates were not statistically significantly different from the statewide rate, it is nevertheless notable that St. Mary's Hospital (Passaic) and UMDNJ University Hospital had no CABG surgery deaths during 2008.
- In the period 2007-2008, no individual surgeon had a statistically significantly higher or lower risk-adjusted mortality rate than the statewide rate. However, as a group surgeons who performed less than 100 isolated CABG surgeries from Cooper Hospital/University Medical Center and St. Mary's Hospital (Passaic) had statistically significantly higher risk-adjusted mortality rates than the statewide rate. Although their rates were not statistically significantly different from the statewide rate, it is nevertheless notable that a few surgeons, including some who performed less than 100 isolated CABG surgeries, had no CABG surgery deaths during this two-year period. Among surgeons who performed 100 or more isolated CABG surgeries in the period 2007-2008, Dr. James Klein of Englewood Hospital and Medical Center, Dr. Richard Neibart from Jersey Shore Medical Center, Dr. Eric Somberg from Hackensack University Medical Center and Dr. Nilesh Patel from St. Michael's Medical Center had no CABG surgery deaths.
- Key factors that are associated with a patient's chance of surviving the operation include*:
  - patient's age;
  - whether the patient has various preoperative risk factors, such as

cerebrovascular accident, carotid test with more than 75% occlusion, lung disease, renal failure;
- whether the patient has preoperative cardiac status such as ejection fraction less than 30%, myocardial infarction within 21 days of the surgery or resuscitation;
- whether the patient had previous open heart surgery.

- The average length of hospital stay for a typical CABG surgery patient in 2008 was 7.05 days compared with 6.97 days in 2007.

- The risk-adjusted length of stay by hospital ranged from 5.06 days in St. Michael's Medical Center to 7.02 days in Jersey City Medical Center and Newark Beth Israel Medical Center.

- There were also important differences in length of stay by surgeon. Risk-adjusted average length of stay by individual eligible surgeon in the period 2007-2008 ranged from 4.50 days to 7.57 days.

- In 2008, 5.84 percent of patients had some type of infection, including pneumonia, following isolated CABG surgery. The overall infection rate declined more than 26.0 percent from 7.91 percent in 2007 to 5.84 percent in 2008 (not risk-adjusted).

- As expected, isolated CABG patients who develop infections after surgery have a much higher mortality rate (9.63 percent vs 0.97 percent) and a longer hospital stay (16.33 days vs. 6.48 days) compared to those who have no infections.

* *More information on risk factors and methods used in this report is presented in Appendix D.*

Introduction

This report is for patients and families of patients facing the possibility of coronary artery bypass graft (CABG) surgery. It provides mortality rates for the 18 hospitals that performed cardiac surgery in 2008 and the physicians performing this common cardiac surgical procedure in 2007-2008. As part of the Department's continued effort to provide information to consumers, this report includes information on hospital length of stay and infections. The report provides risk-adjusted length of post-surgery hospital stay for CABG surgery patients by hospital and by eligible surgeon (i.e., surgeon who performed at least 100 isolated CABG operations in one hospital in the years 2007 and 2008 combined) while rates of infections are reported for the state as a whole.

For this report, the Department of Health and Senior Services collected data on 4,620 patients who had bypass surgery with no other major surgery during the same admission (simply referred to as isolated CABG in this report) in 2008. This is the most recent year for which a complete and audited data set is available. The data have been "risk-adjusted," which means that they were adjusted to take into account the patient's health conditions before surgery. This risk-adjustment allows for fair comparisons among hospitals and surgeons treating diverse patient populations.

An important goal of this analysis is to give hospitals data they can use in assessing quality of care related to bypass surgery. There is strong evidence, from other states with similar reports, that this information encourages hospitals to examine their process of care and make changes that can improve quality of care and, ultimately, save lives.

New Jersey's mortality rate for isolated CABG surgery has shown a significant decline since public reporting began with 1994 data. For 2008, the observed mortality rate of 1.47 percent is lower than the mortality rate of 2.00 for 2007, suggesting a continued downward trend (Appendix D). When data from all years are pooled and analyzed, risk-adjusted mortality rate declined 26.0 percent between 2007 and 2008. However, the decline is not statistically significant. Risk-adjusted mortality rate declined 68.0 percent between 1994 and 2008, which is statistically significant. A difference is called **"statistically significant"** when it is too large to be due to chance or random variation.

Another goal of the report is to give patients and physicians important information to use in discussing questions and issues related to bypass surgery. Please remember that volumes, mortality rates and length of stay in this report are just additional factors to consider in deciding where to have cardiac surgery. You and your physician together can make the best choice after full consideration of your medical needs. Also note that hospital data in this report are from 2008, while surgeon data refer to 2007 and 2008 combined. These data may not reflect the current performance of a specific hospital, which may have revamped its program since then. Also, some surgeons listed in the cardiac surgery centers may have already left the facility since the data were reported.

Readers who have followed the Department's CABG surgery reports for years prior to 2000 will observe that the mortality rates presented in this report may appear to be higher than previously released. This is not really the case. Instead, starting with the 2000 CABG surgery report, the Department, in consultation with the Cardiovascular Health Advisory Panel (CHAP), changed its definition of mortality to reduce the possibility that hospital discharge policies could artificially lower CABG surgery mortality rates. The definition is discussed in greater detail later in this report along with recent clarifications to CABG surgery classification.

Cardiovascular Health Advisory Panel

A Cardiovascular Health Advisory Panel (CHAP) was established by the Commissioner of Health by Executive Order (No. 187 (2001) and amended by Executive Directive 207) to provide the Commissioner with expert advice on sound cardiovascular health policy. CHAP provides advice on cardiovascular health promotion, disease prevention, standards of care, emerging technologies and their applications to cardiac services in the State, review of the State's cardiac data for quality assessment, performance evaluation and research. CHAP's membership includes clinicians in the field such as surgeons, cardiologists, nurses and professional associations and consumer representatives (See Appendix B).

Heart Disease and Cardiac Surgery in New Jersey

Heart diseases continue to be the leading causes of death of Americans with 616,067 deaths in 2007. Almost every 30 seconds, someone in the United States will suffer a heart attack, and about once every minute, someone will die from one. In New Jersey, heart diseases are the leading causes of death, accounting for 18,831 deaths in 2007 for an age-standardized death rate of 191.9 per 100,000, which is about the same as the national age-standardized rate of 190.9 per 100,000. (www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf, page 102).

The most common form of heart disease is coronary artery disease. It occurs when the coronary arteries, which carry blood to the heart muscle, become clogged or partially blocked by fatty deposits on the artery walls. This can lead to chest pain, or angina, which is a warning sign for a heart attack. A heart attack occurs when a coronary artery is totally blocked.

Treatment Options

Treatment for coronary artery disease will vary for different patients. The choice of treatment depends on the nature and severity of the disease and other factors unique to each patient.

For some patients, lifestyle changes such as quitting smoking, eating a low-fat diet, and getting more exercise may be enough. Some patients require special medications. Others may need medical procedures such as angioplasty or coronary artery bypass graft surgery. Angioplasty reduces obstructions of fatty deposits in coronary arteries and has become an increasingly common treatment method. Bypass surgery uses an artery or vein taken from another part of the body to divert blood around the clogged part of a patient's artery or arteries.

This report is about coronary artery bypass graft surgery outcomes. It describes the performance records of 18 hospitals in New Jersey that offered this type of surgery in 2008 and the surgeons who performed this operation at least 100 times between January 2007 and December 2008 in a hospital. The information in this report can help you in discussions with your doctor about bypass surgery.

Definition of Operative Mortality

Beginning with the 2000 report, the Department, after consulting with the CHAP, revised the way mortality is defined for the purposes of the Department's cardiac surgery report. Previously, the Department defined patient death for this report as in-hospital death before discharge from the hospital after isolated CABG surgery. As a result, patients who died after being discharged home or to post-acute care facilities were not counted for purposes of calculating CABG surgery mortality rates. This caused concerns about "gaming" of outcomes through discharge practices.

Therefore, beginning with the 2000 report, the Department included in its definition of "operative mortality" deaths up to 30 days post-surgery or deaths occurring during the hospital

stay in which the surgery was performed, no matter how many days after the procedure. Deaths occurring within 30 days after surgery, but post-discharge, have been identified by matching patient records in the Department's open heart data base against the state's official death records.

Further, in an attempt to continuously improve the quality of data used in assessing CABG surgery mortality, the Department, in consultation with CHAP, reviewed the way operative procedures are coded for the purpose of the cardiac surgery report in New Jersey. The Department issued an operative procedure coding guide to be followed by all hospitals starting with 2005 data. This guideline was designed to avoid differential reporting of operative procedures by hospitals.

Applying the revised definitions of mortality, the Department also recalculated the statewide CABG surgery mortality rates for the prior years, in order to analyze the trend over time. Operative mortality rate estimates by year are presented in Figure 5. Appendix D, Table D3 presents the statewide operative mortality rate estimates for the period 1994-2008.

Performance Data

In an isolated CABG surgery, no other major heart procedure is performed at the same time. The number of people who died during the hospitalization in which the operation was performed, or after discharge but within 30 days of the surgery, was 68, or 1.47 percent of 4,620 who had the surgery in 2008. This statewide operative CABG surgery mortality rate (1.47 percent) is used as the yard stick in evaluating hospital performance.

Risk-Adjusted Mortality

In evaluating the performance of hospitals and individual surgeons, it would be unfair to make comparisons only on the basis of how many patients died. The mortality risk for patients undergoing bypass surgery varies significantly with how healthy patients are prior to surgery. For instance, an 85-year-old who has renal failure and severe lung disease would be at higher risk during this surgery than a 50-year-old who has no history of chronic disease.

In order to produce fair comparisons, the Department applied a method that estimates **risk-adjusted mortality rates**. The risk-adjusted mortality rate assigns "extra credit" to hospitals and surgeons with sicker patient populations, in order not to disadvantage them in the performance comparisons.

Each hospital was required to submit data which contain a risk profile for each patient undergoing bypass surgery.

Key factors that are associated with a patient's chance of surviving the isolated CABG operation include:

- the patient's age;
- whether the patient has various preoperative risk factors, such as:
  - cerebrovascular accident;
  - carotid occlusion more than 75%;
  - lung disease;
  - renal failure;
- whether the patient has preoperative cardiac status such as:
  - ejection fraction less than 30%;
  - myocardial infarction within 21 days of the surgery;
  - whether the patient has cardiopulmonary resuscitation required within one hour before surgery;
- whether the patient had previous open heart surgery.

Weights derived from the statistical model were assigned for each key risk factor and calculations were performed for each hospital to produce **risk-adjusted mortality rates** as a fair basis of comparison (see Appendix D for more details).

Performance Reports Lead to Improvement

This performance report is for use not only by you and your doctors, but also by hospitals to improve the quality of their care and their patients' outcomes. On a risk-adjusted basis, the New Jersey statewide risk-adjusted mortality rate for isolated CABG surgery declined 26.0 percent between 2007 and 2008, which was not statistically significant. Nevertheless, it is a continuation of the overall decline of 68.0 percent in the statewide risk-adjusted CABG mortality rate since 1994. Evidence both from New Jersey and other states that have published similar performance reports (i.e. California, Massachusetts, New York and Pennsylvania) suggests that these reports contribute to the decline in mortality rates and improve the overall quality of bypass surgery.

Hospitals

This report provides risk-adjusted mortality rates for each of the 18 hospitals in New Jersey that were licensed to perform coronary artery bypass graft surgery in 2008. You will see that there are substantive variations among the hospitals. Through statistical analysis, the Department is able to determine in which cases the variations reflect real differences in performance after accounting for levels of risk among patients.

Nevertheless, these data should not be used as the sole factor in making choices about hospitals, but should be part of the discussion between you and your doctor.

Surgeons

A risk-adjusted mortality rate was also calculated for each of the 39 surgeons who performed at least 100 isolated CABG operations in one hospital in the years 2007 and 2008 combined. Even though two years of data were combined, several surgeons still fell short of the 100 cases the Department considers the minimum needed to calculate reliable risk-adjusted mortality rates. The Department recognizes that the volumes of some surgeons may be low because they had left those facilities during the year. Statistics for these low-volume surgeons are grouped under the hospital where the operations took place, in a category called **"All Others."** These surgeons are listed by name but with no risk-adjusted mortality rates, since their small numbers do not permit an accurate indication of their performance (Table 2). This report shows the total number of open heart and CABG surgeries these low volume surgeons performed, as well as their number of CABG surgery operative deaths.

Volume Affects Quality

Many studies nationally and in other states have shown that, in general, hospitals and surgeons that perform bypass surgery more frequently have lower patient mortality rates. New Jersey's data also confirm this general trend. However, there are exceptions, and a number of hospitals with low volumes have results that are in line with the statewide rate.

Isolated CABG Surgery Volume at New Jersey Hospitals in 2008

Figure 1 shows the number of isolated CABG surgery operations performed in 2008 in each of the 18 hospitals. You can see that some hospitals do more of these procedures than others, with isolated CABG surgery volume ranging from a low of 58 to a high of 582. Isolated CABG surgery is the most common type of cardiac surgery accounting for about 56 percent (55.5%) in 2008. Isolated CABG surgery volume in New Jersey has been declining starting in 2000 while angioplasty has stabilized on a higher level. Between 2000 and 2008, the number of isolated CABG surgeries in New Jersey has declined by 44 percent (43.8%).

Hospital Risk-Adjusted Mortality

Figure 2 shows the risk-adjusted mortality rate for each New Jersey hospital performing bypass surgery in 2008. The risk-adjusted mortality rate takes into account the patients' risk factors going into surgery as well as the actual mortality rate after the surgery, in order to make a fair assessment of hospital performance.

In trying to determine a hospital's or surgeon's performance, it is important to account for the fact that some differences occur simply due to chance or random variation. Statistical tests are conducted on the data so that we can be as certain as possible that the differences are due to actual differences in performance. A difference is called **"statistically significant"** when it is too large to be due to chance or random variation.

Each hospital's and each surgeon's mortality rate reflects three components: *the quality of their care, the patients' risk factors that affect mortality, and an element of random variation.* Readers of this report should be interested only in the first component, the quality of care delivered by hospitals and surgeons. We use a nationally-accepted risk-adjustment method to control for the second component, risk factors of CABG surgery patients seen by hospitals and surgeons. Because the third component, *random variation*, cannot be observed to be controlled for in the statistical model, we estimate how much higher or lower the risk-adjusted mortality rate could have been given the impact of random variation, using a confidence interval given at the 95% level.

In Figure 2, the dark line in the middle of each hospital's bar represents its estimated risk-adjusted mortality rate. When estimating rates using data, however, we cannot be sure if this number is the actual rate for the facility and not due to chance. We can only be relatively sure that the true rate falls somewhere within the bar. In analyzing data, we use what is called a "95 percent confidence interval," and the bar represents the lower and upper limits of this confidence interval. We are 95 percent confident that the hospital's actual risk-adjusted mortality rate falls within the range shown by the bar. Another way of saying it is that the bar represents the statistical margin of error for the estimation of that rate.

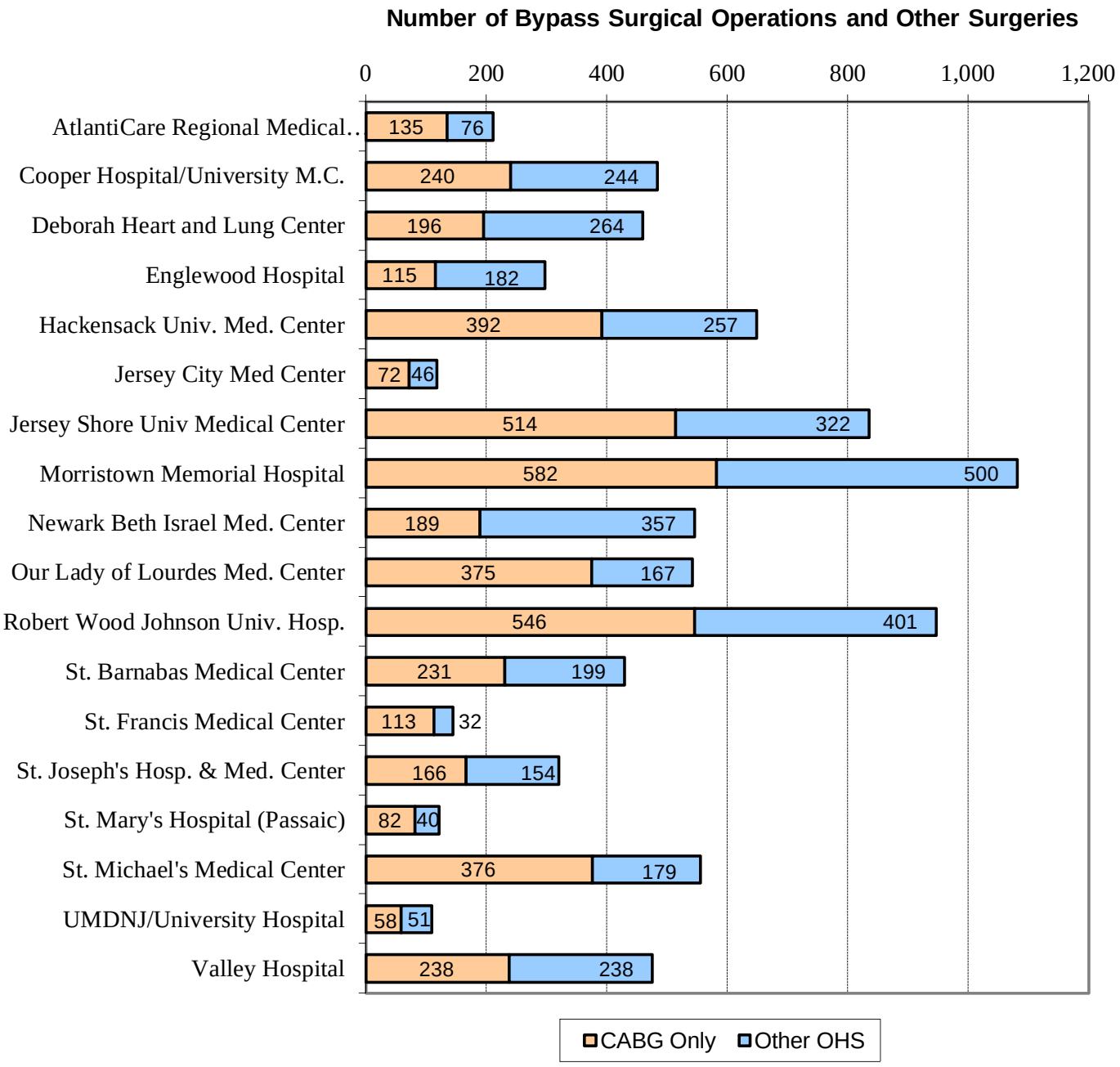
The vertical line on Figure 2 represents New Jersey's statewide isolated CABG surgery operative mortality rate per 100 cases for 2008, i.e. 1.47. Each hospital's performance is displayed graphically in relation to this statewide rate.

Figure 2 indicates that all 18 hospitals have bars that cross the statewide mortality rate line (1.47 percent). That means that their risk-adjusted mortality rates were not statistically different from the statewide rate.

When using this report, it is important to remember that the charts are designed to show whether a hospital's or surgeon's risk-adjusted mortality rate is significantly above or below the statewide rate, or whether a rate is statistically the same as the statewide rate. Thus, it is more important to view the bars in relation to the statewide mortality rate line than it is to examine the individual calculated rates on the bars. The chart should not be used to make hospital-to-hospital or surgeon-to-surgeon comparisons, only to compare hospitals and surgeons to the statewide rate.

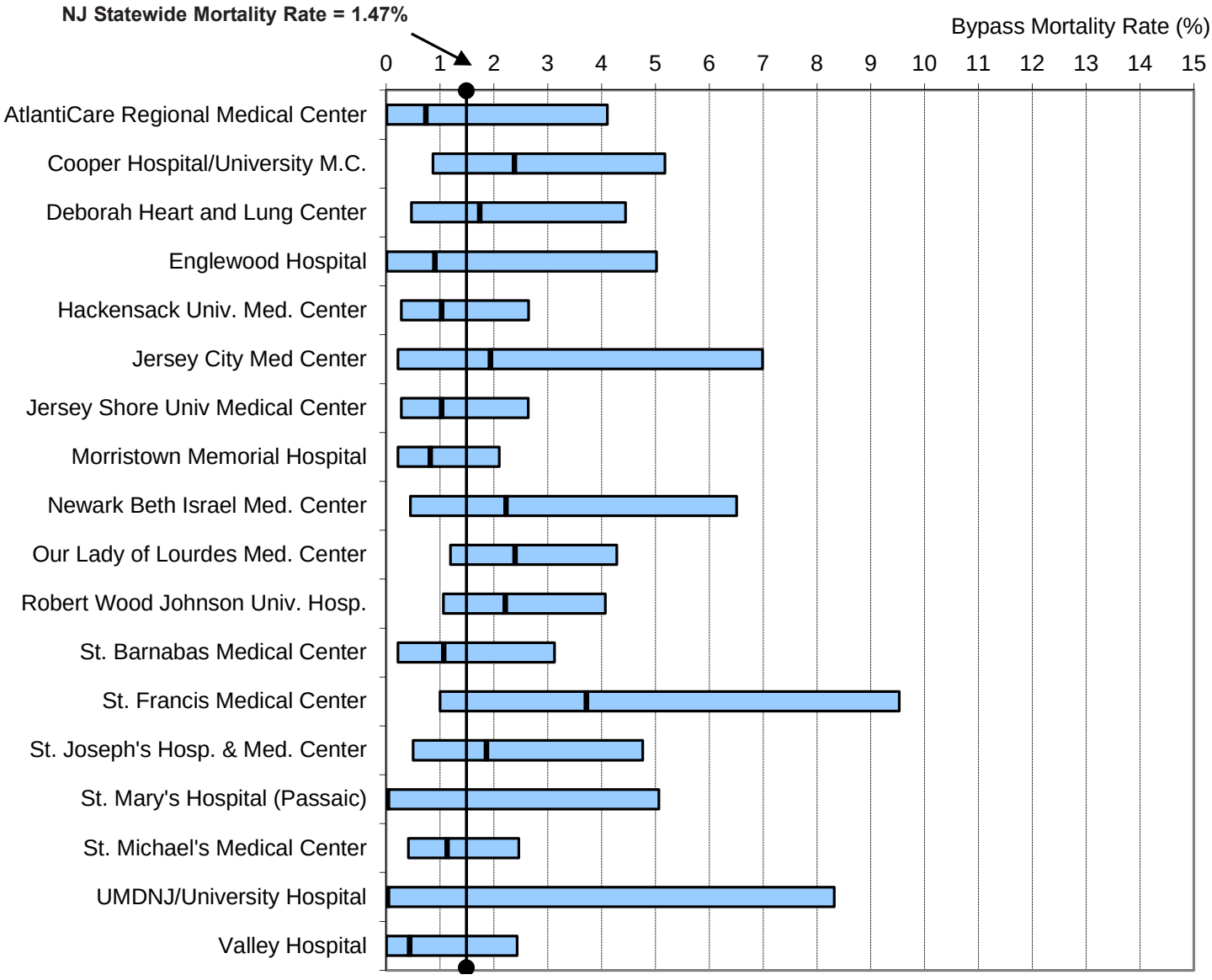
In examining the charts, you will see that some bars are shorter than others. The bar is shorter for hospitals or surgeons performing more surgeries, and longer for those with lower volumes. This reflects the fact that larger numbers -- in this case, more surgeries -- increase the precision of a statistic.

Figure 1
Number of Isolated Coronary Bypass Graft Surgeries vs. Other Open Heart Surgeries, 2008



Source: New Jersey Department of Health and Senior Services

Figure 2
Risk-Adjusted Operative Mortality Rate* by Hospital (2008)



SOURCE: New Jersey Department of Health and Senior Services

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

Statewide CABG Surgery Related Infections

The Department has included information on CABG surgery in-hospital infections as an additional tool to monitor hospital performance. The statewide infection rates are provided as one more factor to be considered by policy makers and others involved in quality of care monitoring.

Infections reported in the Open Heart Surgery database included sternal-deep infection (involving muscle, bone and/or mediastinum requiring operative intervention), thoracotomy, leg infections, septicemia (presence of bacteria in the blood stream) and urinary tract infections (UTI). The table also includes post-operative pneumonia. For comparison purposes, statewide infection rates, the corresponding mortality rates and the average length of stay are presented in Table 1 to provide perspective to the statewide rates.

Table 1 indicates that 2.25 percent of patients who underwent isolated CABG surgery had pneumonia. Slightly over three percent (3.05%) had UTI and about one and a quarter percent (1.26%) had septicemia. Statewide, almost six percent (5.84%) of isolated CABG patients had some form of infection (including pneumonia) reported.

As expected, there was a large difference in observed CABG surgery mortality between those who had infections (9.63%) and those who did not (0.97%). Also, patients who developed post-surgery infections stayed in the hospital more than two and half times as long (16.33 days) as those who had no infections (6.48 days).

Statewide, overall infection rate after isolated CABG surgery declined more than 26.0 percent from 7.91 percent in 2007 to 5.84 percent in 2008 (not risk-adjusted). In addition, the decline in infection rate occurred to every type of infection reported (see Cardiac Surgery in New Jersey 2007, www.state.nj.us/health/health-carequality/documents/cardconsumer07.pdf).

Table 1
Statewide In-hospital Infection Rate and Operative Mortality Rate by Infection Type, 2008

	Number of Cases	Infection Rate (%)	Operative Mortality*		Average Length of Stay (in Days)
			Number	Rate (%) (Observed)	
Cases with Infections	**270**	**5.84**	**26**	**9.63**	**16.33**
Sternal-Deep	13	0.28	0	0.00	23.00
Thoracotomy	0	0.00	N.A.	N.A.	N.A.
Leg	17	0.37	0	0.00	17.53
Septicemia	58	1.26	15	25.86	25.55
UTI	141	3.05	10	7.09	14.64
Pneumonia	104	2.25	13	12.50	19.93
Cases without Infections	**4,350**		**42**	**0.97**	**6.48**
Total CABG cases	**4,620**		**68**	**1.47**	**7.05**

SOURCE: New Jersey Department of Health and Senior Services

* Operative Mortality includes:
(1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and
(2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

Length of Stay by Hospital

The Department has included information on post-surgery length of stay as an additional tool to monitor hospital and surgeon performance on CABG surgery. The statewide average is 7.05 days.

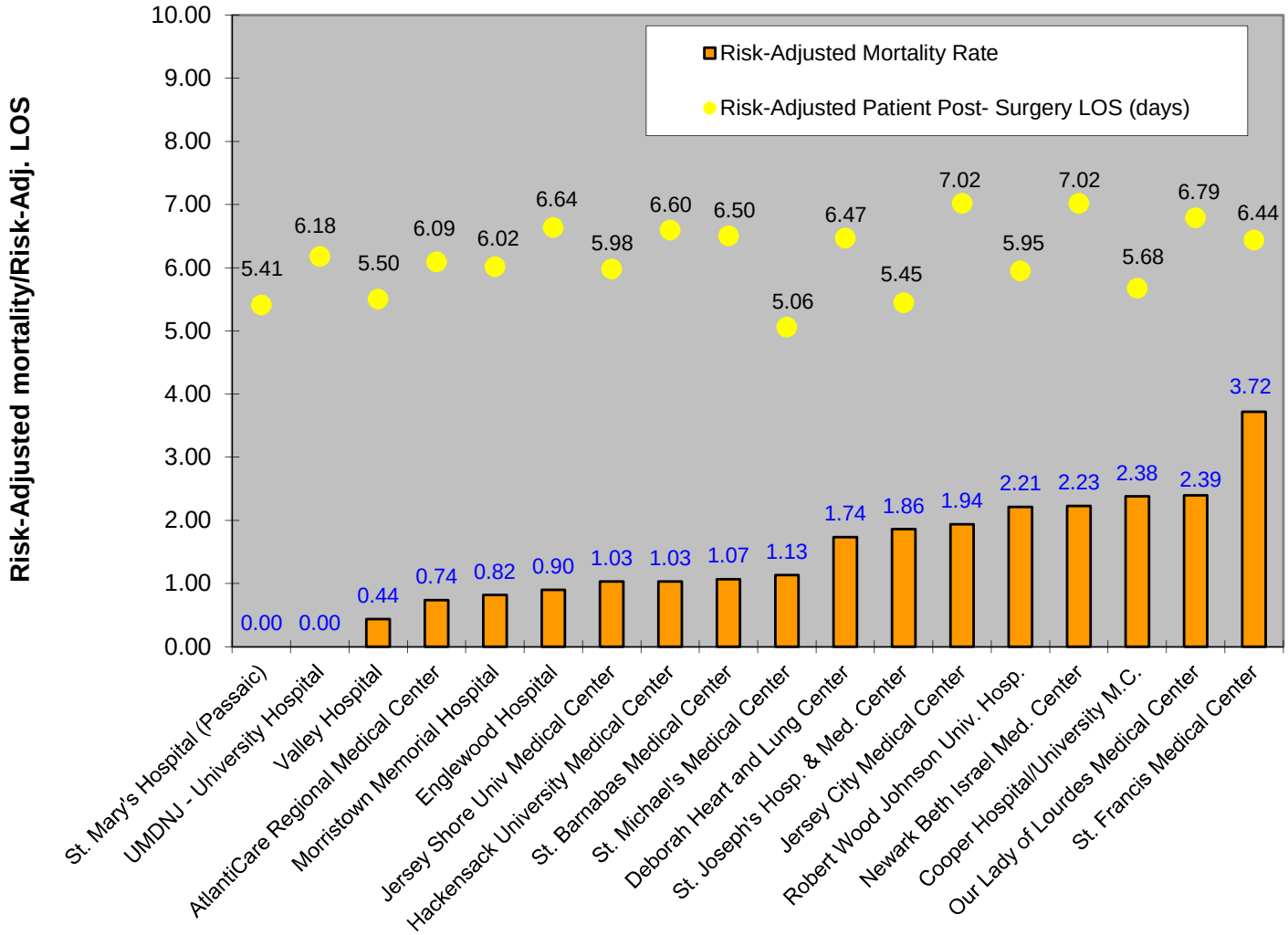
The risk-adjustment model excluded in-hospital deaths, very low lengths of stay (low outliers) and very long lengths of stay (high outliers) while fitting the regression model to reduce outlier effects on the model.

The risk-adjusted lengths of stay by hospital are displayed in Figure 3 and compared against their respective risk-adjusted mortality rates.

Figure 3 shows that there is a marked variation in risk-adjusted length of stay by hospital. The risk-adjusted length of stay by hospital ranged from 5.06 days in St. Michael's Medical Center to 7.02 days in Jersey City Medical Center and Newark Beth Israel Medical Center. Hospitals with high risk-adjusted mortality rates do not seem to have longer lengths of stay (See Figure 3).

Length of stay data for individual surgeons is presented later in this report.

Figure 3
Risk-Adjusted Operative Mortality and Length of Stay by Hospital, 2008



Individual Surgeon Performance

Figure 4 and Table 2 show the risk-adjusted mortality rate for each of the 39 surgeons who performed at least 100 isolated CABG surgery operations in one hospital in New Jersey in the years 2007 and 2008 combined. In addition, Table 2 shows the risk-adjusted post-operative length of hospitalization for each surgeon.

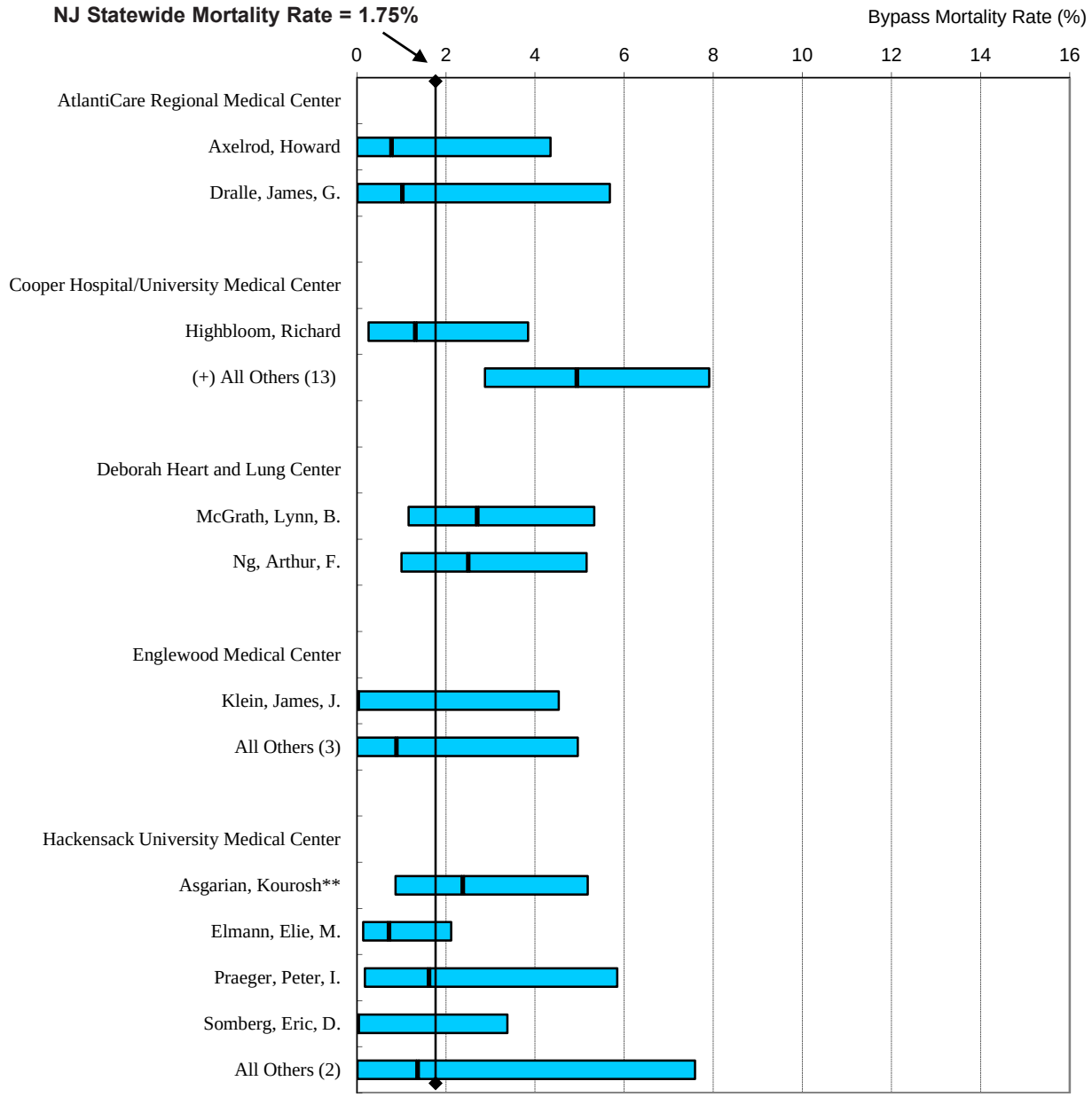
Figure 4 lists surgeons by name under the hospital at which they practice. At the end of each list of named surgeons, some hospitals have an "All Others" category. **"All Others"** includes all surgeons who performed too few procedures at that hospital for an individual risk-adjusted mortality rate to be calculated. The category "All Others" is only displayed on Figure 4 when it includes at least two or more surgeons and 25 or more total patients. Figure 4 displays a bar for a surgeon only if 100 or more isolated CABG surgeries were performed by the surgeon in one hospital in the years 2007 and 2008 combined. For a group of surgeons (i.e. All Others) a bar is shown when the group includes at least two or more surgeons and 25 or more total patients. It is important to note that some surgeons may no longer be practicing cardiac surgery in the facilities where they are listed.

Once again, the vertical line on Figure 4 represents the statewide operative mortality rate for 2007-2008 combined. Note that, when two years' data are combined, the statewide operative mortality rate was 1.75 percent. If a surgeon has a bar completely to the left of the statewide line, i.e. 1.75, it means that the surgeon's mortality rate was statistically significantly lower than the statewide rate. In 2007-2008, there was no surgeon whose bar was completely to the left of the statewide line. As is the case for some in this report, it is possible for a surgeon to have no patient deaths and still have his/her bar cross the statewide line. Though not intuitive, this happens because the bar is the result of an upper and lower bound which includes standard errors of the estimated mortality rate. Although their rates were not statistically significantly different from the statewide rate, it is nevertheless notable that a few surgeons, including some who performed less than 100 isolated CABG surgeries, had no CABG surgery deaths during this two-year period. Among surgeons who performed 100 or more isolated CABG surgeries in the period 2007-2008, Dr. James Klein of Englewood Hospital and Medical Center, Dr. Richard Neibart from Jersey Shore Medical Center, Dr. Eric Somberg from Hackensack University Medical Center and Dr. Nilesh Patel from St. Michael's Medical Center had no CABG surgery deaths.

If a surgeon has a bar completely to the right of the statewide mortality rate line, it means that the surgeon's mortality rate was statistically significantly higher than the statewide rate for this two-year period. In 2007-2008, there were two groups of surgeons listed in the "All Others" category, whose bars were completely to the right of the line. Surgeons in the "All Others" group from Cooper Hospital/ University Medical Center and St. Mary's Hospital (Passaic) had statistically significantly higher risk-adjusted mortality rates than the statewide rate. Most of the surgeons in the "All Others" group from the two hospitals no longer perform cardiac surgeries in New Jersey.

In addition to risk-adjusted mortality for surgeons, Table 2 also shows risk-adjusted patient length of stay for each surgeon who performed at least 100 CABG surgeries in the 2007-2008 reporting period. There is an important variation in length of stay among eligible surgeons where the shortest length of stay was 4.50 days while the longest was 7.57 days. The reasons behind the wide variation in mean lengths of stay are not clear and need further study.

Figure 4
Surgeon Risk-Adjusted Operative Mortality* Rate (2007 - 2008)



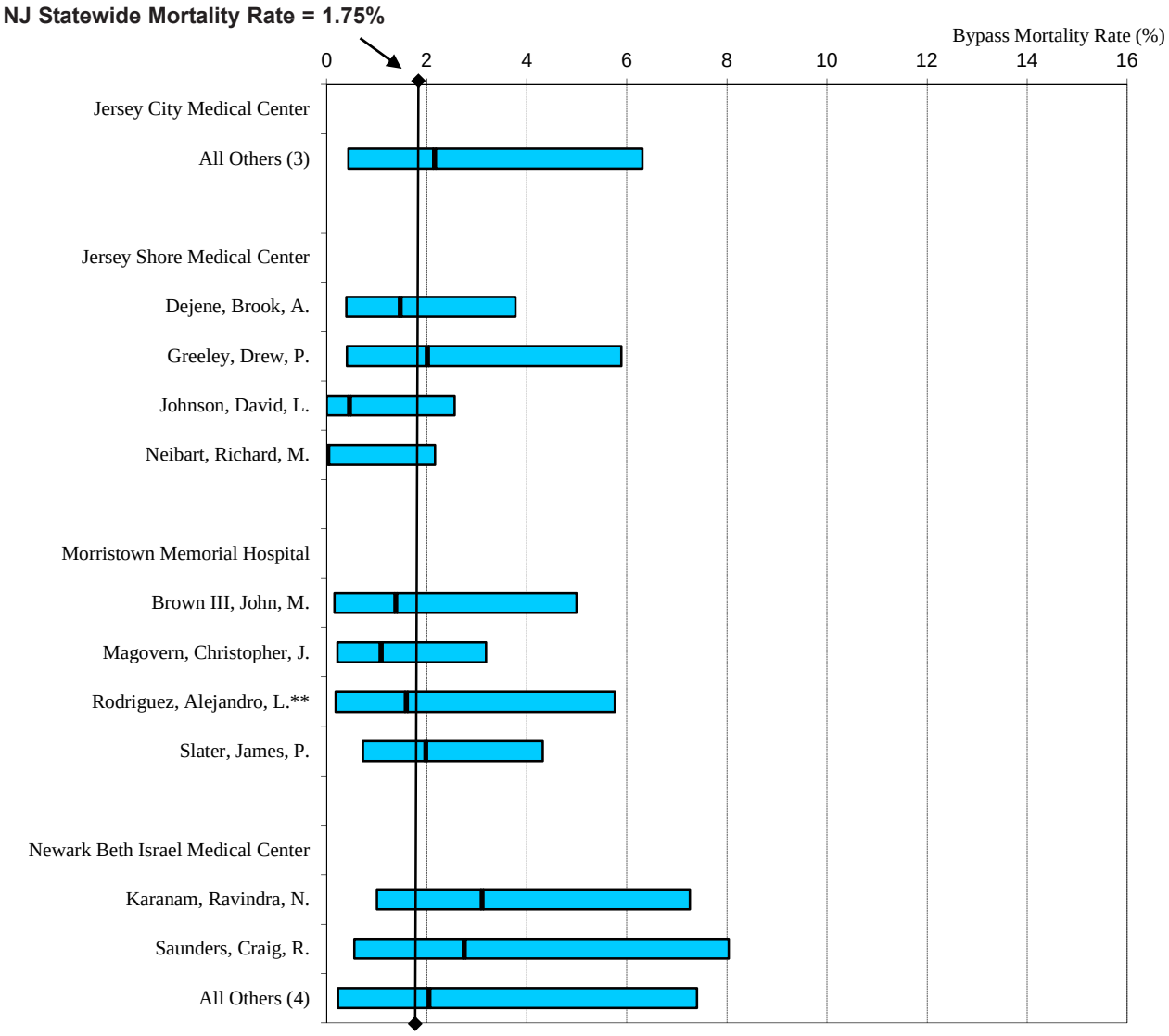
SOURCE: New Jersey Department of Health and Senior Services.

* = Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days;
and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

(+) = Risk-adjusted mortality rate significantly higher than the New Jersey mortality rate based on 95 percent confidence interval.

** = Surgeon not currently performing CABG surgery in this hospital.

Figure 4 (continued)
Surgeon Risk-Adjusted Operative Mortality* Rate (2007 - 2008)



SOURCE: New Jersey Department of Health and Senior Services.

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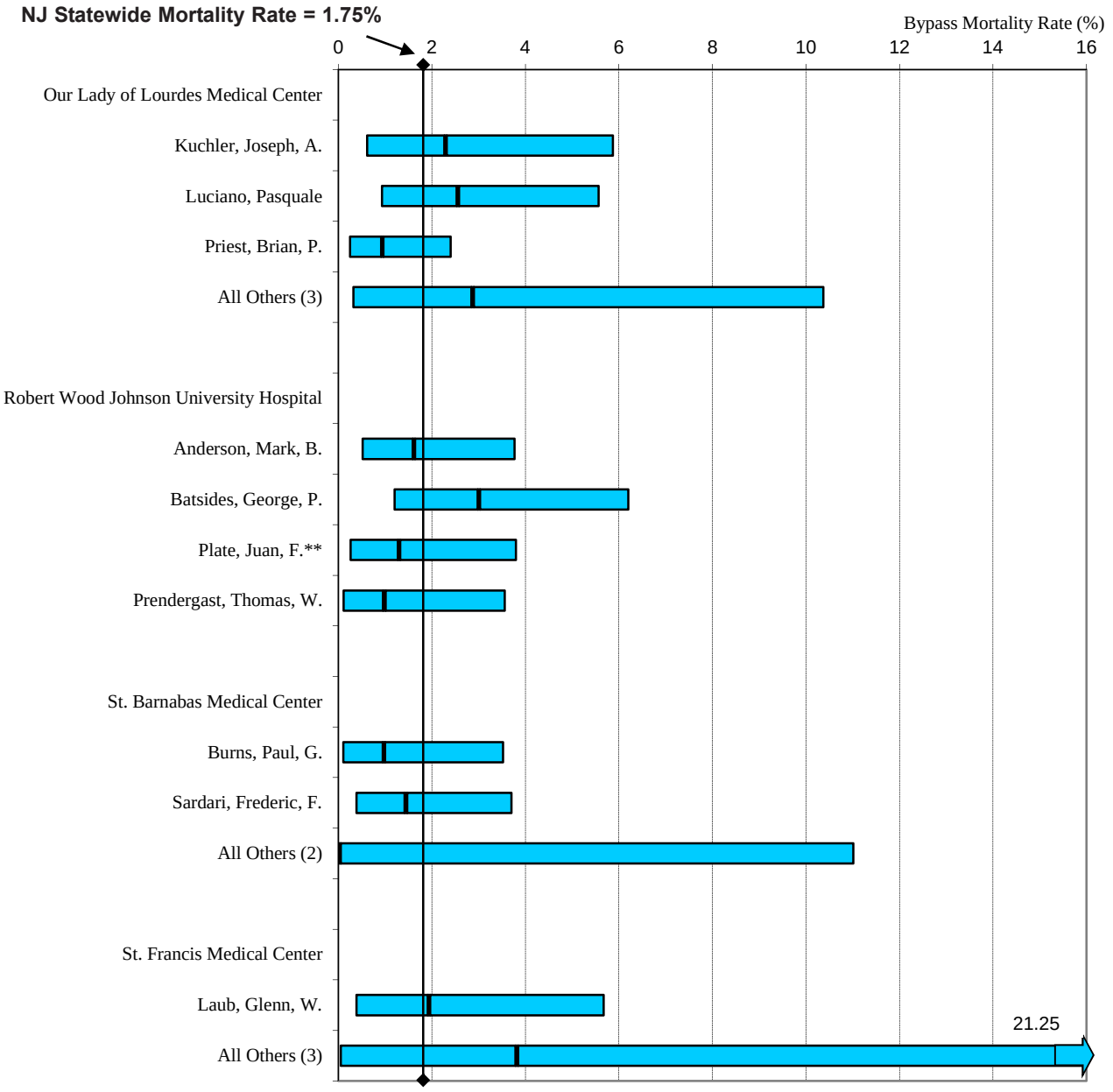
Figure 4 (continued)
Surgeon Risk-Adjusted Operative Mortality* Rate (2007 - 2008)



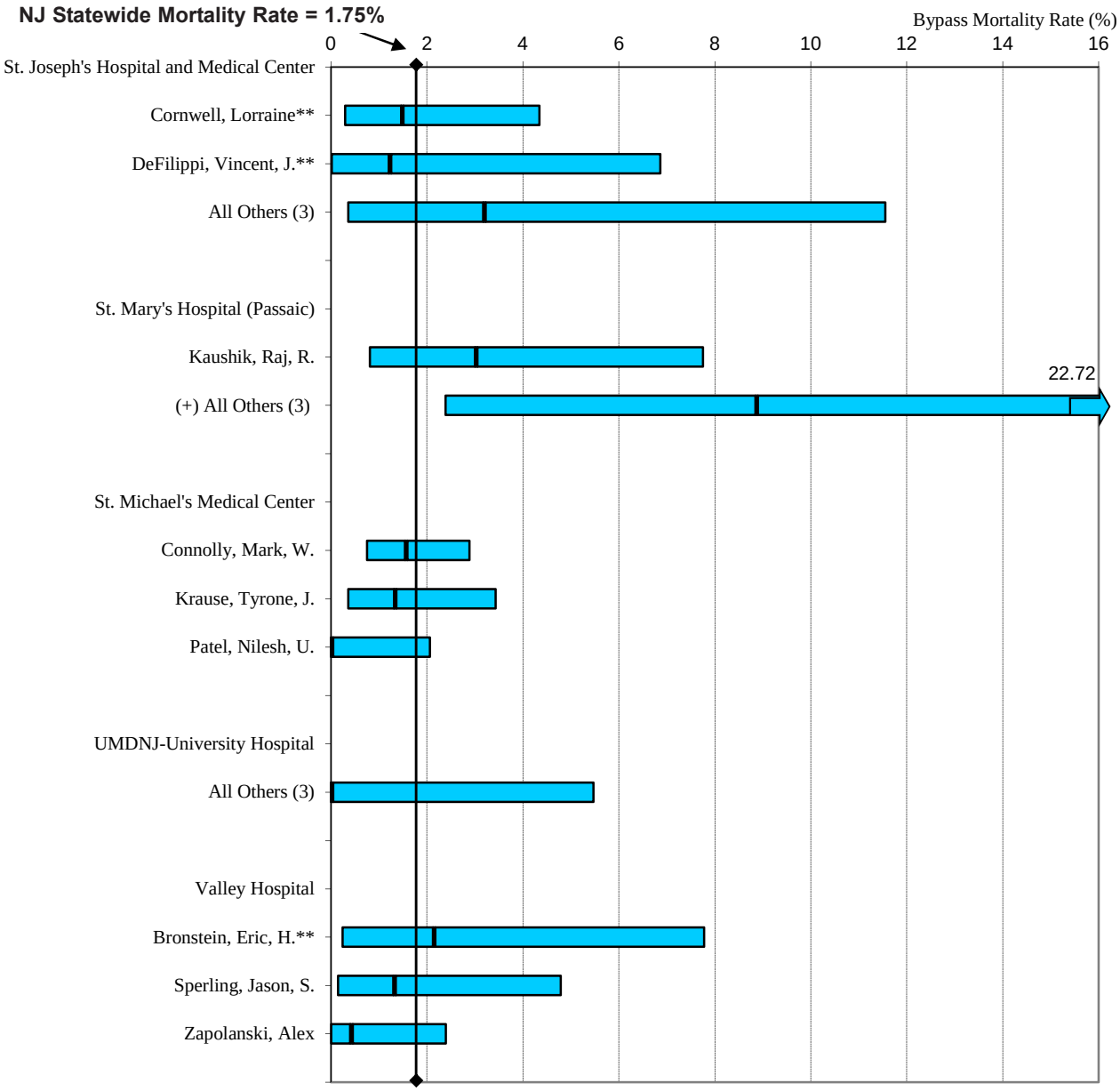
SOURCE: New Jersey Department of Health and Senior Services.

* = Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days;
and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

(+) = Risk-adjusted mortality rate significantly higher than the New Jersey mortality rate based on 95 percent confidence interval.

** = Surgeon not currently performing CABG surgery in this hospital.

Figure 4 (continued)
Surgeon Risk-Adjusted Operative Mortality* Rate (2007 - 2008)



SOURCE: New Jersey Department of Health and Senior Services.

* = Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days;
and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

(+) = Risk-adjusted mortality rate significantly higher than the New Jersey mortality rate based on 95 percent confidence interval.

** = Surgeon not currently performing CABG surgery in this hospital.

Table 2

Risk-Adjusted Operative Mortality* Rate and Post-Surgery Length of Stay by Surgeon (2007 - 2008)

Hospital and Surgeon	Total Open Heart Procedures	Number of Isolated CABG Operations	Patient Operative Deaths*	Observed Patient Mortality(%)	Expected Patient Mortality(%)	Risk-Adjusted Patient Mortality (%)		95% Confidence Interval	Risk-Adjusted Post-Surgery Length of Stay
AtlantiCare Regional Medical Center									
Axelrod, Howard	227	152	1	0.66	1.47	0.78		(0.01, 4.35)	6.45
Dralle, James, G.	219	131	1	0.76	1.31	1.02		(0.01, 5.68)	6.35
Cooper Hospital/University Medical Center									
Highbloom, Richard	225	195	3	1.54	2.04	1.31		(0.26, 3.84)	5.60
All Others (13)	616	263	17	6.46	2.28	4.94	**HI**	(2.88, 7.91)	6.44
Bowen, Frank	77	33	3						
Burns, Richard, K.**	7	0	0						
Deangelo, Frank, J.**	5	0	0						
Eakins, James, S.**	5	0	0						
Finnegan, James, O.**	1	0	0						
Fusco, Cynthia	5	0	0						
Joseph, D'Andrea, K.	7	0	0						
Lotano, Vincent, E.**	73	53	2						
Marra, Steven, W.**	120	91	10						
Rosenbloom, Michael	298	86	2						
Ross, Steven, E.	8	0	0						
Sjoholm, Lars	5	0	0						
Tsiotsias, George	5	0	0						
Deborah Heart and Lung Center									
McGrath, Lynn, B.	653	290	8	2.76	1.78	2.71		(1.16, 5.33)	6.71
Ng, Arthur, F.	337	162	7	4.32	3.02	2.50		(1.00, 5.16)	6.25
All Others (1)	33	14	0						
Anderson, William, A.**	33	14	0						
Englewood Hospital & Medical Center									
Klein, James, J.	247	102	0	0.00	1.39	0.00		(0.00, 4.51)	6.64
All Others (3)	286	105	1	0.95	1.87	0.89		(0.01, 4.96)	6.36
Ergin, Arisan, M.	94	26	0						
McCullough, Jock, N.	185	74	1						
McMurtry, Kirk, A.**	7	5	0						
Hackensack University Medical Center									
Asgarian, Kourosh**	398	238	6	2.52	1.85	2.38		(0.87, 5.18)	5.61
Elmann, Elie, M.	447	288	3	1.04	2.51	0.72		(0.15, 2.12)	7.15
Praeger, Peter, I.	199	141	2	1.42	1.53	1.62		(0.18, 5.85)	6.51
Somberg, Eric, D.	252	158	0	0.00	1.21	0.00		(0.00, 3.35)	7.06
All Others (2)	184	94	1	1.06	1.36	1.36		(0.02, 7.59)	6.07
Masroor, Saqib**	76	37	1						
McCullough, Jock, N.**	108	57	0						

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

HI = The risk-adjusted patient mortality is significantly higher than the state average mortality rate, based on 95 percent confidence interval.

** = Surgeon not currently performing CABG surgery in this hospital.

Table 2 (continued)

Risk-Adjusted Operative Mortality* Rate and Post-Surgery Length of Stay by Surgeon (2007 - 2008)

Hospital and Surgeon	Total Open Heart Procedures	Number of Isolated CABG Operations	Patient Operative Deaths*	Observed Patient Mortality(%)	Expected Patient Mortality(%)	Risk-Adjusted Patient Mortality (%)	95% Confidence Interval	Risk-Adjusted Post-Surgery Length of Stay
Jersey City Medical Center								
All Others (3)	205	122	3	2.46	1.99	2.16	(0.43, 6.31)	6.85
Asher, Alain, S.**	2	0	0					
Hanhan, Ziad, G.	39	29	0					
McMurtry, Kirk, A.	164	93	3					
Jersey Shore University Medical Center								
Dejene, Brook, A.	419	299	4	1.34	1.58	1.47	(0.40, 3.77)	5.76
Greeley, Drew, P.	428	243	3	1.23	1.07	2.02	(0.41, 5.89)	5.89
Johnson, David, L.	425	269	1	0.37	1.41	0.46	(0.01, 2.56)	6.07
Neibart, Richard, M.	413	278	0	0.00	1.07	0.00	(0.00, 2.14)	6.19
Morristown Memorial Hospital								
Brown III, John, M.	797	273	2	0.73	0.92	1.38	(0.16, 5.00)	6.00
Magovern, Christopher, J.	567	353	3	0.85	1.36	1.09	(0.22, 3.18)	6.11
Rodriguez, Alejandro, L.**	228	151	2	1.32	1.45	1.60	(0.18, 5.76)	6.59
Slater, James, P.	562	384	6	1.56	1.38	1.98	(0.72, 4.32)	6.32
Newark Beth Israel Medical Center								
Karanam, Ravindra, N.	285	152	5	3.29	1.85	3.11	(1.00, 7.26)	7.27
Saunders, Craig, R.	441	151	3	1.99	1.26	2.75	(0.55, 8.04)	6.77
All Others (4)	350	98	2	2.04	1.74	2.05	(0.23, 7.40)	6.93
Camacho, Margarita	238	53	2					
McBride, Lawrence**	110	45	0					
Sardari, Frederic, F.	1	0	0					
Starr, Joanne**	1	0	0					
Our Lady of Lourdes Medical Center								
Kuchler, Joseph, A.	320	191	4	2.09	1.59	2.29	(0.62, 5.87)	7.57
Luciano, Pasquale	266	209	6	2.87	1.96	2.56	(0.93, 5.56)	7.43
Priest, Brian, P.	473	325	4	1.23	2.29	0.94	(0.25, 2.40)	6.38
All Others (3)	73	55	2	3.64	2.21	2.87	(0.32, 10.37)	6.84
Metcalf, Randy, K.**	45	37	1					
Nayar, Amrit, P.**	14	7	1					
Puc, Matthew, M.**	14	11	0					
Robert Wood Johnson University Hospital								
Anderson, Mark, B.	611	316	5	1.58	1.71	1.62	(0.52, 3.77)	6.06
Batsides, George, P.	256	177	7	3.95	2.30	3.01	(1.21, 6.20)	6.31
Plate, Juan, F.**	306	225	3	1.33	1.79	1.30	(0.26, 3.80)	6.22
Prendergast, Thomas, W.	398	294	2	0.68	1.21	0.99	(0.11, 3.56)	5.92
All Others (2)	251	85	3					
Mosca, Ralph, S.**	2	0	0					
Scholz, Peter, M.	249	85	3					

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

** = Surgeon not currently performing CABG surgery in this hospital.

Table 2 (continued)

Risk-Adjusted Operative Mortality* Rate and Post-Surgery Length of Stay by Surgeon (2007 - 2008)

Hospital and Surgeon	Total Open Heart Procedures	Number of Isolated CABG Operations	Patient Operative Deaths*	Observed Patient Mortality(%)	Expected Patient Mortality(%)	Risk-Adjusted Patient Mortality (%)	95% Confidence Interval	Risk-Adjusted Post-Surgery Length of Stay
St Barnabas Medical Center								
Burns, Paul, G.	416	224	2	0.89	1.60	0.98	(0.11, 3.52)	6.55
Sardari, Frederic, F.	393	235	4	1.70	2.06	1.45	(0.39, 3.70)	6.58
All Others (2)	58	27	0	0.00	2.16	0.00	(0.00, 10.99)	6.24
Goldenberg, Bruce, S.**	28	20	0					
Saunders, Craig, R.	30	7	0					
St Francis Medical Center								
Laub, Glenn, W.	253	199	3	1.51	1.36	1.94	(0.39, 5.67)	6.62
All Others (3)	41	35	1	2.86	1.31	3.82	(0.05, 21.25)	6.19
Costic, Joseph	34	30	1					
Deshpande, Anil	6	4	0					
Shariff, Haji	1	1	0					
St Joseph's Hospital and Medical Center								
Cornwell, Lorraine**	224	130	3	2.31	2.71	1.49	(0.30, 4.35)	6.19
DeFilippi, Vincent, J.**	307	142	1	0.70	1.00	1.23	(0.02, 6.87)	6.68
All Others (3)	128	76	2	2.63	1.44	3.20	(0.36, 11.55)	4.50
Bronstein, Eric, H.	114	69	2					
Goldenberg, Bruce, S.**	3	1	0					
Kaushik, Raj, R.**	11	6	0					
St. Mary's Hospital (Passaic)								
Kaushik, Raj, R.	242	161	4	2.48	1.43	3.03	(0.81, 7.75)	5.70
All Others (3)	44	33	4	12.12	2.39	8.87 **HI**	(2.39, 22.72)	6.18
Chuback, John, A.**	1	1	0					
Goldenberg, Bruce, S.**	30	20	3					
Shakir, Huzaifa, A.	13	12	1					
St Michael's Medical Center								
Connolly, Mark, W.	625	386	10	2.59	2.88	1.57	(0.75, 2.89)	5.38
Krause, Tyrone, J.	240	158	4	2.53	3.30	1.34	(0.36, 3.43)	5.40
Patel, Nilesh, U.	225	189	0	0.00	1.66	0.00	(0.00, 2.04)	4.55
All Others (1)	20	19	4					
Codoyannis, Aristides, B.**	20	19	4					
UMDNJ University Hospital								
All Others (3)	219	91	0	0.00	1.29	0.00	(0.00, 5.45)	6.03
Esrig, Barry, C.**	24	8	0					
Lovoulos, Constantinos	42	24	0					
Sambol, Justin, T.	153	59	0					
Valley Hospital								
Bronstein, Eric, H.**	202	107	2	1.87	1.52	2.15	(0.24, 7.78)	5.70
Sperling, Jason, S.	277	159	2	1.26	1.66	1.33	(0.15, 4.79)	5.60
Zapolanski, Alex	465	206	1	0.49	1.97	0.43	(0.01, 2.40)	5.52
All Others (2)	13	3	0	0.00	1.08	0.00	(0.00, 100.00)	5.30
Brizzio, Mariano	2	2	0					
Mindich, Bruce, P.**	11	1	0					
State Total (2007 - 2008)	16,789	9,563	167	1.75	1.75	1.75		6.84

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

HI = The risk-adjusted patient mortality is significantly higher than the state average mortality rate, based on 95 percent confidence interval.

** = Surgeon not currently performing CABG surgery in this hospital.

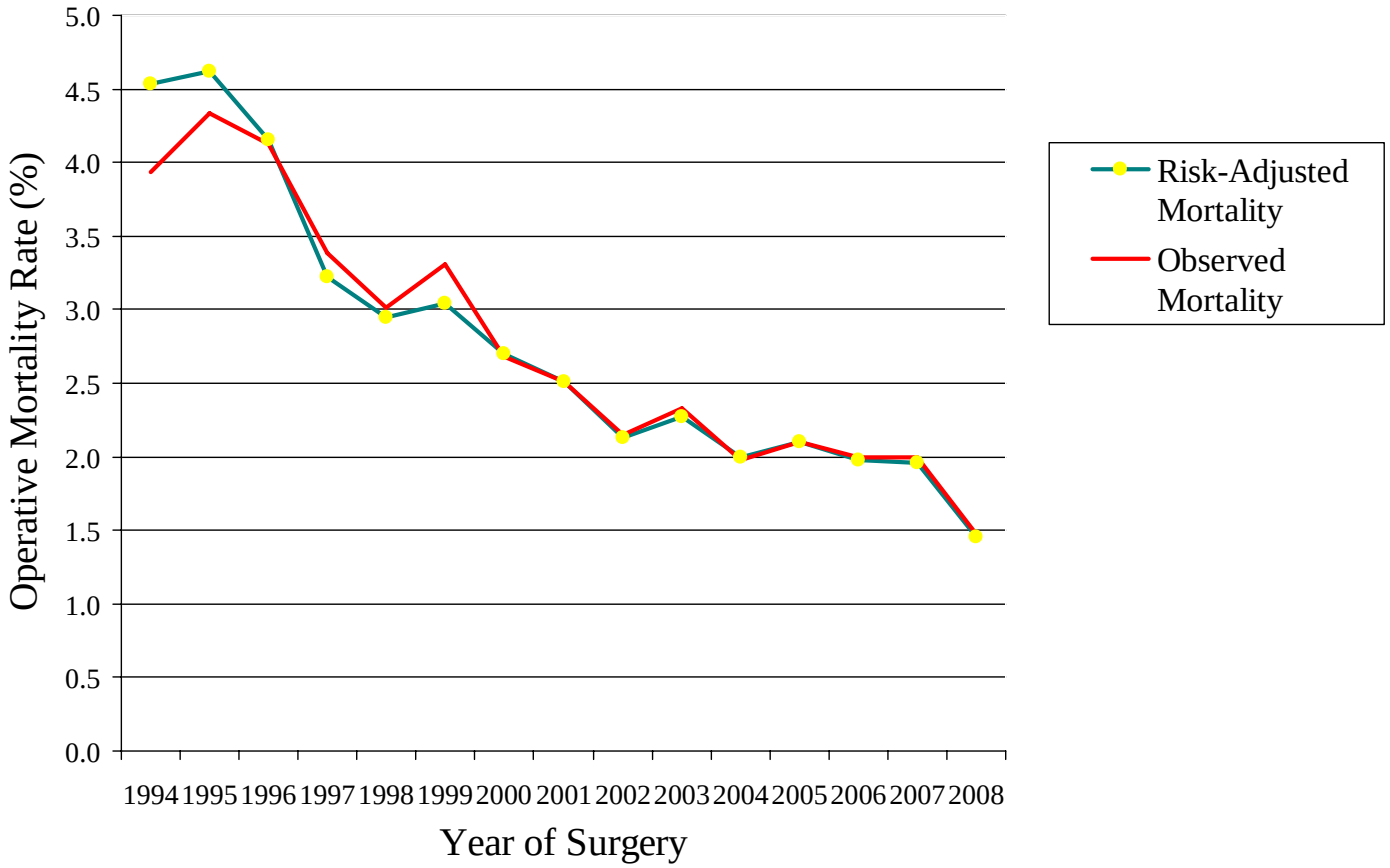
Statewide Trends in Risk-Adjusted CABG Surgery Mortality Rates: Pooled Estimates

Figure 5 presents the statewide risk-adjusted mortality rates for years 1994 to 2008 derived by pooling data from all years.

Figure 5 also presents the trend in statewide observed isolated CABG surgery operative mortality rates for years 1994-2008. The observed operative mortality rate estimates exhibit a declining trend that is similar to the risk-adjusted mortality estimates. (Sources: Appendix C; Appendix D, Table D3). When compared with 1994, the risk-adjusted patient mortality in 2008 dropped by 68.0 percent.

When a linear regression line is fitted to the pooled annual estimates, CABG surgery mortality rate has been declining, in absolute terms, at the rate of 0.21 percentage points per year (See Appendix D, Figure D1).

Figure 5
Trends in Statewide CABG Surgery Mortality Rates



Appendix A

Questions and answers

These are answers to some commonly asked questions that may be of interest to you as you read this report.

Q: Should I go only to the hospitals with below-average risk-adjusted mortality rates?
A: Not necessarily. There are many factors to consider in determining the best hospital for you. Among these are your own personal risk factors and the experience certain hospitals have treating patients with those risk factors. Before making up your mind, you should discuss this report with the physician, usually a cardiologist, who refers you for cardiac surgery. The cardiologist's knowledge and expertise will be a valuable guide in making your decision. You should also keep in mind that the data in this guide is from 2008 and that a hospital's performance may have changed since then.

Q: Should I avoid any surgeon whose volume is low in this report?
A: No, not necessarily. First, there are lower volume surgeons with good patient outcomes. Second, there may be a good explanation for why a surgeon had a low volume that is unrelated to his/her experience. For example, the surgeon may have recently moved from another state, where he/she performed a high volume of these procedures. It is best to discuss your concerns with your referring doctor.

Q: Should I refuse to go to a hospital for heart surgery if that hospital has a worse than average mortality record?
A: Important decisions in areas such as cardiac surgery should be made after considering all available information. The statistics in this report are a starting point for discussions with your doctor. But they do not tell the complete story. That is why it is critical to bring your concerns and questions to your doctor.

Q: Is it better to go to a hospital with a high volume of cases?
A: National studies have demonstrated that, in general, hospitals with higher volumes have better results. However, some hospitals with high volumes have relatively high mortality rates, while others with low volumes have lower mortality rates.

Notes on data:

The data used in this study were reported by hospitals according to criteria established by the Department, with assistance from the clinical experts. Additionally, the Department has made a good faith effort to ensure that the data elements and definitions are consistent with those issued by the Society for Thoracic Surgeons (STS). The data were audited by an independent reviewer under contract to the Department.

Throughout the process of developing this report, the Department has taken steps to make sure that all hospitals were informed about data reporting and auditing requirements, as well as the statistical methods being used to risk-adjust the reported mortality data.

The Department considers it a vital function of hospitals to be able to collect and report complete, accurate medical information on patients. This function is critical not only to the success of the cardiac surgery report, but to the hospitals' own ongoing efforts to improve the quality of care for all patients. The Department and hospitals will continue working to improve data collection procedures so that this report contains the best possible information.

Appendix B

New Jersey's Cardiovascular Health Advisory Panel (CHAP) Members

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Appendix C

Statewide Observed In-hospital and Operative Mortality Rates:

Year of Operation	Mortality Rate	
	In-hospital	Operative Mortality*
1994-1995	3.75	4.14
1996-1997	3.37	3.75
1998	2.60	3.01
1999	2.89	3.31
2000	2.22	2.68
2001	2.01	2.51
2002	1.80	2.15
2003	1.91	2.33
2004	1.54	1.98
2005	1.83	2.10
2006	1.73	2.00
2007	1.66	2.00
2008	1.19	1.47

* Operative mortality includes the following:

- all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and
- deaths occurring after discharge from hospital, but within 30 days of the procedures.

Appendix D

Summary of Methods Used in this Report

Background

Five states, including New Jersey, have issued reports on isolated CABG surgery outcomes for hospitals, and sometimes surgeons. New York first published a bypass surgery report in 1990 presenting 1989 data, with the latest report released in December 2010 using 2006-2008 data. New York State also publishes a performance report on angioplasty programs and physicians. Starting with its 1990 data, Pennsylvania has published several cardiac surgery reports, with its latest report released in May 2011 using 2008-2009 data. California has also published several cardiac surgery reports, with the most recent released in October 2010 using 2007 data. Massachusetts published its first report on CABG surgery in October 2004 using 2002 data and released its latest report on a fiscal year basis (October 1, 2008 to September 30, 2009) in January 2010. In 1997, New Jersey began reporting on patient mortality for isolated CABG surgery hospitals and surgeons, using 1994 and 1995 data combined.

The experience from these states is that disclosures have contributed to hospital quality improvement initiatives and significant reductions in bypass surgery mortality rate.

Factors that affect a patient's risk of CABG surgery mortality

The observed patient CABG surgery mortality rate for a hospital or surgeon is estimated as the number of CABG surgery patients who died in the hospital during or after surgery, or patients who died after discharge but within 30 days post-surgery, divided by the total number of patients who underwent the CABG surgery.

Unfortunately, this observed patient mortality rate is not a complete measure of the quality of care provided by a hospital or a surgeon, because it does not account for how sick the patients were before surgery. If one hospital had considerably sicker patients than another hospital, it would be expected that its observed mortality rate would be somewhat higher. So it would not be fair to evaluate surgeons and hospitals performing bypass surgery solely on the basis of the percentage of their patients that died. For instance, an 80 year-old patient who has renal failure and severe lung disease is at a higher risk of dying, when undergoing this surgery, than a 50 year-old patient with no history of chronic disease.

To perform an even-handed analysis of the quality of surgical care provided by surgeons and hospitals performing bypass surgery, the Department adjusts the patient mortality rates for each surgeon and each hospital by the pre-surgery risk factors of each patient. This method gives hospitals and surgeons who operate on less healthy patients "extra credit." Such hospitals and surgeons are not at a disadvantage when the outcome of the surgical care they provide is presented next to that of other hospitals and surgeons. Additionally, as stated earlier, extremely high risk patients, where the probability of death is very high, may, with the concurrence of the expert clinical panel, be excluded from the calculation.

The risk adjustment method is a statistical approach that uses results of a logistic regression analysis to assess the average risk of an isolated CABG surgery for a patient. Key elements of the health histories of patients who have undergone isolated CABG surgery in the same period, as well as their socio-demographic characteristics, are taken into account to estimate the expected outcome of an isolated CABG surgery.

Assessing patient risk factors

A logistic regression model which included all the before-surgery health and demographic factors was fitted to the data for the period covered by this report to identify those risk factors that were important in predicting whether a patient would die after an isolated CABG surgery. The general form of a logistic regression model for estimating the "logit" of the probability of dying (p), denoted by Yi, is presented as follows:

$$Y_i = \sum_{k}^{K} \beta_k X_{ki} + \varepsilon_i \text{ , } Where X_{0i} = 1;$$

$$Y_i = \log_e \left(\frac{p_i}{1 - p_i} \right) = \text{ the "logit" of } p_i$$

i = 1,2,…,n; k = 0,1,2,...,K,
β_k= Logistic regression coefficient for risk factor X_k,
K = Number of risk factors in the model,
n = Number of patients,
ε_i = Random error term i.

The statistically significant risk factors for this report (Xk) identified by the stepwise logistic regression analysis method are presented in Table D1. Table D1 also includes estimates of coefficients for the statistically significant risk factors, an indication of the level of statistical significance (p-values), and odds ratios. The list of risk factors includes only those that were statistically significant in predicting isolated CABG surgery mortality with p-values of 0.05 or smaller.

The odds ratios are derived from the coefficients, and are used to compare the relative importance of the risk factors in predicting mortality from isolated CABG surgery. For each of the risk factors identified in Table D1, the odds ratio represents how much as likely a patient is to die when compared to a patient who is in the reference group. So, for example, Table D1 shows that a patient who had renal failure with dialysis is more than six times (odds ratio = 6.03) as likely to die during or after isolated CABG surgery compared to a patient who did not have renal disease. This is based on the assumption that both patients have the same set of other risk factors presented in the table.

Similarly, the odds of dying during or after isolated CABG surgery for a patient who had a Myocardial Infarction (MI) within 24 hours before surgery is more than eight times as likely (odds ratio= 8.38) compared with the odds of a patient who did not have a history of MI.

Estimation of risk-adjusted mortality rates

The risk factors presented in Table D1 were used in the fitted logistic regression model to predict the probability of death from isolated CABG surgery for each patient. The sum of predicted probabilities of dying for patients operated on in each hospital divided by the number of patients operated on in that hospital provides the predicted (or expected) death rate associated with the hospital. A similar analysis for a surgeon results in the expected death rate associated with that surgeon. Terms such as "expected" and "predicted" are used interchangeably in this report to signify that the estimates are derived from predicted probabilities after accounting for risk factors.

The predicted probability of dying for patient i ($\hat{p}_i$) is given as follows:

$$\hat{p}_i = \frac{e^{(\hat{Y}_i)}}{1 + e^{(\hat{Y}_i)}}, \text{ Where } i = 1,2,3,...,n \text{ ; and}$$

$$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_{1i} + \hat{\beta}_2 X_{2i} + \hat{\beta}_3 X_{3i} + ... + \hat{\beta}_k X_{ki}$$

To assess the performance of each hospital or surgeon, we compared the observed patient mortality with the expected or predicted patient mortality, based on the risk factors existing for the hospital's or surgeon's patients. First, the observed patient mortality is divided by the expected mortality. If the resulting ratio is larger than one, the hospital or surgeon has a higher patient mortality than expected on the basis of their patient mix. If the ratio is smaller than one, the hospital or surgeon has a lower mortality than expected, based on their patient mix. The ratio is then multiplied by the statewide patient mortality rate to produce the risk-adjusted patient mortality rate for the hospital or the surgeon.

The risk-adjusted mortality rate represents the best estimate the fitted model provides using the statistically significant health risk factors. The risk-adjusted patient mortality rate represents what the associated hospital's or surgeon's patient mortality would have been if they had a mix of patients identical to the statewide mix. Thus, the risk-adjusted patient mortality has, to the extent possible, ironed out differences among hospitals and surgeons in patient mortality arising from the severity of illness of their patients.

The statistical methods described above are tested to determine if they are sufficiently accurate in predicting the risk of death for all patients – for those who are severely ill prior to undergoing isolated CABG surgery as well as those who are relatively healthy. In the analysis of data for this report, the tests confirmed that the model is reasonably accurate in predicting how patients of different risk levels will fare when undergoing isolated CABG surgery. The area under the Receiver Operating Characteristic (ROC) curve, denoted by C-statistic in Table D1, was used to evaluate model performance. The C-statistic may be interpreted as the degree to which the risk factors in the model predicted the probability of death for CABG surgery patients. Specifically, the C-statistic measures the tendency of the predicted mortality for patients in the sample that died to be higher than that for patients who were discharged alive and were also alive 30 days after CABG surgery. The 2008 model C-statistic is 83.6 percent and is fairly high, suggesting that the model has a very strong predictive power.

Table D1

Risk Factors Identified for Isolated CABG Surgery Operative Mortality* (2008)

Patient Risk Factors Identified	Proportion of patients(%)	Logistic Regression Results		
		Coefficient	P-Value	Odds Ratio
Demographic factors				
Ages 75 to 79	13.85	0.8643	0.0084	2.373
Ages 80 to 84	8.51	0.9759	0.0088	2.654
Ages 85 and over	2.92	2.0386	<.0001	7.680
Health factors				
Cerebrovascular Accident	6.49	0.8044	0.0239	2.235
Cerebrovascular Disease - Carotid Test with >75% Occlusion	1.62	1.6847	0.0010	5.391
Lung Disease - Moderate	4.33	1.2427	0.0014	3.465
Lung Disease - Severe	2.81	1.3528	0.0014	3.868
Renal Failure without Dialysis	4.00	0.8877	0.0391	2.430
Renal Failure with Dialysis	2.45	1.7971	<.0001	6.032
Factors related to functioning of the heart				
Ejection Fraction Less Than 30%	7.08	0.7686	0.0236	2.157
Myocardial Infarction < 24 Hours	2.86	2.1256	<.0001	8.378
Myocardial Infarction 1 - 21 Days	23.51	0.9601	0.0005	2.612
Resuscitation	0.37	2.3276	0.0017	10.253
Previous Open Heart Surgery	2.55	1.4296	0.0042	4.177
Intercept	-5.8118			
C-Statistic	0.836			
Number of CABGs (N)	4,620			

SOURCE: New Jersey Department of Health and Senior Services

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

Risk-adjusted patient mortality rate estimates

This section presents the results of our analysis including:

(1) comparisons of risk-adjusted patient mortality rates for hospitals to the statewide rate in 2008;

(2) comparisons of the statewide risk-adjusted patient mortality rate for each year in 1994-2008 to the rate for the whole period.

The risk-adjusted mortality rate estimates are presented in percentage points. The results also include the lowest and the highest risk-adjusted mortality rate estimates one would expect, using a 95 percent confidence level*.

* *95% confidence limits are calculated as follows:*

$$LCL = \frac{D\left(1-\frac{1}{9D}-\frac{1.96}{3\sqrt{D}}\right)^3}{E}S$$

$$UCL = \frac{(D+1)\left(1-\frac{1}{9(D+1)}+\frac{1.96}{3\sqrt{(D+1)}}\right)^3}{E}S$$

Where D = Observed mortality, and
E = Predicted or Expected mortality,
S = Statewide rate.

(Source: Liddell, F. D. K., Simple Exact Analysis of the Standardised Mortality Ratio. Journal of Epidemiology and Community Health, 1984, 38, 85-88.)

Patient CABG surgery mortality rate by hospital compared with the statewide rate in 2008

The risk-adjusted patient mortality estimates from isolated CABG surgery for each hospital in 2008 are presented in Table D2. The results compare each hospital's risk-adjusted patient mortality rate with the statewide mortality rate.

After adjusting for how sick the patients were before surgery at each hospital, we present the estimates of risk-adjusted patient mortality rate for each hospital in the sixth column of Table D2.

If a hospital's 95 percent confidence interval contains the statewide rate, it means that the difference between the hospital's risk-adjusted mortality rate and the statewide rate was not statistically significant. If the whole of a hospital's 95 percent confidence interval clearly falls to the left of the statewide rate, it means that the hospital's risk-adjusted patient mortality rate was statistically significantly lower than the statewide rate. If the whole of the 95 percent confidence interval falls to the right of the statewide rate, it means that the hospital's risk-adjusted mortality rate was statistically significantly higher than the statewide rate.

The observed operative mortality rate statewide in 2008 for isolated CABG patients was 1.47 percent, based on 68 deaths out of 4,620 isolated CABG operations performed. Table D2 presents the isolated CABG volume, observed mortality rate, expected mortality rate, risk-adjusted mortality rate and its confidence interval, as well as risk-adjusted length of stay following isolated CABG surgery for each of the 18 hospitals.

Table D2

Patient Operative Mortality* and Length of Stay After Isolated CABG Surgery by Hospital (2008)

Hospital	Number of Isolated CABG Operations	Patient Operative Deaths*	Observed Patient Mortality (%)	Expected Patient Mortality (%)	Risk-Adjusted Patient Mortality (%)	95% Confidence Interval	Risk-Adjusted Patient Post-Surgery LOS (days)
AtlantiCare Regional Medical Center	135	1	0.74	1.48	0.74	(0.01, 4.11)	6.09
Cooper Hospital/University M.C.	240	6	2.50	1.55	2.38	(0.87, 5.18)	5.68
Deborah Heart and Lung Center	196	4	2.04	1.73	1.74	(0.47, 4.44)	6.47
Englewood Hospital	115	1	0.87	1.42	0.90	(0.01, 5.02)	6.64
Hackensack University Medical Center	392	4	1.02	1.45	1.03	(0.28, 2.65)	6.60
Jersey City Medical Center	72	2	2.78	2.11	1.94	(0.22, 6.99)	7.02
Jersey Shore Univ Medical Center	514	4	0.78	1.11	1.03	(0.28, 2.64)	5.98
Morristown Memorial Hospital	582	4	0.69	1.23	0.82	(0.22, 2.10)	6.02
Newark Beth Israel Med. Center	189	3	1.59	1.05	2.23	(0.45, 6.51)	7.02
Our Lady of Lourdes Medical Center	375	11	2.93	1.80	2.39	(1.19, 4.28)	6.79
Robert Wood Johnson Univ. Hosp.	546	10	1.83	1.22	2.21	(1.06, 4.07)	5.95
St. Barnabas Medical Center	231	3	1.30	1.79	1.07	(0.21, 3.12)	6.50
St. Francis Medical Center	113	4	3.54	1.40	3.72	(1.00, 9.53)	6.44
St. Joseph's Hosp. & Med. Center	166	4	2.41	1.91	1.86	(0.50, 4.76)	5.45
St. Mary's Hospital (Passaic)	82	0	0.00	1.31	0.00	(0.00, 5.04)	5.41
St. Michael's Medical Center	376	6	1.60	2.07	1.13	(0.41, 2.47)	5.06
UMDNJ - University Hospital	58	0	0.00	1.12	0.00	(0.00, 8.30)	6.18
Valley Hospital	238	1	0.42	1.41	0.44	(0.01, 2.43)	5.50
Statewide	4,620	68	1.47	1.47	1.47		6.07

SOURCE: New Jersey Department of Health and Senior Services

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

Annual risk-adjusted mortality compared to the combined 1994-2008 risk-adjusted mortality

Table D3 presents the results of an analysis to identify the trend in the statewide mortality rate of patients who underwent isolated CABG surgery using a statistical model based on the pooled data collected over the period 1994-2008. For each of the years, the table presents the observed patient mortality rate, the expected patient mortality rate, and the statewide risk-adjusted patient mortality rate estimate. Note that the numbers differ from those shown in reports produced before, due to the revised definition of mortality and the use of pooled data for the analysis. The table further exhibits whether the risk-adjusted mortality rate for the year is statistically different from the pooled mortality rate for the 1994-2008 period.

Table D3 also shows that between 2007 and 2008, the number of isolated CABG surgeries performed in New Jersey declined from 4,943 to 4,620 or by 6.5 percent. Over the same time period, the number of deaths declined from 99 to 68 or by 31.3 percent. On risk-adjusted basis, the mortality rate declined 26.0 percent between 2007 and 2008, although the decline was not statistically significant. However, since 1994 risk-adjusted mortality rate has declined 68.0 percent, which was statistically significant.

The trend in operative CABG mortality rate between 1994 and 2008 was estimated by fitting a regression line of pooled annual risk-adjusted CABG mortality rates to procedure year (Figure D1). According to the fitted regression line, operative mortality from CABG surgery has been declining, in absolute terms, at the rate of 0.21 percentage points per year between 1994 and 2008 ($R2 = 0.88$).

Table D3

Annual Risk-Adjusted Patient Operative Mortality Rate* Derived from the Pooled Data for the Period 1994-2008

Year	Number of Isolated CABG Operations	Operative Patient Mortality*	Observed Patient Mortality Rate (%)	Predicted Patient Mortality Rate (%)	Risk-Adjusted Patient Mortality Rate (%)		Yearly Change in Risk-Adjusted Mortality Rate (%)	Percent Change from 1994 Risk-Adjusted Mortality Rate (%)
1994	6,957	274	3.94	2.49	4.53	**HI**	----	----
1995	7,553	327	4.33	2.68	4.62	**HI**	0.09	2.0
1996	8,262	341	4.13	2.85	4.15	**HI**	-0.47	-8.4
1997	8,286	280	3.38	3.01	3.22	**SA**	-0.93	-28.9
1998	8,377	252	3.01	2.92	2.95	**SA**	-0.27	-34.8
1999	8,108	268	3.31	3.04	3.11	**SA**	0.16	-31.3
2000	8,220	220	2.68	2.84	2.70	**SA**	-0.42	-40.4
2001	8,045	202	2.51	2.87	2.51	**SA**	-0.19	-44.7
2002	7,391	159	2.15	2.88	2.13	**LO**	-0.37	-52.9
2003	6,817	159	2.33	2.94	2.27	**LO**	0.14	-49.9
2004	6,177	122	1.98	2.83	2.00	**LO**	-0.28	-55.9
2005	5,576	117	2.10	2.86	2.10	**LO**	0.10	-53.7
2006	5,211	104	2.00	2.88	1.98	**LO**	-0.12	-56.2
2007	4,943	99	2.00	2.93	1.96	**LO**	-0.03	-56.8
2008	4,620	68	1.47	2.91	1.45	**LO**	-0.53	-68.0

SOURCE: New Jersey Department of Health and Senior Services

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

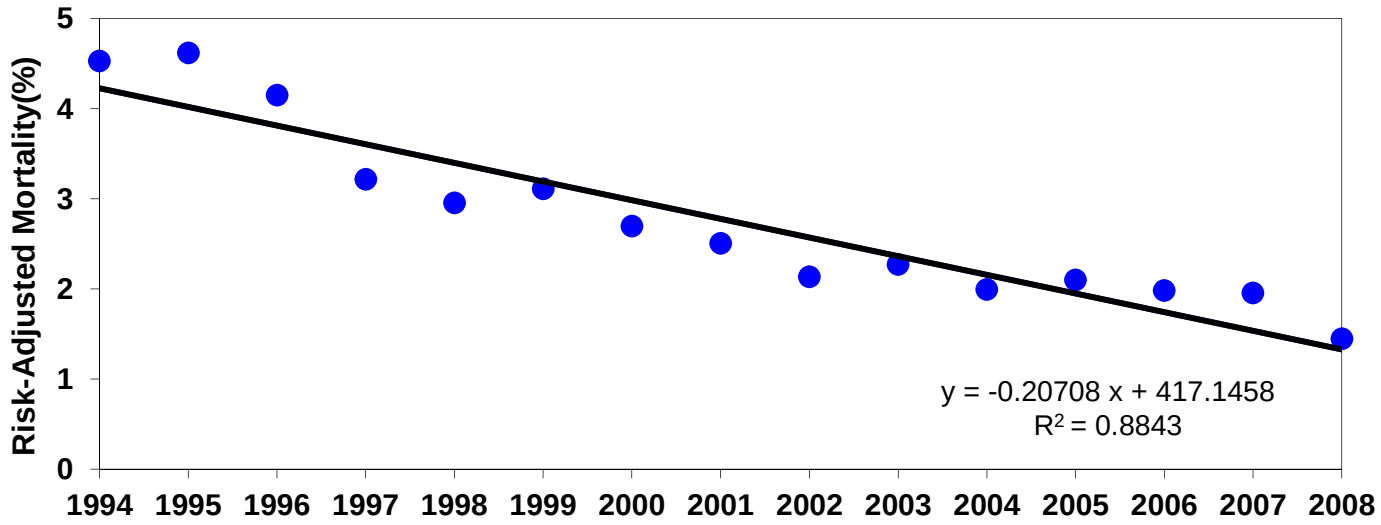
LO - The risk-adjusted patient mortality is significantly lower than the mortality for the 1994-2008 combined when evaluated with a 95 percent confidence interval.

SA - The risk-adjusted patient mortality is same as the mortality for the 1994-2008 combined when evaluated with a 95 percent confidence interval.

HI - The risk-adjusted patient mortality is significantly higher than the mortality for the 1994-2008 combined when evaluated with a 95 percent confidence interval.

Figure D1

Trend in Risk-Adjusted Operative Mortality* Rate (1994-2008)



SOURCE: New Jersey Department of Health and Senior Services.

* Operative Mortality includes: (1) all deaths occurring during the hospitalization in which the operation was performed, even after 30 days; and (2) those deaths occurring after discharge from the hospital, but within 30 days of the procedures.

Risk factors for post-surgery length of stay

In an attempt to predict a patient's post-operative length of stay, we fitted a generalized linear regression model on the log transformation of length of stay. The model was developed using demographic factors, health factors, factors related to functioning of the heart and prior cardiac intervention as predictors. Patients who died during the CABG surgery hospitalization were excluded from analysis as were patients who stayed fewer than two days in hospital and those who stayed over 30 days.

Table D4 presents the final model used to estimate risk-adjusted length of stay by hospital and includes only those predictors found to be statistically significant at five percent or lower levels. Consistent with findings in Pennsylvania, the predictive power of the model is low (only 18.0 percent). Such low predictive power is usually common when one fits a regression model using individual level data as large as these.

Please note that the coefficients provided in Table D4 are in log form and interpretation of the values should take that into consideration.

Table D4

Risk Factors Identified for Isolated CABG Surgery Length of Stay (2008)

Patient Risk Factors Identified	Proportion of Patients(%)	Generalized Linear Regression Results Coefficient	P-Value
Demographic factors			
Age (in years) Squared	---	0.000063	<.0001
Medicaid	1.95	0.1437	0.0005
Health factors			
Transfer In	29.28	0.0433	0.0009
Diabetes - Insulin	12.34	0.1197	<.0001
Lung Disease - Mild or Moderate	13.84	0.0905	<.0001
Lung Disease - Severe	2.61	0.1529	<.0001
Renal Failure with Dialysis	2.26	0.1266	0.0013
Renal Failure without Dialysis	3.90	0.1501	<.0001
IABP Placed Preoperatively	7.77	0.1225	<.0001
Factors related to functioning of the heart			
Arrhythmia	11.76	0.1577	<.0001
Cardiogenic Shock-Hemodynamic Instability	2.19	0.1117	0.0085
Congestive Heart Failure	15.04	0.1057	<.0001
Ejection Fraction 1 - 29%	6.73	0.0984	<.0001
Ejection Fraction 30 - 49%	28.22	0.0303	0.0202
Number of Diseased Vessels - Two	20.09	0.1115	0.0001
Number of Diseased Vessels - Three	75.08	0.1540	<.0001
NYHA Classification - II	33.84	0.0452	0.0126
NYHA Classification - III or IV	52.56	0.0457	0.0101
Intercept	1.2249		
R-Square	17.97		
Number of CABGs (N)*	4,515		

SOURCE: New Jersey Department of Health and Senior Services.

* Excluded are patients who died during hospitalization where CABG was performed; patients with postsurgical LOS > 30 days; and patients with post-surgical LOS < 2 days.

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Limited copies of this report are available by writing to the New Jersey Department of Health and Senior Services, Office of Health Care Quality Assessment, P.O. Box 360, Trenton, NJ 08625, by calling (800) 418-1397, by fax at (609) 984-7735 or by email to hcqa@doh.state.nj.us. The report is also posted on our website at: www.nj.gov/ health/healthcarequality/cardiacsurgery.shtml.

Cardiac Surgery in New Jersey 2008

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