New York State Report on

Mortality after Acute Myocardial Infarction

(Heart Attack)

2015

Department of Health

March 2018

I am pleased to provide, for the first time in NYS, this report of outcomes for patients treated for Acute Myocardial Infarction (AMI, commonly known as “heart attack”). The information contained in this report can be used by hospitals and physicians to improve the quality of care and outcomes for patients with AMI and can provide patients and their families with a better understanding of the risks and outcomes associated with this condition.

The report provides data on risk factors linked to mortality following AMI and has hospital risk-adjusted 30-day mortality rates. The analyses use a risk-adjustment process to account for pre-existing differences in patients’ health statuses. It is important to keep in mind that the information in this report does not include data after 2015. Significant changes may have taken place in some hospitals since that time.

This is an important compliment to the long-standing tradition of careful evaluation and public dissemination of outcomes for cardiac care in NYS. While reports on cardiac surgery and Percutaneous Coronary Intervention provide useful information related to patients undergoing these procedures, they do not include results for patients who do not receive a procedure. The AMI report focuses on a single diagnosis and evaluates outcomes for patients regardless of what, if any, procedure was performed. This additional information allows for evaluation of additional key components of the health care system.

I would also ask that patients and physicians alike give careful consideration to the importance of healthy lifestyles for all those affected by heart disease. Controllable risk factors that contribute to a higher likelihood of developing coronary artery disease are high cholesterol levels, cigarette smoking, high blood pressure, obesity and sedentary lifestyle. Careful attention to these risk factors will contribute to improved health for patients and will help to minimize the development of new blockages in the coronary arteries.

I extend my appreciation to the providers in this State and to the Cardiac Advisory Committee for their efforts in developing and refining this report. The Department of Health will continue to work in partnership with hospitals and physicians to ensure high quality of care for patients with heart disease. We look forward to continuing to provide reports such as this as well as the PCI and Cardiac Surgery Reports on an annual basis. I applaud the continued high quality of care available from our New York State health care providers.

Howard A. Zucker, M.D., J.D.

Commissioner of Health

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Introduction

Heart disease is the leading cause of death in New York State (NYS).[1] Some patients with severe heart disease experience an Acute Myocardial Infarction (AMI), commonly referred to as a heart attack. A heart attack consists of permanent damage to the heart muscle (death of heart tissue) resulting from a reduction in blood flow to the heart. A frequent consequence of this damage is death within a short period of time. This report marks the first time that NYS is releasing to the public information on risk-adjusted mortality outcomes for AMI patients at hospitals across the state.

This report builds upon the New York State Department of Health's long history of data-driven quality improvement activities for cardiac procedures. It is consistent with the Department of Health's mission to protect and promote the health of New Yorkers through prevention, science, and the assurance of quality health care delivery. For over twenty years, a cardiac profile system for cardiac surgery and percutaneous coronary intervention (PCI) has been maintained by the Department of Health. Outcome reports for hospitals and physicians performing these procedures have been publicly available since 1989 for coronary artery bypass surgery, since 1996 for PCI and since 1998 for valve surgery.

Assessing outcomes for all AMI patients, some of whom are not treated with PCI or cardiac surgery, is an important addition to the existing reports on cardiac procedures. One reason is that providing hospitals with meaningful information about outcomes for these patients allows for a broad-based review of potential areas for improvement. Expanding the focus to include patients who do not receive cardiac procedures may prompt some facilities to examine their treatment and transfer patterns to determine if a cardiac procedure, particularly PCI, is being made available to all patients who are likely to benefit from it. Some cardiologists and other clinicians have suggested that outcome reports like this one are an important component of a comprehensive evaluation of cardiac care.

Like the reports on cardiac procedures, these analyses have been conducted under the guidance of the New York State Cardiac Advisory Committee, a group of independent practicing cardiac surgeons, cardiologists and other professionals in related fields.

Purpose of this Report

The purpose of this report is to provide useful information to hospitals to support their ongoing quality improvement efforts surrounding AMI care and to help them identify areas where new or enhanced initiatives may be beneficial. The report includes patients of all ages, and includes all public and private payers. Also, it is intended to provide valuable information to the public about the quality of AMI care provided by New York State hospitals. Optimal treatment of AMI patients typically involves an integrated system of care which may include multiple hospitals as well as pre-hospital emergency medical services. Public availability of these data will enable meaningful evaluation and improvements across and within systems of care.

Because it is a relatively common condition associated with substantial mortality and a rich evidence base to support quality improvement initiatives, multiple government agencies and professional societies have focused on outcomes for AMI. The information in this report is intended to complement data that is available in other reports. In particular, the Centers for Medicare & Medicaid Services (CMS) provide data to hospitals[2] and the public concerning 30-day mortality for AMI.[3] Some of the primary ways in which this NYS report differs from the CMS report are summarized Appendix 1.

Identifying AMI Cases and Assessing Hospital Performance

Data Sources

The primary data source for this report is the Statewide Planning and Research Cooperative System (SPARCS). SPARCS is a comprehensive all-payer data reporting system established in 1979 as a result of cooperation between the healthcare industry and government. SPARCS collects patient level detail on patient characteristics, diagnoses and treatments, services, and charges for each hospital inpatient stay and outpatient visit.[4] In 2007, SPARCS was expanded to include three clinical data elements for AMI patients: systolic blood pressure, diastolic blood pressure, and heart rate. These have been shown to be independent predictors of short-term mortality for AMI patients in earlier studies, and subsequent analyses of New York data confirmed their importance. SPARCS data for 2015 discharges were linked to the New York State Vital Statistics to identify mortality within 30 days of admission for AMI cases.

Identifying AMI Cases for Analysis

All cases identified as an AMI in this report had a principal diagnosis of Acute MI in SPARCS. This report, like the CMS report, includes information about patients with two kinds of AMI:

ST segment Elevation Myocardial Infarction (STEMI) and Non-ST segment Elevation Myocardial Infarction (NSTEMI). It is important to distinguish between these two types of AMI because they have different treatment protocols and levels of risk (STEMI is higher risk). Appendix 2 contains more details on the diagnoses used in this report to identify AMI.

Some records with an AMI diagnosis needed to be excluded from analysis for a variety of reasons. The features that caused cases to be excluded are listed below:

- Age less than 18 years at the time of admission.
- Discharge status indicates the patient left against medical advice or discontinued care.
- Patient discharged on either the same day as admission or the next day and not transferred to another acute care facility.
- Patient residence is not in NYS (because of inability to track mortality status after discharge).
- For patients with two separate AMI admissions who died within 30 days of both admissions, only the first was analyzed and all later records were excluded.

Transfer Patients

There is also a need to combine some records because there is more than one record for patients who have been transferred in the same episode of care. For the purposes of analysis, each patient outcome needs to be attributed to a single hospital. This allows for an unduplicated count of cases and a meaningful statewide mortality rate.

In this report, cases are assigned to the first hospital that treated the patient (whether as an inpatient or in the Emergency Department). Transfers occur most commonly when a patient is treated first at a hospital that does not have PCI on site and is transferred to a hospital that can provide that procedure. Attributing the case to the first hospital, and

not the one that provided additional care, recognizes that optimal treatment for AMI patients presenting to a hospital without PCI onsite often requires transfer to another hospital. This incentivizes hospitals to make appropriate transfers and diminishes any disincentive for the PCI hospital to accept AMI transfers.

Two exceptions to this rule are when the first hospital only has an emergency department and no inpatients, and when the first hospital has no emergency department. Neither of these types of hospitals appears in the report, and the patients transferred from them are attributed to the receiving hospital.

Appendix 3 further describes the identification and analysis of AMI cases including case attribution strategy in less common transfer patterns, situations where the sending and receiving hospital are not in agreement on the principal diagnosis of AMI, and the process for matching records for patients treated at more than one hospital.

Outcome

The outcome of interest in this report is risk-adjusted mortality status 30 days after initial admission or emergency department encounter. All deaths that occur inside or outside the hospital but within 30 days of admission are counted as deaths in the report. Those who expire during the same hospital stay but more than 30 days after admission are not counted as a mortality.

Accounting for Differences in Patient Risk

There are many patient characteristics that influence outcomes after AMI. These include age, the presence of other conditions, the area of the heart affected by the AMI, and hemodynamic state when arriving at the hospital. Appendix 4 describes the methods used to adjust for differences in patient characteristics and presents the significant risk factors for 30-day mortality for NYS AMI patients in 2015.

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[1] NYS Vital Statistics (https://www.health.ny.gov/statistics/leadingcauses_death)

[2] www.qualitynet.org

[3] www.medicare.gov/hospitalcompare

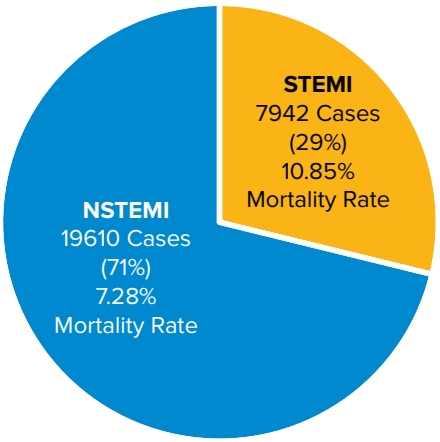
[4] www.health.ny.gov/statistics/sparcs

Acute Myocardial Infarction in NYS: Statewide Results

In 2015 there were 27,552 AMI patients discharged from 182 acute care hospitals. The overall observed 30-day mortality rate for these patients was 8.31%.

Because there are important differences in treatment protocols and expected outcomes for STEMI and NSTEMI patients, it is useful to look at outcomes separately for these groups. Figure 1 shows that of all the AMI patients included in this report, 7,942 (29%) were classified as STEMI and 19,610 (71%) were classified as NSTEMI. The overall observed mortality rates for these two groups were 10.85% and 7.28%, respectively.

Figure 1.
Number and type of acute MI Patients in NYS, 2015

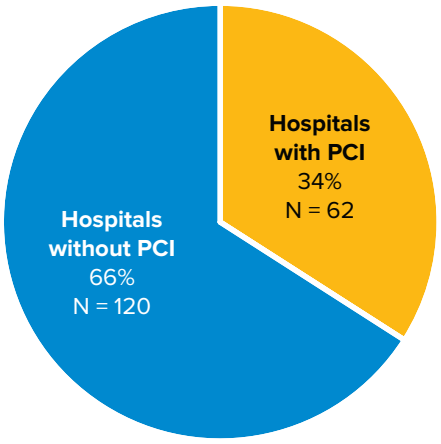


All AMI: 27,522 Cases
8.31% 30-day Mortality Rate

Many patients with an AMI are treated at more than one hospital because not all hospitals are able to perform diagnostic catheterization (an invasive test of the heart that can look for damage caused by the MI) or provide advanced services like PCI and cardiac surgery. These tend to be larger hospitals that have more experience and resources to care for acutely ill cardiac patients. This report distinguishes between PCI and non-PCI centers because PCI is an important treatment for AMI and because all PCI hospitals are able to perform diagnostic catheterization.

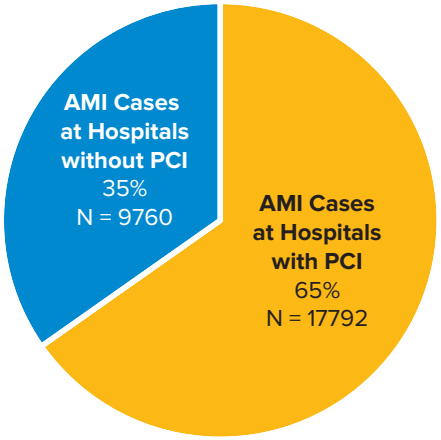
As seen in Figure 2, only 62 (34%) of hospitals with AMI patients are approved to perform PCI. However, as indicated in Figure 3, 65% of all AMI patients are treated at PCI hospitals. Among all AMI patients presenting to a Non-PCI hospital, 70.30% were transferred to a PCI hospital (the percent transferred was 87.63% and 64.92% for STEMI and NSTEMI, respectively).

Figure 2.
Number of hospitals treating AMI patients with and without PCI on site



Hospitals in NYS with AMI Cases in 2015
N = 182

Figure 3.
Number of 2015 AMI Cases at centers with and without PCI onsite



Acute Myocardial Infarction in NYS: Hospital Results

As described in detail in Appendix 4, the expected mortality rate is a measure of severity of illness of a hospital's patients, where a rate higher than the statewide average mortality rate indicates that a hospital's case mix is of higher risk than the statewide mix. A lower expected mortality rate indicates the hospital's patients are of lower risk than the statewide patients overall. The risk-adjusted mortality rate is an estimate of what a hospital's mortality rate would have been if its case mix had been identical to the statewide mix. Consequently, a risk-adjusted mortality rate statistically significantly higher than the statewide mortality rate indicates a performance that is worse than the state as a whole. Likewise, a risk-adjusted mortality rate that is statistically significantly lower than the statewide rate means that the hospital's results are better than the state as a whole.

Table 1 provides the following information for All AMI Cases, STEMI Cases and NSTEMI for each hospital in New York with an AMI volume greater than 25:

- type of hospital (P = provides PCI; N = does not provide PCI)
- number of AMI cases,
- number of 30-day mortalities,
- observed mortality rate (OMR),
- expected mortality rate (EMR),
- risk-adjusted mortality rate (RAMR)
- 95% confidence interval for the RAMR
- A flag to indicate if the hospital's RAMR is statistically different than the NYS rate

For reference and benchmarking purposes, the number of cases and mortality rate for NYS are also provided. There is no expected or risk-adjusted mortality rate for NYS. The NYS observed mortality rate is the basis of comparison for each hospital mortality rate.

These analyses show that four hospitals had risk-adjusted mortality rates that were significantly higher than expected given their patient mix. These hospitals are Faxton-St. Luke's Healthcare St. Luke's Division in Utica, University Hospital of Brooklyn, Columbia Memorial Hospital in Hudson, and Millard Fillmore Suburban Hospital in Buffalo. Three hospitals had mortality rates that were significantly lower than expected (fewer deaths than expected based on their case-mix). These hospitals are Maimonides Medical Center in Brooklyn, Montefiore New Rochelle Hospital, and New York Community Hospital of Brooklyn, Inc.

For treatment of STEMI patients, one hospital (University Hospital of Brooklyn) had a mortality rate significantly higher than expected (more deaths than expected) and no hospitals had mortality rates significantly lower than expected.

For treatment of NSTEMI patients, two hospitals (Columbia Memorial Hospital and Millard Fillmore Suburban Hospital) had mortality rates significantly higher than expected and one hospital (Maimonides Medical Center) had a mortality rate significantly lower than expected.

Figures 4 – 6 provide a visual display of the RAMRs presented in Table 1 for All AMI, STEMI and NSTEMI, respectively. Each graph shows the spread of the hospital RAMRs and confidence intervals as compared to the statewide mortality rate, which is represented by the red vertical line. For each hospital, the diamond shape represents the RAMR and the horizontal line represents the confidence interval, or potential statistical error, for the RAMR. For any hospital where the line crosses the state average line, the RAMR is not statistically different from the state as a whole. Hospitals that are statistical outliers have lines (confidence intervals) that are either entirely above or entirely below the marker for the statewide rate. These hospitals are color coded with blue lines and diamonds indicating lower than expected mortality rates and red lines and diamonds indicating higher than expected mortality rates. A gray horizontal line that extends far above and/or below the statewide average indicates that a hospital has a wide confidence interval. This is common when the hospital has a very small number of cases. It does not necessarily mean that the risk-adjusted mortality rate is very high or very low.

Table 1
Acute Myocardial Infarction in NYS: Hospital Results

Hospital Observed, Expected and Risk-Adjusted 30-Day Mortality Rates for All AMI, STEMI and NSTEMI in NYS, 2015

		All Cases						STEMI Cases		NSTEMI Cases	
Hospital	**Type†**	**Cases**	**Deaths**	**OMR**	**EMR**	**RAMR**	**95% CI for RAMR**	**Cases**	**RAMR**	**Cases**	**RAMR**
New York State		**27552**	**2289**	**8.31**				**7942**	**10.85††**	**19610**	**7.28††**
Western NY											
Bertrand Chaffee Hospital	N	55	7	12.73	6.79	15.58	(6.24, 32.10)	14	14.58	41	16.21
Brooks Memorial Hospital	N	48	10	20.83	14.77	11.72	(5.61, 21.55)	22	16.77	26	8.53
Buffalo General Medical Center	P	690	55	7.97	7.18	9.23	(6.95, 12.01)	269	12.94	421	7.47
Degraff Memorial Hospital	N	47	9	19.15	9.62	16.54	(7.55, 31.40)	20	16.82	27	15.77
Eastern Niagara Hospital - Lockport Division	N	130	14	10.77	8.68	10.31	(5.63, 17.30)	23	25.56	107	7.15
Erie County Medical Center	N	28	0	0.00	7.43	0.00	(0.00, 14.65)	13	0.00	15	0.00
Kenmore Mercy Hospital	N	179	22	12.29	11.06	9.23	(5.79, 13.98)	43	11.60	136	8.18
Medina Memorial Hospital	N	65	7	10.77	9.02	9.92	(3.98, 20.45)	16	6.65	49	10.32
Memorial Hosp of Wm F & Gertrude F Jones A/K/A Jones Memorial Hosp	N	37	5	13.51	8.02	14.00	(4.51, 32.66)	14	20.30	23	10.67
Mercy Hospital of Buffalo	P	514	64	12.45	10.98	9.42	(7.26, 12.03)	185	13.26	329	7.70
Millard Fillmore Suburban Hospital	N	165	30	18.18	9.31	16.23*	(10.95, 23.17)	48	12.99	117	15.29*
Mount St Marys Hospital and Health Center	N	175	12	6.86	7.22	7.89	(4.07, 13.79)	39	14.48	136	5.37
Niagara Falls Memorial Medical Center	N	70	9	12.86	9.35	11.42	(5.21, 21.69)	11	9.96	59	10.67
Olean General Hospital	P	144	12	8.33	5.72	12.11	(6.25, 21.16)	35	12.47	109	11.21
Sisters of Charity Hospital	N	92	14	15.22	9.39	13.47	(7.36, 22.60)	19	15.91	73	12.32
Sisters of Charity Hospital - St Joseph Campus	N	136	16	11.76	12.04	8.12	(4.64, 13.18)	44	9.60	92	7.74
United Memorial Medical Center North Street Campus	N	99	8	8.08	7.57	8.87	(3.82, 17.48)	23	6.33	76	8.81
Woman's Christian Association	N	171	9	5.26	6.72	6.51	(2.97, 12.36)	72	6.65	99	6.63
Wyoming County Community Hospital	N	51	6	11.76	8.98	10.89	(3.97, 23.69)	12	13.81	39	9.83
Finger Lakes											
Arnot Ogden Medical Center	P	213	25	11.74	10.08	9.68	(6.26, 14.29)	54	10.99	159	8.81
Clifton Springs Hospital and Clinic	N	35	5	14.29	13.43	8.83	(2.85, 20.62)	14	10.22	21	8.47
Corning Hospital	N	153	11	7.19	5.37	11.12	(5.54, 19.89)	29	5.72	124	11.51
F F Thompson Hospital	N	101	11	10.89	9.39	9.63	(4.80, 17.24)	34	20.46	67	3.09
Geneva General Hospital	N	77	5	6.49	6.86	7.86	(2.53, 18.34)	28	4.16	49	10.87

		All Cases						STEMI Cases		NSTEMI Cases	
Hospital	**Type†**	**Cases**	**Deaths**	**OMR**	**EMR**	**RAMR**	**95% CI for RAMR**	**Cases**	**RAMR**	**Cases**	**RAMR**
Highland Hospital	N	57	3	5.26	5.60	7.81	(1.57, 22.82)	12	19.95	45	3.46
Ira Davenport Memorial Hospital Inc	N	51	4	7.84	11.38	5.73	(1.54, 14.66)	7	21.42	44	1.70
Newark-Wayne Community Hospital	N	80	3	3.75	6.17	5.05	(1.01, 14.75)	20	9.65	60	2.71
Nicholas H Noyes Memorial Hospital	N	55	3	5.45	5.36	8.46	(1.70, 24.72)	21	14.83	34	4.91
Rochester General Hospital	P	596	44	7.38	8.14	7.53	(5.47, 10.11)	159	10.79	437	6.06
Schuyler Hospital	N	39	2	5.13	6.36	6.70	(0.75, 24.20)	14	20.85	25	0.00
Soldiers and Sailors Memorial Hospital of Yates County Inc	N	26	1	3.85	6.04	5.29	(0.07, 29.43)	8	0.00	18	5.82
St James Mercy Hospital	N	64	3	4.69	6.27	6.21	(1.25, 18.15)	17	12.75	47	3.15
Strong Memorial Hospital	P	356	27	7.58	7.63	8.26	(5.44, 12.02)	162	9.93	194	8.29
The Unity Hospital of Rochester	P	250	23	9.20	9.47	8.07	(5.11, 12.11)	78	10.39	172	7.13
Central NY											
Auburn Community Hospital	N	144	17	11.81	10.90	9.00	(5.24, 14.41)	32	6.99	112	11.02
Canton-Potsdam Hospital	N	115	9	7.83	8.42	7.72	(3.52, 14.66)	28	8.40	87	7.17
Cayuga Medical Center at Ithaca	P	133	10	7.52	8.98	6.96	(3.33, 12.80)	61	8.26	72	6.78
Claxton-Hepburn Medical Center	N	68	3	4.41	6.48	5.65	(1.14, 16.52)	23	3.95	45	8.74
Community Memorial Hospital Inc	N	30	2	6.67	4.91	11.29	(1.27, 40.77)	11	18.04	19	8.37
Cortland Regional Medical Center Inc	N	60	3	5.00	8.23	5.05	(1.01, 14.76)	15	7.81	45	4.10
Crouse Hospital	P	152	12	7.89	7.11	9.23	(4.76, 16.12)	49	7.33	103	10.29
Faxton-St Lukes Healthcare St Lukes Division	P	150	24	16.00	10.08	13.18*	(8.44, 19.61)	42	15.96	108	12.02
Lewis County General Hospital	N	32	3	9.38	9.95	7.83	(1.57, 22.87)	12	18.47	20	0.00
Little Falls Hospital	N	47	4	8.51	8.54	8.28	(2.23, 21.19)	16	11.59	31	6.03
Massena Memorial Hospital	N	64	4	6.25	6.54	7.93	(2.13, 20.31)	21	7.05	43	8.24
Oneida Healthcare	N	39	3	7.69	9.82	6.51	(1.31, 19.01)	23	7.68	16	7.25
Oswego Hospital	N	105	8	7.62	8.57	7.39	(3.18, 14.56)	20	0.00	85	8.55
Rome Memorial Hospital, Inc	N	45	4	8.89	6.82	10.84	(2.92, 27.74)	18	7.03	27	14.34
Samaritan Medical Center	N	124	13	10.48	7.29	11.94	(6.35, 20.43)	41	18.99	83	9.07
St Elizabeth Medical Center	P	239	16	6.69	6.45	8.62	(4.93, 14.01)	108	12.00	131	6.86
St Josephs Hospital Health Center	P	466	28	6.01	4.44	11.25	(7.47, 16.26)	181	14.34	285	10.04
University Hospital SUNY Health Science Center	P	140	15	10.71	6.58	13.52	(7.56, 22.31)	42	16.66	98	12.72
NY-Penn											
Chenango Memorial Hospital Inc	N	46	6	13.04	7.43	14.58	(5.32, 31.73)	8	37.33	38	11.63
Our Lady of Lourdes Memorial Hospital Inc	N	143	13	9.09	11.49	6.57	(3.50, 11.24)	26	4.37	117	6.98
United Health Services Hospitals Inc. - Wilson Medical Center	P	348	34	9.77	8.53	9.51	(6.59, 13.29)	135	10.70	213	9.73

		All Cases						STEMI Cases		NSTEMI Cases	
Hospital	**Type†**	**Cases**	**Deaths**	**OMR**	**EMR**	**RAMR**	**95% CI for RAMR**	**Cases**	**RAMR**	**Cases**	**RAMR**
Northeastern NY											
Adirondack Medical Center-Saranac Lake Site	N	53	4	7.55	6.78	9.25	(2.49, 23.69)	12	27.50	41	5.19
Albany Medical Center Hospital	P	325	25	7.69	8.59	7.44	(4.81, 10.98)	133	7.00	192	8.79
Albany Memorial Hospital	N	52	4	7.69	5.72	11.17	(3.00, 28.59)	21	8.64	31	12.69
Alice Hyde Medical Center	N	105	14	13.33	7.62	14.54	(7.94, 24.40)	22	14.87	83	13.78
Aurelia Osborn Fox Memorial Hospital	N	64	5	7.81	7.89	8.23	(2.65, 19.20)	13	10.15	51	7.31
Cobleskill Regional Hospital	N	40	1	2.50	7.77	2.67	(0.03, 14.87)	12	5.82	28	0.00
Columbia Memorial Hospital	N	80	18	22.50	11.38	16.43*	(9.73, 25.97)	20	15.59	60	15.57*
Delaware Valley Hospital Inc	N	33	4	12.12	6.63	15.18	(4.08, 38.86)	12	23.88	21	11.37
Ellis Hospital	P	418	43	10.29	8.02	10.65	(7.71, 14.35)	156	12.41	262	10.32
Glens Falls Hospital	P	192	12	6.25	6.82	7.62	(3.93, 13.30)	70	10.66	122	6.46
Mary Imogene Bassett Hospital	P	146	9	6.16	5.96	8.59	(3.92, 16.31)	39	13.20	107	6.72
Nathan Littauer Hospital	N	60	8	13.33	6.36	17.43	(7.50, 34.35)	16	11.60	44	17.70
Samaritan Hospital	P	157	11	7.01	8.79	6.62	(3.30, 11.84)	50	10.50	107	5.05
Saratoga Hospital	P	142	15	10.56	7.90	11.11	(6.21, 18.33)	41	18.31	101	8.24
St Peters Hospital	P	322	21	6.52	5.75	9.43	(5.83, 14.41)	85	9.82	237	8.97
St. Mary's Healthcare	N	143	18	12.59	11.46	9.13	(5.41, 14.43)	31	9.63	112	8.80
St. Mary's Hospital	N	60	9	15.00	8.08	15.42	(7.03, 29.27)	15	12.20	45	16.59
The University of Vermont Health Network - Champlain Valley Physicians	P	227	21	9.25	6.66	11.53	(7.14, 17.63)	44	10.51	183	12.22
Mid-Hudson											
Bon Secours Community Hospital	N	43	5	11.63	11.18	8.64	(2.79, 20.17)	8	12.66	35	7.37
Catskill Regional Medical Center	N	130	12	9.23	6.43	11.93	(6.16, 20.83)	22	13.64	108	10.58
Ellenville Regional Hospital	N	25	1	4.00	6.48	5.13	(0.07, 28.55)	9	16.90	16	0.00
Good Samaritan Hospital of Suffern	P	307	24	7.82	8.03	8.09	(5.18, 12.04)	110	8.99	197	7.77
HealthAlliance Hospital Broadway Campus	N	158	16	10.13	11.41	7.37	(4.21, 11.98)	51	9.78	107	6.34
Mid-Hudson Valley Division of Westchester Medical Center	N	30	5	16.67	12.24	11.31	(3.65, 26.40)	6	14.06	24	10.26
Montefiore Mount Vernon Hospital	N	28	3	10.71	6.42	13.87	(2.79, 40.54)	5	37.32	23	9.67
Montefiore New Rochelle Hospital	N	91	3	3.30	11.84	2.31**	(0.46, 6.76)	26	2.34	65	2.37
New York-Presbyterian/ Lawrence Hospital	P	183	12	6.56	9.25	5.89	(3.04, 10.29)	35	2.62	148	6.27
NewYork-Presbyterian/ Hudson Valley Hospital	N	172	16	9.30	8.70	8.89	(5.08, 14.43)	28	18.46	144	7.17
Northern Dutchess Hospital	N	72	6	8.33	8.60	8.05	(2.94, 17.52)	20	11.26	52	6.61

		All Cases						STEMI Cases		NSTEMI Cases	
Hospital	**Type†**	**Cases**	**Deaths**	**OMR**	**EMR**	**RAMR**	**95% CI for RAMR**	**Cases**	**RAMR**	**Cases**	**RAMR**
Northern Westchester Hospital	N	107	9	8.41	9.99	6.99	(3.19, 13.28)	18	4.70	89	6.94
Nyack Hospital	N	135	12	8.89	10.86	6.80	(3.51, 11.88)	35	10.56	100	5.52
Orange Regional Medical Center	P	423	28	6.62	5.96	9.23	(6.13, 13.35)	123	10.54	300	8.58
Phelps Memorial Hospital Assn	N	78	9	11.54	10.71	8.95	(4.08, 16.99)	22	11.46	56	7.97
Putnam Hospital Center	N	138	12	8.70	9.48	7.62	(3.93, 13.31)	35	6.04	103	8.51
SJRH - St Johns Division	N	146	9	6.16	7.36	6.96	(3.17, 13.20)	26	14.80	120	4.65
St Anthony Community Hospital	N	42	3	7.14	6.35	9.35	(1.88, 27.32)	7	0.00	35	8.92
St Joseph's Medical Center	N	48	4	8.33	10.51	6.59	(1.77, 16.87)	14	11.77	34	5.30
St Luke's Cornwall Hospital/Newburgh	P	246	19	7.72	8.69	7.38	(4.44, 11.53)	64	7.15	182	6.92
Vassar Brothers Medical Center	P	409	37	9.05	8.54	8.80	(6.19, 12.13)	141	10.28	268	8.47
Westchester Medical Center	P	164	11	6.71	8.70	6.41	(3.19, 11.47)	96	8.53	68	5.34
White Plains Hospital Center	P	200	17	8.50	9.48	7.45	(4.34, 11.93)	63	8.39	137	6.99
New York City - The Bronx											
Bronx-Lebanon Hospital Center - Concourse Division	P	209	20	9.57	8.11	9.80	(5.98, 15.13)	80	12.59	129	8.81
Jacobi Medical Center	N	92	5	5.43	7.27	6.21	(2.00, 14.49)	21	6.44	71	6.57
Lincoln Medical & Mental Health Center	N	133	4	3.01	4.92	5.08	(1.37, 13.00)	18	7.33	115	4.31
Montefiore Med Center - Jack D Weiler Hosp of A Einstein College Div	P	336	18	5.36	6.49	6.86	(4.06, 10.84)	128	9.93	208	5.21
Montefiore Medical Center - Henry & Lucy Moses Div	P	267	24	8.99	6.93	10.77	(6.90, 16.03)	87	15.74	180	8.39
Montefiore Medical Center-Wakefield Hospital	N	62	3	4.84	11.89	3.38	(0.68, 9.88)	12	5.34	50	2.73
SBH Health System	P	112	7	6.25	7.67	6.77	(2.71, 13.94)	34	9.67	78	5.57
New York City - Brooklyn											
Brookdale Hospital Medical Center	P	237	26	10.97	11.52	7.91	(5.17, 11.59)	75	12.06	162	6.27
Brooklyn Hospital Center - Downtown Campus	N	168	19	11.31	10.64	8.83	(5.32, 13.80)	17	8.36	151	8.10
Coney Island Hospital	N	151	11	7.28	9.04	6.69	(3.34, 11.97)	40	7.37	111	6.11
Kings County Hospital Center	N	178	12	6.74	7.11	7.88	(4.07, 13.76)	24	0.00	154	8.14
Kingsbrook Jewish Medical Center	N	128	13	10.16	10.31	8.19	(4.35, 14.00)	6	0.00	122	7.84
Maimonides Medical Center	P	727	46	6.33	8.49	6.19**	(4.53, 8.25)	227	10.30	500	4.71**
Mount Sinai Brooklyn	N	179	22	12.29	15.35	6.65	(4.17, 10.07)	38	7.75	141	6.18
NYU Lutheran Medical Center	P	145	9	6.21	8.50	6.06	(2.77, 11.51)	38	8.45	107	5.15
New York Community Hospital of Brooklyn, Inc	N	92	6	6.52	16.68	3.25**	(1.19, 7.07)	26	3.48	66	3.20
New York Methodist Hospital	P	402	26	6.47	8.73	6.15	(4.02, 9.02)	72	9.62	330	4.96
University Hospital of Brooklyn	P	190	21	11.05	6.40	14.35*	(8.88, 21.94)	58	23.65*	132	9.85

		All Cases						STEMI Cases		NSTEMI Cases	
Hospital	**Type†**	**Cases**	**Deaths**	**OMR**	**EMR**	**RAMR**	**95% CI for RAMR**	**Cases**	**RAMR**	**Cases**	**RAMR**
Woodhull Medical & Mental Health Center	N	98	6	6.12	8.50	5.98	(2.18, 13.02)	17	11.13	81	4.04
Wyckoff Heights Medical Center	N	149	7	4.70	7.15	5.46	(2.19, 11.25)	15	12.85	134	4.06
New York City - Manhattan											
Bellevue Hospital Center	P	129	4	3.10	5.73	4.49	(1.21, 11.50)	36	9.99	93	1.76
Harlem Hospital Center	N	35	1	2.86	6.94	3.42	(0.04, 19.02)	11	8.11	24	0.00
Lenox Hill Hospital	P	228	18	7.89	7.76	8.45	(5.01, 13.36)	64	12.75	164	6.53
Metropolitan Hospital Center	N	84	7	8.33	8.93	7.76	(3.11, 15.98)	11	13.20	73	6.22
Mount Sinai Beth Israel	P	291	24	8.25	9.02	7.59	(4.86, 11.30)	104	11.53	187	5.71
Mount Sinai Hospital	P	270	16	5.93	7.99	6.16	(3.52, 10.01)	49	9.27	221	4.90
Mount Sinai Roosevelt	N	46	6	13.04	12.59	8.61	(3.14, 18.74)	10	10.31	36	7.68
Mount Sinai St. Luke's	P	293	19	6.48	9.00	5.98	(3.60, 9.35)	68	6.44	225	5.68
NYU Hospitals Center	P	241	15	6.22	7.23	7.15	(4.00, 11.80)	64	7.33	177	6.96
New York Presbyterian Hospital - Allen Hospital	N	105	13	12.38	8.57	12.00	(6.38, 20.52)	26	19.27	79	9.71
New York Presbyterian Hospital - Columbia Presbyterian Center	P	353	25	7.08	7.39	7.96	(5.15, 11.75)	75	12.44	278	6.38
New York Presbyterian Hospital - New York Weill Cornell Center	P	250	11	4.40	7.81	4.68	(2.33, 8.37)	69	8.13	181	3.40
New York-Presbyterian/Lower Manhattan Hospital	N	41	4	9.76	13.22	6.13	(1.65, 15.69)	15	14.02	26	3.76
New York City - Queens											
Elmhurst Hospital Center	P	286	25	8.74	7.92	9.17	(5.93, 13.54)	112	12.85	174	7.40
Flushing Hospital Medical Center	N	56	3	5.36	6.11	7.28	(1.46, 21.28)	12	0.00	44	8.12
Forest Hills Hospital	N	205	25	12.20	11.71	8.65	(5.60, 12.77)	39	13.71	166	6.78
Jamaica Hospital Medical Center	P	523	42	8.03	8.10	8.24	(5.94, 11.13)	144	10.17	379	7.58
Long Island Jewish Medical Center	P	365	19	5.21	7.53	5.74	(3.46, 8.97)	119	7.62	246	4.97
Mount Sinai Hospital - Mount Sinai Hospital of Queens	N	114	8	7.02	8.65	6.74	(2.90, 13.29)	19	4.94	95	6.65
NewYork-Presbyterian/Queens	P	344	31	9.01	6.97	10.74	(7.29, 15.24)	134	13.19	210	9.93
Queens Hospital Center	N	184	10	5.43	4.76	9.48	(4.54, 17.43)	36	12.21	148	8.35
St Johns Episcopal Hospital So Shore	N	57	5	8.77	9.27	7.86	(2.53, 18.34)	9	24.11	48	4.98
New York City - Staten Island											
Richmond University Medical Center	P	162	11	6.79	7.70	7.33	(3.65, 13.12)	39	13.86	123	5.10
Staten Island University Hosp-North	P	464	44	9.48	7.68	10.26	(7.46, 13.78)	129	15.07	335	8.23
Staten Island University Hosp-South	N	54	7	12.96	10.37	10.38	(4.16, 21.39)	16	17.77	38	6.91

		All Cases						STEMI Cases		NSTEMI Cases	
Hospital	**Type†**	**Cases**	**Deaths**	**OMR**	**EMR**	**RAMR**	**95% CI for RAMR**	**Cases**	**RAMR**	**Cases**	**RAMR**
Nassau-Suffolk											
Brookhaven Memorial Hospital Medical Center Inc	P	194	10	5.15	9.22	4.64	(2.22, 8.54)	37	8.71	157	3.60
Eastern Long Island Hospital	N	28	2	7.14	8.40	7.07	(0.79, 25.52)	10	9.08	18	6.30
Franklin Hospital	N	258	17	6.59	7.70	7.11	(4.14, 11.39)	50	6.18	208	6.98
Glen Cove Hospital	N	75	8	10.67	11.28	7.85	(3.38, 15.48)	21	3.25	54	9.94
Good Samaritan Hospital Medical Center	P	402	26	6.47	7.43	7.24	(4.73, 10.60)	117	9.93	285	6.15
Huntington Hospital	P	204	21	10.29	8.29	10.32	(6.39, 15.77)	58	23.27	146	6.87
John T Mather Memorial Hospital of Port Jefferson New York Inc	N	224	18	8.04	7.99	8.35	(4.95, 13.20)	49	6.85	175	8.30
Mercy Medical Center	N	196	15	7.65	10.76	5.91	(3.30, 9.74)	20	6.46	176	5.33
Nassau University Medical Center	N	88	11	12.50	10.22	10.16	(5.07, 18.19)	29	12.19	59	9.62
North Shore University Hospital	P	375	27	7.20	8.33	7.18	(4.73, 10.45)	113	11.34	262	5.31
Peconic Bay Medical Center	N	116	7	6.03	8.84	5.67	(2.27, 11.68)	27	3.49	89	6.11
Plainview Hospital	N	206	19	9.22	10.43	7.35	(4.42, 11.48)	47	11.63	159	6.06
South Nassau Communities Hospital	P	226	30	13.27	10.70	10.31	(6.95, 14.72)	82	13.81	144	8.88
Southampton Hospital	N	77	5	6.49	9.69	5.57	(1.79, 13.00)	28	8.28	49	4.12
St Catherine of Siena Hospital	P	200	18	9.00	9.72	7.69	(4.56, 12.16)	45	10.82	155	6.44
St Charles Hospital	N	56	6	10.71	9.78	9.10	(3.32, 19.82)	12	0.00	44	10.04
St Francis Hospital	P	312	24	7.69	7.71	8.29	(5.31, 12.34)	67	12.38	245	6.67
St. Joseph Hospital	N	218	23	10.55	9.29	9.43	(5.98, 14.15)	51	5.18	167	9.51
Syosset Hospital	N	41	5	12.20	15.35	6.60	(2.13, 15.40)	6	0.00	35	6.25
University Hospital	P	448	29	6.47	7.84	6.86	(4.59, 9.85)	161	10.94	287	4.78
Winthrop-University Hospital	P	348	24	6.90	7.75	7.39	(4.73, 10.99)	133	7.83	215	7.32
Other 19 non-PCI and 1 PCI hospitals with <25 AMI patients		**292**	**21**	**7.19**				**89**		**203**	
New York State		**27552**	**2289**	**8.31**				**7942**	**10.85††**	**19610**	**7.28††**

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

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

† Type: N = Non-PCI Hospital; P = PCI Hospital.

†† Observed mortality rates are presented for the entire NYS population.

Figure 4

Hospital Risk-Adjusted 30-Day Mortality Rates and 95 Percent Confidence Intervals for All AMI

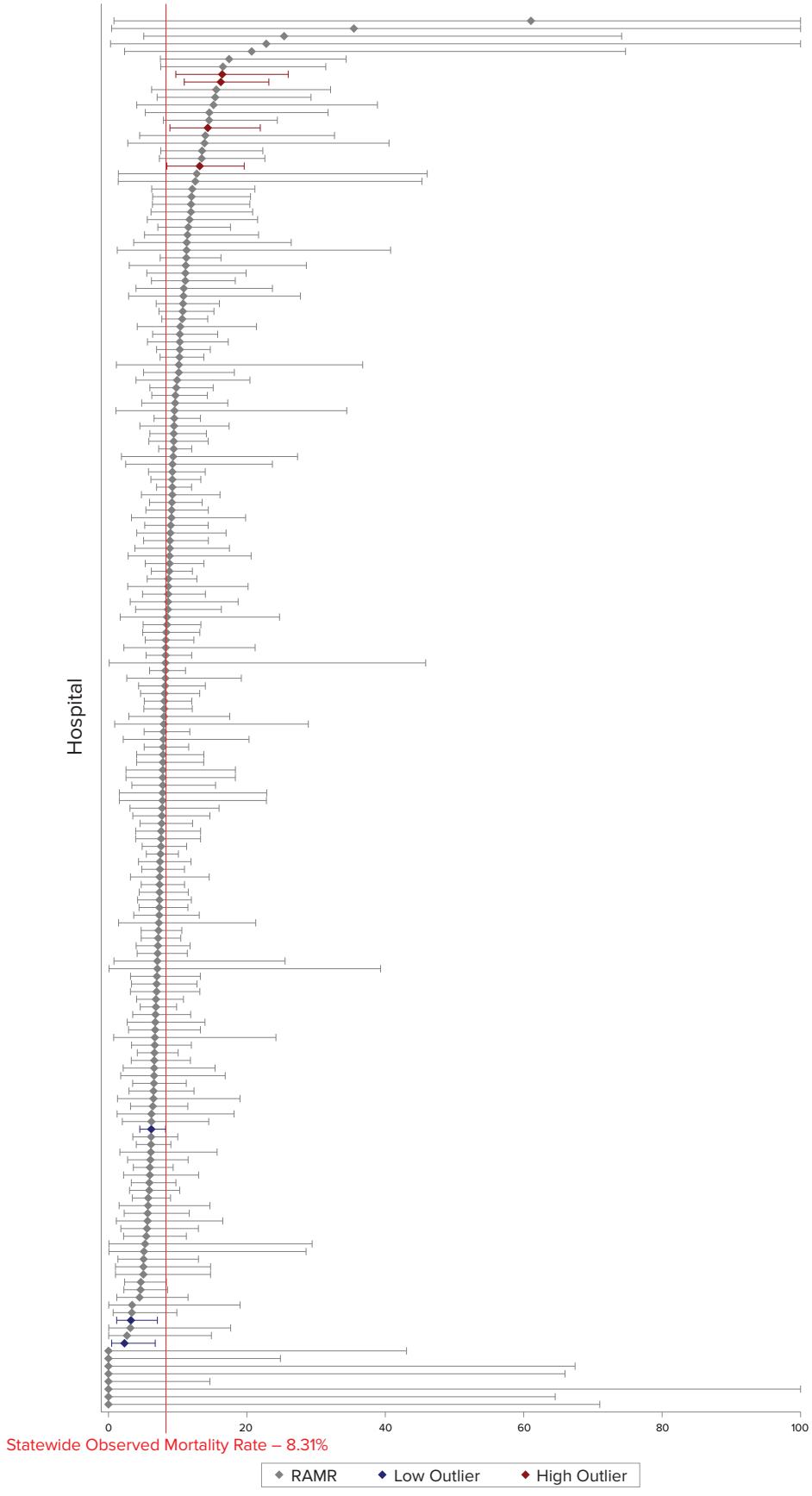


Figure 5

Hospital Risk-Adjusted 30-Day Mortality Rates and 95 Percent Confidence Intervals for STEMI

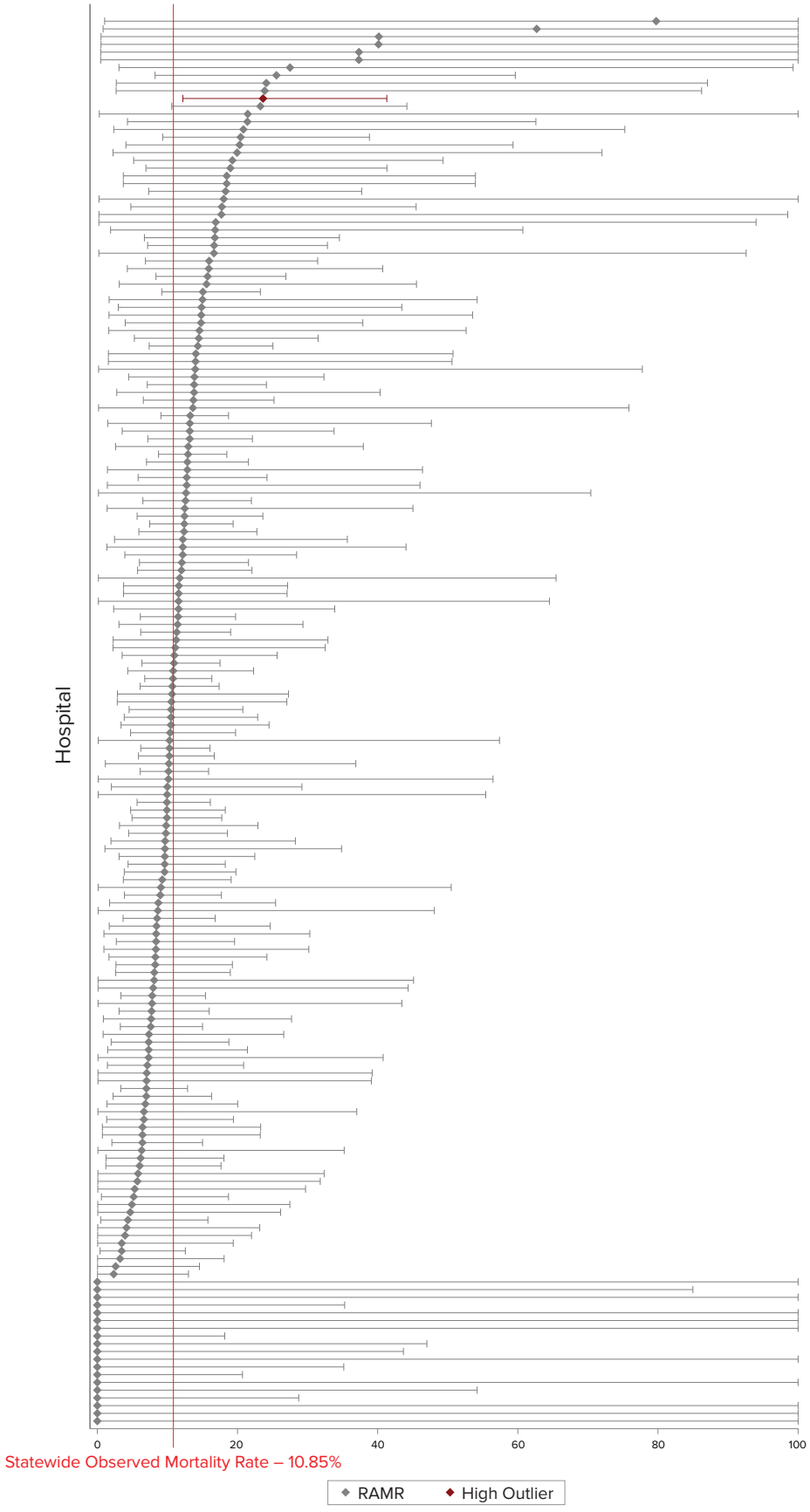
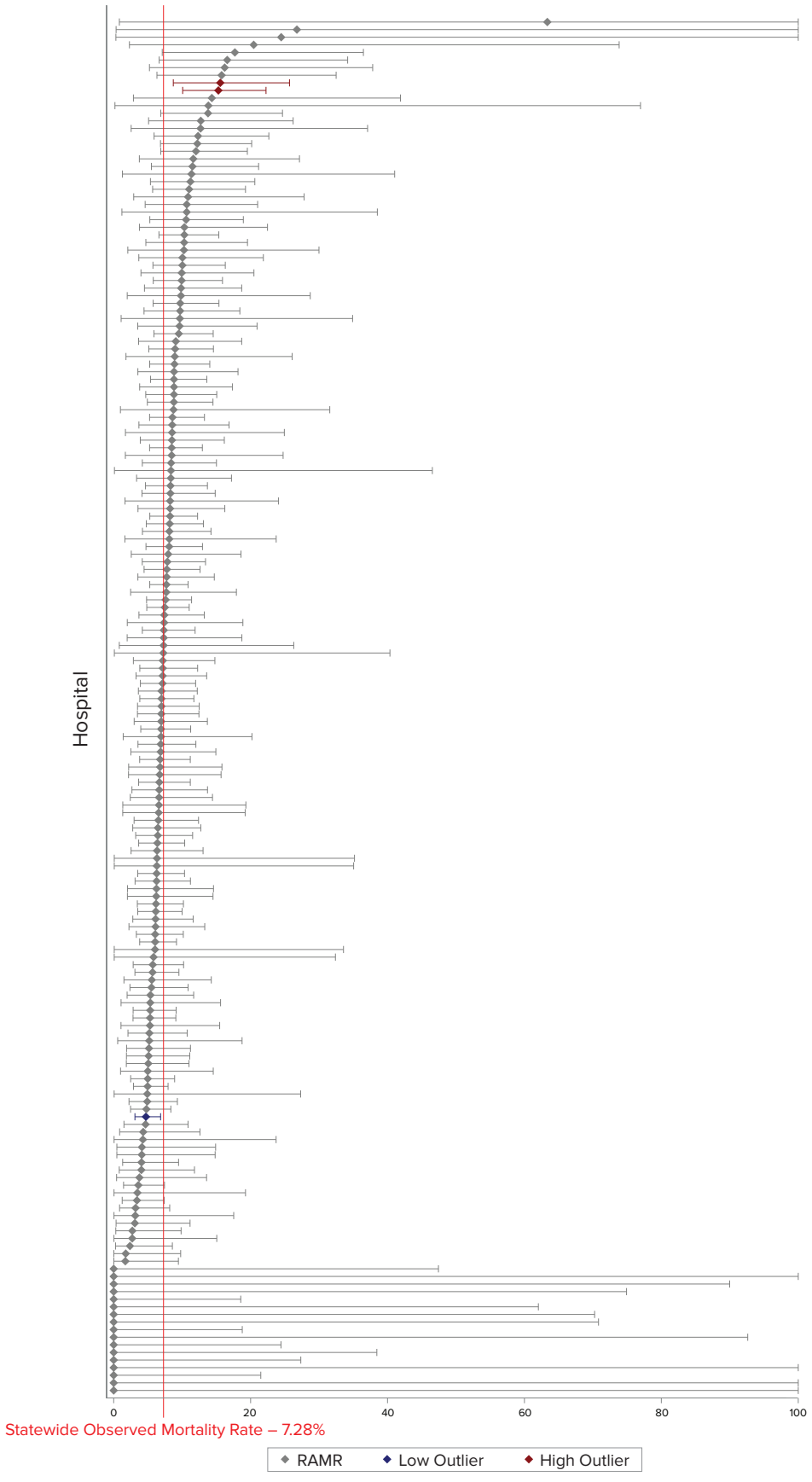


Figure 6

Hospital Risk-Adjusted 30-Day Mortality Rates and 95 Percent Confidence Intervals for NSTEMI



Summary

This is the first public AMI report issued in New York State. We are hopeful that in conjunction with detailed supporting information about processes of care and patient characteristics that will be sent to hospitals in the State, it will serve as an opportunity for hospitals and coordinated systems of care (ambulances, hospitals without PCI, hospitals with PCI) to improve quality of care and outcomes. We are also hopeful that it will prove valuable to prospective patients by providing them information about the nature of care for AMI patients and the outcomes for these patients across the state. Through the dissemination of the report to providers and the public, the Department is striving to meet its mission of assuring the highest quality of health care delivery.

Appendix 1
Differences Between the Centers for Medicare and Medicaid Services and the New York State Methodologies for Evaluating Risk-Adjusted Mortality Rates for Hospitals Providing AMI Care

NYS AMI Report	CMS AMI Report[5,6]
Includes patients from all payer sources and all ages over 18	Includes only Medicare patients over age 65
Results compared to other NYS hospitals	Results compared to national average
Includes clinical variables (blood pressure and heart rate)	Does not include clinical variables
Patients treated in the Emergency Department of one hospital and transferred to another hospital are analyzed with other cases from the first hospital	Patients treated in the Emergency Department of one hospital and transferred to another hospital are analyzed with other cases from the second hospital
Records included in analysis for some scenarios when not all segments of episode of care indicate principal diagnosis of AMI	All segments in episode of care must have principal diagnosis of AMI
Ordinary logistic regression	Hierarchal logistic regression
Comorbidities identified from current episode of care and analyzed with Condition Categories (CC) Also, Present at Admission Codes are used to distinguish between complications of care and comorbidities, and hospital admission during the previous 12 months is used as a variable in the risk-adjustment process.	Comorbidities identified from previous 12 months and analyzed with Condition Categories (CC)

With respect to these methodological differences, the New York data includes all patients over age 18, so it should be more reflective of overall quality of care than data that are limited to patients aged 65 and over. A recent study shows that relative hospital risk-adjusted mortality rates rankings can be quite different for all patients than they are for younger patients.[7]

Also, by comparing the New York hospitals to one another rather than to all hospitals nationally, nearby hospitals can be compared with one another more equitably.

To improve the ability to predict short-term mortality for AMI patients, NYS added heart rate and blood pressure to its administrative (SPARCS) data. A New York study has shown that these variables are significant independent predictors of mortality in NYS, and that when added to the typical administrative variables in a statistical model, they change hospital risk-adjusted mortality and outlier status substantially.[8]

New York's decision to attribute outcomes of emergency department transfers as well as outcomes of inpatient transfers to the transferring hospital is based on the observation that whether a transferred patient is regarded as an admission in the transferring hospital differs according to administrative conventions in hospitals. Furthermore, the rationale for giving the transferring hospital credit for providing timely effective treatment and appropriate transfer should not differ based on the admission

status of the patient prior to transfer. A New York study has shown that the assessed risk-adjusted mortality and outlier status of hospitals can change substantially based on the hospitals to which emergency department transfers are attributed.[9]

While the CMS methodology requires that all segments of a patient's hospital stay must carry a primary diagnosis of AMI, the NYS methodology retains other cases for analysis in some situations. This typically occurs when first hospital is a non-PCI hospital that did not report the case with a primary diagnosis of AMI and the receiving hospital did report the diagnosis. This decision is based on a review of a sample of cases at selected hospitals that suggests that the principal diagnosis is generally coded more accurately at hospitals with PCI on site. Decision rules for these assignments are detailed in Appendix 3.

Ordinary logistic regression was used in the New York methodology whereas hierarchical logistic regression was used by CMS. Each of these methods has its advantages and disadvantages, and it was decided to use the same method used in New York's other cardiac reports.

New York's methodology differs from the CMS methodology in the use of comorbidities in the statistical model in two ways. First, CMS uses all patient encounters in the previous 12 months to determine whether comorbidities not coded in the index admission were coded earlier and can therefore be included in the risk-adjustment model. Although this was not done in the New York methodology, the New York database does have the advantage that it can distinguish between complications (which should not be included in the statistical model) and comorbidities (which should be considered as candidates for the model) by virtue of its Present on Admission (POA) codes that identify whether a diagnosis was present at the time the patient was admitted to the hospital. Furthermore, New York uses a risk-adjustment variable that denotes whether the patient was admitted to a New York hospital for any reason in the past 365 days.

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[5] https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html

[6] https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1163010421830

[7] (Dharmarajan K, McNamara RL, Wang Y, et al., Age Differences in Hospital Mortality for Acute Myocardial Infarction: Implications for Hospital Profiling, *Annals of Internal Medicine*)

[8] Hannan EL, Samadashvili Z, Cozzens K, Walford G, Jacobs AK, Venditti FJ, Holmes DR Jr, Berger PB, Stamato NJ, Hughes S., Appending Limited Clinical Data to an Administrative Database for Acute Myocardial Infarction Patients: The Impact on the Assessment of Hospital Quality, *Medical Care* 2016;54:538-545).

[9] Samadashvili Z, Hannan EL, Cozzens K, Walford G, Jacobs AK, Berger PB, Holmes DH Jr, Venditti FJ, Curtis J. Assessing Hospital Performance for Acute Myocardial Infarction: How Should Emergency Department Transfers be Attributed? *Medical Care* 2015;53:245-252).

Appendix 2 – Principal Diagnosis of AMI

SPARCS defines the Principal Diagnosis as: "the condition established after study to be chiefly responsible for occasioning the patient's visit for care. ...[t]he Principal Diagnosis represents the reason for the patient's care, it may not necessarily be the diagnosis which represents the greatest length of stay, the greatest consumption of resources, or the most life-threatening condition."[10]

The list that follows details the diagnosis codes that were included in analysis if reported as the Principal Diagnosis. The list contains codes for both International Classification of Diseases 9th and 10th revision (ICD-9 and ICD-10) codes because ICD-10 codes were reported to SPARCS as of 10/01/15. It should be noted that, as in the CMS reporting of AMI outcomes, this analysis includes patients that are presenting for their initial episode of care as well as those reported with an episode of care that is unspecified.

STEMI vs. NSTEMI

ICD-9-CM diagnosis codes 410.7x and ICD-10-CM diagnosis codes I21.4 and I22.2 refer to a Non-ST Segment Elevation MI (NSTEMI). All other codes are classified as STEMI.

ICD-9-CM and ICD-10-CM Principal Diagnosis Codes for AMI Patients Included in Analysis.*

ICD-9-CM Codes	Description
410.0x	Acute myocardial infarction of anterolateral wall
410.1x	Acute myocardial infarction of other anterior wall
410.2x	Acute myocardial infarction of inferolateral wall
410.3x	Acute myocardial infarction of inferoposterior wall
410.4x	Acute myocardial infarction of other inferior wall
410.5x	Acute myocardial infarction of other lateral wall
410.6x	Acute myocardial infarction true posterior wall infarction
410.7x	Acute myocardial infarction subendocardial infarction
410.8x	Acute myocardial infarction of other specified sites
410.9x	Acute myocardial infarction unspecified site

*Where x is 0 or 1

The following Fifth-Digit sub-classification is for use with category ICD-9 codes starting with 410:

0 episode of care unspecified
Use when the source document does not contain sufficient information for the assignment of fifth-digit 1 or 2.

1 initial episode of care
Use fifth-digit 1 to designate the first episode of care (regardless of facility site) for a newly diagnosed myocardial infarction. The fifth-digit 1 is assigned regardless of the number of times a patient may be transferred during the initial episode of care.

2 subsequent episode of care (not included in analysis)
Use fifth-digit 2 to designate an episode of care following the initial episode when the patient is admitted for further observation, evaluation or treatment for a myocardial infarction that has received initial treatment, but is still less than 8 weeks old.

[10] SPARCS X12-837 Input Data Specifications (http://www.health.ny.gov/statistics/sparcs/sysdoc/input5010.pdf

ICD-10-CM Codes	Description
I21.01	ST elevation (STEMI) myocardial infarction involving left main coronary artery
I21.02	ST elevation (STEMI) myocardial infarction involving left anterior descending coronary artery
I21.09	ST elevation (STEMI) myocardial infarction involving other coronary artery of anterior wall
I21.11	ST elevation (STEMI) myocardial infarction involving right coronary artery
I21.19	ST elevation (STEMI) myocardial infarction involving other coronary artery of inferior wall
I21.21	ST elevation (STEMI) myocardial infarction involving left circumflex coronary artery
I21.29	ST elevation (STEMI) myocardial infarction involving other sites
I21.3	ST elevation (STEMI) myocardial infarction of unspecified site
I21.4	Non-ST elevation (NSTEMI) myocardial infarction
I22.0	Subsequent ST elevation (STEMI) myocardial infarction of anterior wall
I22.1	Subsequent ST elevation (STEMI) myocardial infarction of inferior wall
I22.2	Subsequent non-ST elevation (NSTEMI) myocardial infarction
I22.8	Subsequent ST elevation (STEMI) myocardial infarction of other sites
I22.9	Subsequent ST elevation (STEMI) myocardial infarction of unspecified site

Appendix 3
Technical Details for Construction of AMI Study Population

1. SPARCS Inpatient, Emergency Department and Ambulatory Surgery Records with a Principal Diagnosis of AMI (see Appendix 2) at acute care hospitals with inpatient beds and an Emergency Department were considered for analysis.
2. Records for the same patient in the same episode of care at different hospitals were matched to consolidate transfers into a single record for each patient's episode of care. In general, the following rules were used. However, additional transfers were identified by matching SPARCS data with the Department of Health's Percutaneous Coronary Interventions Reporting System.
   a. For patients transferred from either an acute care hospital's inpatient facility or its emergency department to a second hospital, the patient outcome is attributed to the first hospital, and that patient is not reported for the second hospital.
   b. All "transfer out" records must have a disposition code of "02 - Discharged/ transferred to a Short-Term General Hospital for Inpatient Care" for two records to match.
   c. Patients transferred from free-standing emergency department or from a hospital with no emergency department (e.g. a cancer specialty hospital) to a second hospital are attributed to the second hospital.
   d. There must be no more than 1 day between the discharge date of the first record and the admission date of the second record.
   e. Patient identifiers, including complete or partial match on SPARCS Unique Personal Identifier (first 2 and last 2 letters of the last name, first 2 letters of the first name, and last 4 digits of Social Security Number), gender, date of birth, race, ethnicity, and patient address (including ZIP code) were used to identify patients with multiple records.
3. To be included in analysis, all linked patient records must include
   a. an Inpatient record

      OR

   b. consist of only an Emergency Department record with a disposition code "02- Discharged/transferred to a Short-Term General Hospital for Inpatient Care" that could not be linked to any inpatient record. This accounts for hospitals that transfer patients from their Emergency Department to an out-of-state PCI center by allowing those cases to remain in the analysis.
4. In some cases, there was disagreement on the linked records concerning the principal diagnosis of AMI. If the record had a primary diagnosis of AMI on any segments of the episode of care occurring at a PCI center then it was treated as an AMI case. If the record had no segments at a PCI center then all segments must have the principal diagnosis of AMI; otherwise the case was excluded.
5. Comorbidities from linked records were used in analysis if present on any segment. Clinical data (heart rate and blood pressure) were taken from the first segment if present on the file and otherwise taken from the second segment. Demographic characteristics (age, sex, race/ethnicity, primary payer) were taken from the first segment in the episode of care.
6. Location of infarction, based on diagnosis code for the AMI, is used in the risk-adjustment model as well as in the categorization of cases as STEMI or NSTEMI. When a record contains two segments for a single episode of care and both

segments indicate an AMI but have a discrepancy on the specific diagnosis code used, the diagnosis code for analysis is selected according to the following strategy:

- First: If the patient underwent PCI or CABG, the diagnosis code from the hospital that performed that procedure is used.
- Second: If there was no PCI or CABG performed, the diagnosis code from the hospital capable of performing PCI is used.
- Third: If the segment contains no episodes of care from a hospital capable of performing PCI, then the diagnosis from the second hospital is used.

The strategy for selecting diagnosis codes when there are three segments in the episode of care is similar and gives preference to the last segment that includes a PCI or CABG procedure or that occurred at a center with PCI capability or the last segment if there were no segments from PCI capable hospitals

Appendix 4
Risk Adjustment Methodology and Significant Predictors of 30-day Mortality for AMI discharges

Logistic regression analysis was used to weight patient risk factors in such a way to predict the chance each patient will have of dying given his or her specific characteristics. The mortality rate for each hospital is also predicted using the statistical model. This is accomplished by adding the predicted probabilities of death for each of the hospital's patients and dividing by the number of patients. The predicted probability of death for each patient is derived from the statistical model in Table 4.1. The resulting rate is an estimate of what the hospital's mortality rate would have been if the hospital's performance was identical to the state performance. The percentage is called the predicted or expected mortality rate (EMR). A hospital's EMR is contrasted with its observed mortality rate (OMR), which is the number of patients who died divided by the total number of patients.

The risk-adjusted mortality rate (RAMR) represents the best estimate, based on the associated statistical model, of what the hospital's mortality rate would have been if the hospital had a mix of patients identical to the statewide mix. Thus, the RAMR has, to the extent possible, ironed out differences among hospitals in patient severity of illness. The RAMR is calculated as follows:

$$RAMR=(OMR/EMR\times NYS\ Rate)\times 100$$

There is no Statewide EMR or RAMR, because the statewide data is not risk-adjusted since it comprises the entire population of interest. The Statewide OMR (number of total cases divided by number of total deaths) serves as the basis for comparison for each hospital's EMR and RAMR.

If the RAMR is significantly lower than the statewide mortality rate, the hospital has a better performance than the state as a whole; if the RAMR is significantly higher than the statewide mortality rate, the hospital has a worse performance than the state as a whole. To prevent misinterpretation of differences caused by chance variation, expected ranges (confidence intervals) are included in the reported results. 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, have confidence intervals entirely below the statewide rate.

The significant risk factors for 30-day mortality for AMI in 2015 are presented in Table 4.1. Roughly speaking, the odds ratio for a risk factor represents the number of times more likely to die within 30 days 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 Previous Hospitalization within 12 months is 1.29. This means that a patient who has an inpatient record in a NYS hospital in the 365 days prior to admission is approximately 1.29 times as likely to die within 30 days as a patient who has all the other significant risk factors the same but who has not had a previous hospitalization within 12 months.

In this model, there are seven categories for Age (18-44, 45-54, 55-64, 65-74, 75-84, 85-94 and 95 or more years old). The first category (ages 18-44) is the reference category, which means the odds ratio for all other age groups are relative to patients aged 18-44. For example, a patient aged 75 to 84 years old is approximately 5.90 times as likely to die within 30 days of their AMI admission as a patient under age 45, if all the other significant risk factors are the same.

The first of the clinical risk factors is AMI location. This is based on the primary diagnosis code and is described in Appendix 2. There are five categories for MI location in this model. The reference category is Subendocardial (410.70 or 410.71 in ICD-9, and 121.4 or 122.2 in ICD-10), which is also called NSTEMI in the coding instructions. This group represented 71.17% of all analyzed MI cases and had the lowest odds of 30-day mortality. The risk for patients with all other types of MI are compared to the otherwise identical patients with a Subendocardial MI/ NSTEMI.

Heart rate is defined as the patient heart rate in beats per minutes (bpm) taken at the first patient contact after arrival. In this model, it is divided into five categories (≤ 54 bpm, 55-74 bpm, 75-94 bpm, 95-114 bpm, ≥115 bpm). The reference category is 55-74 bpm. Patients with a heart rate 95 or higher are at a statistically significantly increased risk of mortality than otherwise identical patients whose heart rate is lower than 95 bpm upon arrival.

Mean Arterial Pressure is calculated as: 2/3 DBP+1/3 SBP where DBP is the Diastolic Blood Pressure on Arrival in mmHg and SBP is the Systolic Blood Pressure on arrival in mmHg. Patients with a Mean Arterial Pressure less than 95 mmHg are at increased risk of 30-day mortality after AMI admission.

The comorbidities present in the model are based on diagnoses reported in the patient record for any segment of the AMI episode of care. They are organized into Condition Categories (CCs) which are used to group similar diagnoses together in meaningful ways for analysis. In two instances (Kidney Disease and Skin Ulcers) the comorbidities are represented in a hierarchy, with the most severe condition listed first followed by less severe conditions. For these conditions, a patient is analyzed in the most severe level indicated by the record and would not be included in multiple levels even if a less severe condition in the category is also present on the record.

For many conditions, the diagnosis was only counted as a comorbidity if it was flagged as “Present on Admission” in the SPARCS record. This helps assure that conditions that developed in the hospital after the AMI or resulting from the AMI are not considered as a risk factor in the analysis. Some conditions, for example Cancer, were deemed to be unlikely to develop during the AMI hospitalization and thus were counted as a comorbidity even if “Present on Admission” was not indicated.

Table 4.1
Multivariable Risk Factor Equation for 30-Day Mortality after AMI in NYS, 2015 discharges.

		Logistic Regression		
Risk Factors	Prevalence (%)	Coefficient	P-value	Odds Ratio
Demographic				
Patient Age (year)				
18-44	4.50	— Reference —		1.00
45-54	13.24	0.50	0.0717	1.65
55-64	22.85	0.84	0.0014	2.32
65-74	22.94	1.12	<.0001	3.05
75-84	20.48	1.77	<.0001	5.90
85-94	14.26	2.41	<.0001	11.13
≥95	1.72	3.08	<.0001	21.76
Patient History				
Previous 12-month Hospitalization	30.02	0.25	<.0001	1.29
Clinical Risk Factors				
AMI Location				
Anterolateral and other anterior wall (ICD-9: 410.0x and 410.1x. ICD-10: I21.01, I21.02, I21.09, and I22.0)	10.35	0.71	<.0001	2.03
Inferolateral, inferoposterior, and other inferior wall (ICD-9: 410.2x, 410.3x, and 410.4x. ICD-10: I21.11, I21.19, and I22.1)	13.02	0.53	<.0001	1.70
Other lateral wall, true posterior wall, and other specified sites (ICD-9: 410.5x, 410.6x, and 410.8x. ICD-10: I21.21, I21.29, and I22.8)	1.84	1.11	<.0001	3.03
Unspecified sites (ICD-9: 410.9x. ICD-10: I21.3 and I22.2)	3.61	1.39	<.0001	4.01
Subendocardial (ICD-9: 410.7x. ICD-10: I21.4 and I22.2)	71.17	— Reference —		1.00
Heart Rate (bpm)				
≤54	4.65	0.22	0.0689	1.25
55-74	37.26	— Reference —		1.00
75-94	33.67	0.10	0.1043	1.11
95-114	16.42	0.48	<.0001	1.62
≥115	8.00	0.38	<.0001	1.46
Mean Arterial Pressure (mmHg)				
≤64	2.68	1.38	<.0001	3.96
65-84	18.69	0.64	<.0001	1.90
85-94	17.75	0.29	<.0001	1.34
95-104	17.85	0.05	0.5516	1.05
≥105	43.03	— Reference —		1.00

		Logistic Regression		
Risk Factors	Prevalence (%)	Coefficient	P-value	Odds Ratio
Demographic				
Comorbidities (indenting indicates hierarchical order)				
Metastatic Cancer and Acute Leukemia (CC8)	0.97	1.70	<.0001	5.45
Lung, Upper Digestive Tract, and Other Severe Cancers (CC9)	1.34	1.27	<.0001	3.57
Protein-Calorie Malnutrition (CC21*)	2.61	0.88	<.0001	2.40
End-Stage Liver Disease (CC27)	0.28	1.50	<.0001	4.48
Severe Hematological Disorders (CC46), Coagulation Defects and Other Specified Hematological Disorders (CC48)	6.42	0.89	<.0001	2.44
Dementia, With (CC51) or Without Complication (CC52)	7.66	1.05	<.0001	2.85
Coma, Brain Compression/Anoxic Damage (CC80*)	1.35	2.70	<.0001	14.83
Respirator Dependence/ Tracheostomy Status (CC82*) Respiratory Arrest (CC83*), and Cardio-Respiratory Failure and Shock (CC84*)	12.73	1.78	<.0001	5.94
Specified Heart Arrhythmias (CC96*)	21.97	0.65	<.0001	1.92
Cerebral Hemorrhage (CC99*)	0.16	1.52	<.0001	4.58
Hemiplegia/Hemiparesis (CC103*)	1.58	0.84	<.0001	2.31
Vascular Disease with Complications (CC107*)	1.10	1.10	<.0001	3.01
Dialysis Status (CC134), Acute Renal Failure (CC135*), and Chronic Kidney Disease, Stage 5 (CC136)	17.04	1.13	<.0001	3.09
Chronic Kidney Disease, Severe (Stage 4) (CC137), Moderate (Stage 3) (CC138), Mild or Unspecified (Stages 1-2 or Unspecified) (CC139), Unspecified Renal Failure (CC140*), and Nephritis (CC141)	11.88	0.63	<.0001	1.88
Pressure Ulcer of Skin with Necrosis Through to Muscle, Tendon, or Bone (CC157*)	0.09	1.59	0.0014	4.91
Pressure Ulcer of Skin with Full (CC158*) or Partial (CC159*) Thickness Skin Loss, and Pressure Pre-Ulcer Skin Changes or Unspecified Stage (CC160*)	1.32	1.10	<.0001	3.00
Hip Fracture/Dislocation (CC170*)	0.22	1.47	<.0001	4.34
Amputation Status, Lower Limb/ Amputation Complications (CC189*)	1.64	1.01	<.0001	2.76
Square of Total Number of Comorbidities		-0.11	<.0001	0.89

Intercept = -5.9092

C Statistic = 0.863

* indicates these comorbidities were used only if they were present on admission (POA)

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