Published in final edited form as:

Am J Cardiol. 2015 June 01; 115(11): 1494–1501. doi:10.1016/j.amjcard.2015.02.050.

State Mandated Public Reporting and Outcomes of Percutaneous Coronary Intervention in the United States

Matthew A. Cavender, MD, MPH^{a,*}, Karen E. Joynt, MD, MPH^{a,b}, Craig S. Parzynski, MS^c, Frederick S. Resnic, MD^d, John S. Rumsfeld, MD, PhD^e, Mauro Moscucci, MD, MBA^f, Frederick A. Masoudi, MD, MSPH^g, Jephtha P. Curtis, MD^c, Eric D. Peterson, MD, MPH^h, Hitinder S. Gurm, MDⁱ

^aBrigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts

^bHarvard School of Public Health, VA Boston Healthcare System, Boston, Massachusetts

^cYale Center for Outcomes Research and Evaluation, Yale School of Medicine, New Haven, Connecticut

^dLahey Clinic, Burlington, Massachusetts

^eDenver VA Medical Center, Denver, Colorado

^fUniversity of Miami School of Medicine, Miami, Florida

^gUniversity of Colorado, Anschutz Medical Campus, Aurora, Colorado

^hDuke Clinical Research Institute, Durham, North Carolina

ⁱUniversity of Michigan, Ann Arbor, Michigan

Abstract

Public reporting has been proposed as a strategy to improve health care quality. Percutaneous coronary interventions (PCIs) performed in the United States from July 1, 2009, to June 30, 2011, included in the CathPCI Registry were identified (n = 1,340,213). Patient characteristics and predicted and observed in-hospital mortality were compared between patients treated with PCI in states with mandated public reporting (Massachusetts, New York, Pennsylvania) and states without mandated public reporting. Most PCIs occurred in states without mandatory public reporting (88%, n = 1,184,544). Relative to patients treated in nonpublic reporting states, those who underwent PCI in public reporting states had similar predicted in-hospital mortality (1.39% vs 1.37%, p = 0.17) but lower observed in-hospital mortality (1.19% vs 1.41%, adjusted odds ratio [OR_{adj}] 0.80; 95% confidence interval [CI] 0.74, 0.88; p < 0.001). In patients for whom outcomes were available at 180 days, the differences in mortality persisted (4.6% vs 5.4%, OR_{adj} 0.85, 95% CI 0.79 to 0.92, p < 0.001), whereas there was no difference in myocardial infarction (OR_{adj} 0.97, 95% CI 0.89 to 1.07) or revascularization (OR_{adj} 1.05, 95% CI 0.92 to 1.20). Hospital readmissions were increased at 180 days in patients who underwent PCI in public reporting states (OR_{adj} 1.08, 95% CI 1.03 to 1.12, p = 0.001). In conclusion, patients who underwent PCI in states

*Corresponding author: Tel: (617) 278-0140; fax: (888) 249-5261, mcavender@partners.org (M.A. Cavender).

Supplementary Data

Supplementary data related with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.amjcard.2015.02.050>.

with mandated public reporting of outcomes had similar predicted risks but significantly lower observed risks of death during hospitalization and in the 6 months after PCI. These findings support considering public reporting as a potential strategy for improving outcomes of patients who underwent PCI although further studies are warranted to delineate the reasons for these differences.

Three states currently mandate reporting of percutaneous coronary intervention (PCI) outcomes: New York since 1991, Pennsylvania since 2001, and Massachusetts since 2005.¹ New Jersey has mandated the collection of data necessary to implement public reporting since 2007, but the state has not yet released the data to the public. We used the CathPCI Registry to evaluate the relation between mandatory public reporting and patient selection for PCI by identifying differences in patient characteristics, cardiac status, and indications for PCI in states with and without mandatory public reporting. In addition, we evaluated the relation between reporting and quality of care, as measured by care processes. Finally, we compared predicted and actual in-hospital mortality and other outcomes in patients who underwent PCI in states with and without mandatory public reporting.

Methods

The CathPCI Registry is a national clinical registry program sponsored by the American College of Cardiology (ACC) and the Society for Cardiovascular Angiography and Interventions (SCAI) that has been previously described.²⁻⁴ All patient visits for PCI from July 1, 2009, to June 30, 2011, in version 4 of the CathPCI Registry (n = 1,340,213) were included. Procedures were categorized based on whether it was performed in a state that mandated public reporting of clinical outcomes to the state (New York, Pennsylvania, and Massachusetts) or without mandated public reporting of clinical outcomes (remainder of the CathPCI Registry; Figure 1).

New Jersey has been collecting data but has not implemented mandatory reporting and, thus, was analyzed separately. States (e.g., Maine, Ohio, Kentucky, Texas, Utah, Nevada, California, Colorado, Hawaii) that report risk-adjusted PCI mortality using Agency for Healthcare Research and Quality (AHRQ) all-payer hospital claims data were not considered to have public reporting. Although these claims data have been made publicly available, the risk adjustment methods developed by AHRQ do not contain clinical data and are specifically stated to be inappropriate to be used in isolation for comparison of hospitals.⁵

Demographics, hospital characteristics, indications for PCI, and outcomes of patients who underwent PCI in states with mandated public reporting of clinical outcomes were compared. Tests of significance were performed using the chi-square test for categorical variables and the Wilcoxon rank-sum test for continuous variables. Standardized differences between the baseline characteristics of the 2 groups were calculated because of the large sample size.

Each patient's predicted in-hospital mortality was determined using the National Cardiovascular Data Registry (NCDR) risk score model to determine if patients who

underwent PCI in states with mandated public reporting of clinical outcomes were at similar baseline risk compared with patients treated in states without mandated reporting. The NCDR risk score has been previously described.⁶ For these analyses, the variables used in the original NCDR risk score were used to calibrate the model to provide the best statistical fit.

To determine whether differences in patient selection were present between reporting and nonreporting states, the risk difference between the predicted and observed mortality was determined.⁷ A generalized estimating equation logistic regression model accounting for within-site clustering was developed to evaluate the odds of in-hospital mortality after PCI in states with mandated public reporting of clinical outcomes compared with states without mandated reporting. An adjusted model was developed to control for differences in patient case mix (using variables contained in the full NCDR risk score model). Our final model controlled for all variables contained in the full NCDR risk score model plus additional potential confounders, such as patient and hospital characteristics. Stratified analyses were then used to determine whether differences between states with and without mandated public reporting of clinical outcomes varied within certain patient subgroups (elective PCI, acute coronary syndrome [ACS], cardiogenic shock).

Long-term outcomes are not available in the NCDR; however, certain long-term outcomes (death, myocardial infarction, repeat revascularization, readmission) were available in subset of patients at least 65 years of age who underwent an inpatient PCI from January 1, 2010, to December 31, 2011, that could be matched with the research-identifiable Medicare 100% inpatient fee-for-service claims file for a hospitalization that occurred at the same hospital (n = 247,017). The methods in which the NCDR and Medicare claims data were linked have been described previously.⁸ Data regarding readmissions were obtained from inpatient standard analytic files, and data regarding death were obtained from the Medicare enrollment database. The *International Classification of Diseases, Ninth Revision, Clinical Modification*, diagnosis codes were used to identify myocardial infarction (410.X1). *International Classification of Diseases, Ninth Revision, Clinical Modification*, procedure codes were used to identify coronary revascularizations (PCI 36.00, 36.06, 36.07, and 36.09 and coronary artery bypass grafting 36.10 to 36.19). Only revascularizations occurring after discharge from the index hospital stay were included in the revascularization analysis.

For long-term outcomes, unadjusted cumulative incidence curves (accounting for competing risk of death when necessary) and unadjusted/risk-adjusted odds ratio (OR_{adj}) at 180 days were calculated using the same methodology described earlier. The NCDR risk model was used to adjust the death analyses for potential confounders. For outcomes other than death, the Center for Medicare and Medicaid Services (CMS) readmission model variables were used for adjustment.⁹

Analyses of the CathPCI Registry and Medicare claims data were approved by the Yale University Human Investigation Committee and performed using SAS, version 9.3 (SAS Institute, Cary, North Carolina).

Results

We identified 1,340,213 patient visits from 1,227 unique sites who underwent the first PCI captured in version 4 of the CathPCI Registry. Most PCIs were performed in states that do not mandate public reporting of clinical outcomes (88%, $n = 1,184,544$), whereas 12% ($n = 155,669$) were performed in states that mandate public reporting. Of the PCIs performed in states with public reporting, 19% ($n = 28,835$) were performed in Massachusetts, 31% ($n = 48,517$) in New York, and 50% ($n = 78,317$) in Pennsylvania. In states with mandated public reporting of clinical outcomes, a higher proportion of patients had been transferred from another acute care facility to the hospital that performed the PCI (21.9% vs 18.7%, $p < 0.001$).

Patients treated in states with mandated public reporting of clinical outcomes were older, more likely to be men, and a higher proportion had private insurance. They were less likely to have coexisting conditions such as heart failure, end-stage renal disease on hemodialysis, or diabetes (Table 1). A higher proportion of patients in states without mandated public reporting underwent PCI for ACS with the largest difference being in those patients who underwent PCI for unstable angina. In contrast, a higher proportion of patients who underwent PCI in states with mandated public reporting of clinical outcomes underwent the procedure for stable angina. Fewer patients in states with mandated public reporting of clinical outcomes underwent a salvage procedure (defined as a procedure performed for patients in cardiogenic shock and who have either received chest compressions for a total of at least 60 seconds or have been on unanticipated extracorporeal circulatory support) (0.2% vs 0.3%, $p < 0.001$). A slightly lower proportion of patients in states with mandated public reporting underwent PCI after cardiac arrest (1.8% vs 1.9%, $p = 0.03$) and cardiogenic shock (2.2% vs 2.5%, $p < 0.001$).

There were modest differences in the delivery of care when comparing states with mandated reporting of clinical outcomes to states without these programs (Table 2). The median door to balloon times for patients who underwent primary PCI in states with mandated public reporting of clinical outcomes were similar. There was better utilization of evidence-based medications in states with mandated public reporting, with a higher proportion of patients discharged on aspirin (96.8% vs 95.0%, $p < 0.001$), β blockers (85.0% vs, 80.9%, $p < 0.001$), statins (89.1% vs 86.6%, $p < 0.001$), and thienopyridines (97.0% vs 96.3%, $p < 0.001$). The proportion of PCIs considered appropriate using the ACC Appropriate Use Criteria was lower in patients who underwent PCI in public reporting states (Supplementary Table 1).¹⁰

Patients who underwent PCI in states with mandated public reporting of clinical outcomes had similar NCDR model-predicted in-hospital mortality (1.39% vs 1.37%, $p = 0.17$) but lower observed mortality (1.19% vs 1.41%, $p < 0.001$) relative to patients treated in states without mandated public reporting (Table 3). Patients who underwent PCI in states with mandated public reporting of clinical outcomes had significantly lower in-hospital mortality after adjusting for baseline risk and other potential confounders (OR_{adj} 0.80, 95% confidence interval [CI] 0.74 to 0.88, $p < 0.001$; Figure 2).

Of patients who underwent elective PCI, predicted mortality was also similar between the patients in reporting and nonreporting states (0.36% vs 0.37%, $p = 0.26$). However, the actual mortality was lower in the states with mandated public reporting of clinical outcomes (0.25% vs 0.33%, $p = 0.003$, OR_{adj} 0.71, 95% CI 0.58 to 0.87, $p = 0.001$). Of the patients who underwent PCI for ACS, the predicted mortality was higher for states with mandated public reporting of clinical outcomes (1.05% vs 0.98%, $p < 0.001$), but the actual mortality was lower (0.82% vs 0.90%, $p = 0.02$). After adjusting for patient risk and potential confounders, undergoing PCI for ACS in states with mandated public reporting of clinical outcomes was associated with lower odds of in-hospital mortality (OR_{adj} 0.81, 95% CI 0.74 to 0.89, $p < 0.001$). Similar results were seen when comparing PCI outcomes in states with mandatory reporting of clinical outcomes to states that report risk-adjusted PCI mortality using AHRQ all-payer hospital claims data (Supplementary Tables 2 and 3) and states in the same geographic area (Supplementary Table 4). Both predicted and actual mortality were similar in New Jersey, which has collected data but has not yet implemented public reporting (Supplementary Table 5).

Patients with cardiogenic shock treated at hospitals in states mandating public reporting of clinical outcomes had a higher predicted mortality compared with patients treated at hospitals in states without public reporting (26.0% vs 24.4%, $p < 0.001$). There were no differences in observed mortality among patients in the 2 groups (26.6% vs 27.9%, $p = 0.11$); however, after adjusting for patient risk and potential confounders, undergoing PCI in states with mandated public reporting of clinical outcomes was associated with lower odds of in-hospital mortality (OR_{adj} 0.86, 95% CI 0.77 to 0.96, $p = 0.007$).

In the cohort of patients for whom long-term data were available, those treated with PCI in states with mandated public reporting had lower rates of death at 180 days (4.6% vs 5.4%, Figure 3). This association remained present after adjusting for potential confounders (OR_{adj} 0.85, 95% CI 0.79 to 0.92, $p < 0.001$). There was no association between undergoing PCI in states with mandated public reporting and the incidence of myocardial infarction (1.9% vs 2.0%, OR_{adj} 0.97, 95% CI 0.89 to 1.07, $p = 0.57$, Figure 3) or revascularization (5.3% vs 6.1%, OR_{adj} 1.05, 95% CI 0.92 to 1.20, $p = 0.45$, Figure 3) in the 180 days after discharge. Readmission was more common in states with mandated public reporting (31.6% vs 30.6%), and this association remained statistically significant after adjusting for potential confounders (OR_{adj} 1.08, 95% CI 1.03 to 1.12, $p = 0.001$, Figure 3).

Discussion

This is the first study to examine the relation between mandated public reporting and outcomes after PCI using a national clinical registry. Patients who underwent PCI in states with mandated public reporting had a similar predicted risk as those who underwent PCI in states without public reporting. Despite similar risk, public reporting was associated with 20% lower odds of in-hospital death and 15% lower odds of death at 6 months compared with PCI in states without mandated public reporting. The association between mandated public reporting and lower mortality was seen across the spectrum of indications for PCI including patients who underwent PCI for elective indications, ACS, or cardiogenic shock. The association remained in the 180 days after the PCI.

Public reporting is a quality improvement program that has been implemented by some states and is being considered in others.¹¹ These programs have been designed with the idea that increasing the amount of information available will result in better clinical outcomes. Previous studies have shown that public reporting can improve implementation of quality measures¹²; however, before this study, there have been no clinical outcome studies that support the efficacy of a public reporting strategy. In contrast, previous studies have described detrimental effects of public reporting while finding no difference in clinical outcomes.¹³ Joynt et al¹⁴ used claims data to compare Medicare patients with acute myocardial infarction in states with public reporting states with patients from nonreporting states within their geographic region. Among the overall population, they found no difference in mortality at 30 days although patients with STEMI had increased mortality in states with public reporting.

There are many explanations for an association between public reporting and lower odds of death. Mandatory review of procedural outcomes may force institutions to evaluate outcomes and develop quality improvement efforts to bridge gaps in quality.^{15,16} Providing data on the outcomes of PCI could motivate operators to improve or refine their skill set, refer patients to providers/hospitals able to accommodate complex or high-risk patients, or improve health care delivery after PCI. Our finding that the use of evidence-based medications was generally higher in reporting states supports the hypothesis that some of the mortality benefit may have been because of improved processes of care.

It is possible that these findings may be the result of differences between case selection in states with and without mandatory public reporting as our study population includes only those patients in whom PCI was performed. Previous studies have raised concerns that mandating public reporting may result in the denial of care to high-risk patients,^{14,17–19} and survey data have suggested that the public reporting of adverse outcomes influences operators.^{20,21} These studies have led to a concern that public reporting of PCI outcomes could result in providers refusing high-risk patients.^{18–20,22,23} Our study found small differences in the number of patients treated with PCI for cardiogenic shock, after cardiac arrest, or as salvage treatment for STEMI consistent with these concerns. However, using a validated risk adjustment model developed specifically for the CathPCI Registry, states with public reporting and states without public reporting had similar predicted mortality rates, suggesting that public reporting is not associated with meaningful differences in the patients treated with PCI. Adjusting for patient risk and potential confounders strengthened the association between states with mandated public reporting of clinical outcomes and lower odds of death. In addition, we found that patients who underwent PCI in states with mandated public reporting had a modest increase risk of being readmitted to the hospital in the 6 months after the PCI, which suggests that these patients have at least a similar, if not higher, risk profile.

Our findings should be considered within the limitations of the study. The observational design prevents the determination of causality. Although we have used robust statistical modeling to control for confounding, we are unable to account for unmeasured confounders or bias that could affect the precision of the models used to predict mortality in this analysis. For example, our predicted risk estimates could be biased if there is differential

documentation of patient-level data in states with public reporting. We could not ascertain the outcomes of patients who may have had an indication for PCI but were instead treated with medical management. Although we did not see any differential in the risk of patients who underwent PCI, this may be particularly relevant for these analyses as providers in states with public reporting could be more likely to defer revascularization in high-risk patients. Although this registry includes standardized definitions and has a robust audit program, the data included in the registry are not adjudicated. Finally, the public reporting systems used by the states are not uniform and differ in their implementation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgment

The Yale Center for Outcomes Research and Evaluation performed the statistical evaluation, had full access to the CathPCI Registry, and take full responsibility for the integrity of the data and the accuracy of the data analysis.

Disclosures

This research was supported by the American College of Cardiology Foundation's National Cardiovascular Data Registry and by grant U01 HL105270-03 (Center for Cardiovascular Outcomes Research at Yale University) from the National Heart, Lung, and Blood Institute in Bethesda, Maryland. The views expressed in this manuscript represent those of the authors and do not necessarily represent the official views of the NCDR or its associated professional societies identified at www.ncdr.com. Drs Cavender, Joynt, Resnic, Parzynski, and Moscucci report no conflicts of interest. Dr. Rumsfeld reports the following relationship: NCDR (Chief Science Officer). Dr. Masoudi reports the following relationships: NCDR (Senior Medical Officer), Oklahoma Foundation for Medical Quality (contract). Dr. Curtis reports the following relationships: ACC-NCDR (salary support, significant) and CMS (salary support, significant). Dr. Peterson reports the following relationship: NCDR CathPCI Registry (Research grant, principal investigator for data co-ordinating center). Dr. Gurm reports the following relationships: National Institutes of Health and AHRQ (research support).

References

1. Ritley D, Romano P. The State of Cardiac Revascularization Outcomes Reporting. Davis: University of California, Davis, Center for Healthcare Policy and Research, 2011:1–29.
2. Roe MT, Messenger JC, Weintraub WS, Cannon CP, Fonarow GC, Dai D, Chen AY, Klein LW, Masoudi FA, McKay C, Hewitt K, Brindis RG, Peterson ED, Rumsfeld JS. Treatments, trends, and outcomes of acute myocardial infarction and percutaneous coronary intervention. *J Am Coll Cardiol* 2010;56:254–263. [PubMed: 20633817]
3. CathPCI Registry. Standardized data definitions and elements in the NCDR. Available at: http://www.ncdr.com/WebNCDR/docs/public-data-collection-documents/cathpci_v4_codersdictionary_4-4.pdf?sfvrsn=2 Accessed on May 25, 2012.
4. Messenger JC, Ho KK, Young CH, Slattery LE, Draoui JC, Curtis JP, Dehmer GJ, Grover FL, Mirro MJ, Reynolds MR, Rokos IC, Spertus JA, Wang TY, Winston SA, Rumsfeld JS, Masoudi FA. The national cardiovascular data registry (NCDR) data quality brief: the NCDR data quality program in 2012. *J Am Coll Cardiol* 2012;60:1484–1488. [PubMed: 22999725]
5. Agency for Health Care Research and Quality. Guidance on using the AHRQ QI for hospital-level comparative reporting. Available at: <http://www.qualityindicators.ahrq.gov/Downloads/News/AHRQIGuidetoComparativeReportingv10.pdf>. Accessed on August 13, 2012.
6. Peterson ED, Dai D, DeLong ER, Brennan JM, Singh M, Rao SV, Shaw RE, Roe MT, Ho KK, Klein LW, Krone RJ, Weintraub WS, Brindis RG, Rumsfeld JS, Spertus JA. Contemporary mortality risk prediction for percutaneous coronary intervention: results from 588,398 procedures in the National Cardiovascular Data Registry. *J Am Coll Cardiol* 2010;55:1923–1932. [PubMed: 20430263]

7. Drozda JP Jr, Hagan EP, Mirro MJ, Peterson ED, Wright JS. ACCF 2008 health policy statement on principles for public reporting of physician performance data: a report of the American College of Cardiology Foundation Writing Committee to develop principles for public reporting of physician performance data. *J Am Coll Cardiol* 2008;51:1993–2001. [PubMed: 18482675]
8. Douglas PS, Brennan JM, Anstrom KJ, Sedrakyan A, Eisenstein EL, Haque G, Dai D, Kong DF, Hammill B, Curtis L, Matchar D, Brindis R, Peterson ED. Clinical effectiveness of coronary stents in elderly persons: results from 262,700 Medicare patients in the American College of Cardiology-National Cardiovascular Data Registry. *J Am Coll Cardiol* 2009;53:1629–1641. [PubMed: 19406337]
9. Cath PCI Registry. PCI readmission measure. Available at: <http://www.ncdr.com/WebNCDR/analytics/pcireadmissionmeasure>. Accessed on April 29, 2014.
10. Patel MR, Dehmer GJ, Hirshfeld JW, Smith PK, Spertus JA. ACCF/SCAI/STS/AATS/AHA/ASNC/HFSA/SCCT 2012 appropriate use criteria for coronary revascularization focused update: a report of the American College of Cardiology foundation appropriate use criteria task force, Society for Cardiovascular Angiography and Interventions, Society of Thoracic Surgeons, American Association for Thoracic Surgery, American Heart Association, American Society of Nuclear Cardiology, and the Society of Cardiovascular Computed Tomography. *J Am Coll Cardiol* 2012;59:857–881. [PubMed: 22296741]
11. Dehmer GJ, Drozda JP Jr, Brindis RG, Masoudi FA, Rumsfeld JS, Slattery LE, Oetgen WJ. Public reporting of clinical quality data: an update for cardiovascular specialists. *J Am Coll Cardiol* 2014;63: 1239–1245. [PubMed: 24509280]
12. Lamb GC, Smith MA, Weeks WB, Queram C. Publicly reported quality-of-care measures influenced Wisconsin physician groups to improve performance. *Health Aff (Millwood)* 2013;32:536–543. [PubMed: 23459733]
13. Moscucci M, Eagle KA, Share D, Smith D, De Franco AC, O'Donnell M, Kline-Rogers E, Jani SM, Brown DL. Public reporting and case selection for percutaneous coronary interventions: an analysis from two large multicenter percutaneous coronary intervention databases. *J Am Coll Cardiol* 2005;45:1759–1765. [PubMed: 15936602]
14. Joynt KE, Blumenthal DM, Orav E, Resnic FS, Jha AK. Association of public reporting for percutaneous coronary intervention with utilization and outcomes among Medicare beneficiaries with acute myocardial infarction. *JAMA* 2012;308:1460–1468. [PubMed: 23047360]
15. Hibbard JH, Stockard J, Tusler M. Does publicizing hospital performance stimulate quality improvement efforts? *Health Aff* 2003;22: 84–94.
16. Tu JV, Donovan LR, Lee DS, Wang JT, Austin PC, Alter DA, Ko DT. Effectiveness of public report cards for improving the quality of cardiac care: the EFFECT study: a randomized trial. *JAMA* 2009;302: 2330–2337. [PubMed: 19923205]
17. Burack JH, Impellizzeri P, Homel P, Cunningham JN Jr. Public reporting of surgical mortality: a survey of New York State cardiothoracic surgeons. *Ann Thorac Surg* 1999;68:1195–1200. [PubMed: 10543479]
18. Omoigui NA, Miller DP, Brown KJ, Annan K, Cosgrove D III, Lytle B, Loop F, Topol EJ. Outmigration for coronary bypass surgery in an era of public dissemination of clinical outcomes. *Circulation* 1996;93: 27–33. [PubMed: 8616936]
19. Apolito RA, Greenberg MA, Menegus MA, Lowe AM, Sleeper LA, Goldberger MH, Remick J, Radford MJ, Hochman JS. Impact of the New York State Cardiac Surgery and Percutaneous Coronary Intervention Reporting System on the management of patients with acute myocardial infarction complicated by cardiogenic shock. *Am Heart J* 2008;155:267–273. [PubMed: 18215596]
20. Resnic FS, Welt FG. The public health hazards of risk avoidance associated with public reporting of risk-adjusted outcomes in coronary intervention. *J Am Coll Cardiol* 2009;53:825–830. [PubMed: 19264236]
21. Narins CR, Dozier AM, Ling FS, Zareba W. The influence of public reporting of outcome data on medical decision making by physicians. *Arch Intern Med* 2005;165:83–87. [PubMed: 15642879]
22. Klein LW, Ho KK, Singh M, Anderson HV, Hillegass WB, Uretsky BF, Chambers C, Rao SV, Reilly J, Weiner BH, Kern M, Bailey S. Quality assessment and improvement in interventional cardiology: a Position Statement of the Society of Cardiovascular Angiography and Interventions,

part II: public reporting and risk adjustment. *Catheter Cardiovasc Interv* 2011;78:493–502. [PubMed: 21547998]

23. Krumholz HM, Keenan PS, Brush JE Jr, Bufalino VJ, Chernew ME, Epstein AJ, Heidenreich PA, Ho V, Masoudi FA, Matchar DB, Normand SL, Rumsfeld JS, Schuur JD, Smith SC Jr, Spertus JA, Walsh MN. Standards for measures used for public reporting of efficiency in health care: a scientific statement from the American Heart Association Interdisciplinary Council on Quality of Care and Outcomes Research and the American College of Cardiology Foundation. *J Am Coll Cardiol* 2008;52:1518–1526. [PubMed: 19017522]

Figure 1.
Study flow diagram.

Figure 2.

Unadjusted and adjusted ORs comparing the odds of in-hospital death in public reporting versus nonreporting states for all patients and various subgroups. All tests compare public reporting states to nonpublic reporting states within each rows' designated group (e.g., all patients in public reporting states vs all patients in nonpublic reporting States). "†," Estimates for these groups were derived using stratified analyses. Model 1—adjusted for factors included in the NCDR risk score model. Model 2—adjusted for factors included in the NCDR risk score model, female gender, current/recent smoker (within 1 year), dyslipidemia, family history of premature CAD, antianginal medication within 2 weeks before PCI, previous cardiac arrest, anginal classification within 2 weeks, Canadian Cardiovascular Society class I angina versus no symptoms, Canadian Cardiovascular Society class II angina versus no symptoms, Canadian Cardiovascular Society class III angina versus no symptoms, Canadian Cardiovascular Society class IV angina versus no symptoms, hemoglobin, preprocedure hemoglobin (g/dl), hemoglobin (unknown), and hospital type (non-for-profit vs public, private vs public).

Figure 3.

Cumulative incidence of (A) death, (B) myocardial infarction, (C) revascularization, (D) readmission in public reporting, and nonpublic reporting states with patients with available Medicare data.

OR adjusted for factors included in the NCDR risk score model, female gender, current/recent smoker (within 1 year), dyslipidemia, family history of premature CAD, antianginal medication within 2 weeks before PCI, previous cardiac arrest, anginal classification within 2 weeks, Canadian Cardiovascular Society class I angina versus no symptoms, Canadian Cardiovascular Society class II angina versus no symptoms, Canadian Cardiovascular Society class III angina versus no symptoms, Canadian Cardiovascular Society class IV angina versus no symptoms, hemoglobin, preprocedure hemoglobin (g/dl), hemoglobin (unknown), and hospital type (non-for-profit vs public, private vs public).

Table 1

Baseline demographics

Variable	Mandated Public Reporting		
	No (n= 1,184,544)	Yes (n= 155,669)	Standardized Difference
Age, Mean (SD)	64.6 (12.09)	65.0 (12.11)	0.03
Women	388,313 (32.8%)	48,758 (31.3%)	0.03
White	1,045,491 (88.3%)	138,442 (88.9%)	0.10
Black	97,741 (8.3%)	10,798 (6.9%)	
Asian	24,059 (2.0%)	4,458 (2.9%)	
American Indian/Alaskan Native	6,236 (0.5%)	310 (0.2%)	
Native Hawaiian/Pacific Islander	2,499 (0.2%)	117 (0.1%)	
Insurance Provider			
Private Health Insurance	746,543 (63.0%)	102,555 (65.9%)	0.27
Medicare	610,608 (51.6%)	72,406 (46.5%)	
Medicaid	108,083 (9.1%)	14,943 (9.6%)	
Other	54,512 (4.4%)	4,355 (2.9%)	
None	81,111 (6.9%)	4,839 (3.1%)	
Indication for PCI			
Elective PCI	348,134 (29.4%)	53,603 (34.4%)	0.10
PCI for ACS	806,034 (68.1%)	98,593 (63.3%)	
PCI with Shock	30,004 (2.5%)	3,431 (2.2%)	
Prior MI	353,857 (29.9%)	45,576 (29.3%)	0.01
Prior Heart Failure	139,560 (11.8%)	16,589 (10.7%)	0.04
Prior PCI	479,867 (40.5%)	60,766 (39.0%)	0.03
Prior Coronary Bypass	222,324 (18.8%)	26,311 (16.9%)	0.05
Currently on Dialysis	28,096 (2.4%)	3,263 (2.1%)	0.02
Diabetes Mellitus	428,005 (36.1%)	54,945 (35.3%)	0.02
Presentation			
No symptoms	108,042 (9.1%)	17,960 (11.5%)	0.15
Symptoms unlikely to be ischemic	35,549 (3.0%)	3,924 (2.5%)	
Stable angina pectoris	204,543 (17.3%)	31,719 (20.4%)	

Variable	Mandated Public Reporting			Standardized Difference
	No (n= 1,184,544)	Yes (n= 155,669)		
Unstable angina pectoris	442,777 (37.4%)	51,335 (33.0%)		
Non-STEMI	210,443 (17.8%)	26,908 (17.3%)		
ST-Elevation MI	182,818 (15.4%)	23,781 (15.3%)		
PCI Status				
Elective	536,556 (45.3%)	66,312 (42.6%)		0.06
Urgent	443,538 (37.4%)	62,484 (40.1%)		
Emergency	199,813 (16.9%)	26,426 (17.0%)		
Salvage	3,948 (0.3%)	366 (0.2%)		
Cardiac Arrest within 24 Hours	22,290 (1.9%)	2,803 (1.8%)		0.01
IABP	29,502 (2.5%)	4,382 (2.8%)		0.02
Left Ventricular Ejection Fraction < 30%	45,884 (3.9%)	5,863 (3.8%)		0.01

Table 2

Differences in processes of care between states with and without public reporting

	Mandated Public Reporting		P-Value*
	No	Yes	
Red Blood Cell Transfusion	31,856 (2.7%)	3,747 (2.4%)	<0.001
PCI performed with Large Contrast Volume	307,902 (30.5%)	42,567 (29.6%)	<0.001
Door to balloon time (in patients with immediate PCI for STEM/PCI, minutes, median (25th, 75th percentiles))			
Discharge Medications in Patients Discharged Alive	62 (47, 78)	62 (46, 78)	0.87
ACE-Inhibitor/ARB	743,411 (63.7%)	94,651 (61.5%)	<0.001
Aspirin	1,109,767 (95.0%)	148,950 (96.8%)	<0.001
Beta Blockers	944,403 (80.9%)	130,807 (85.0%)	<0.001
Statin	1,011,008 (86.6%)	137,003 (89.1%)	<0.001
Non-Statin	189,742 (16.3%)	22,199 (14.4%)	<0.001
Any Thienopyridines	1,113,558 (96.3%)	148,121 (97.0%)	<0.001
Clopidogrel	971,065 (83.2%)	132,979 (86.5%)	<0.001
Ticlopidine	3,877 (0.3%)	625 (0.4%)	<0.001
Prasugrel	141,028 (12.1%)	14,908 (9.7%)	<0.001

* All tests compare public reporting states to non-public reporting states within each row's designated group (e.g. All patients in public reporting states versus all patients in non-public reporting states).

Predicted versus actual in-hospital mortality of US patients undergoing PCI in states with mandatory public reporting compared to states without public reporting of clinical outcomes data

Table 3

	Mandated Public Reporting			P-Value
	No (n= 1,184,544)	Yes (n=155,669)		
All Patients Undergoing PCI				
Predicted Mortality based on NCDR Risk Score %, (SE)	1.39 (0.01)	1.37 (0.01)		0.17
Actual Mortality %, (SE)	1.41 (0.01)	1.19 (0.03)		<0.001
Difference between Predicted/Actual Mortality (%)	+0.02	-0.18		
Patients Undergoing Elective PCI				
Predicted Mortality based on NCDR Risk Score %, (SE)	0.36 (0.003)	0.37 (0.01)		0.26
Actual Mortality %, (SE)	0.33 (0.01)	0.25 (0.02)		0.003
Difference between Predicted/Actual Mortality (%)	-0.03	-0.12		
Patients undergoing Undergoing PCI for ACS				
Predicted Mortality based on NCDR Risk Score %, (SE)	0.98 (0.003)	1.05 (0.01)		<0.001
Actual Mortality %, (SE)	0.90 (0.01)	0.82 (0.03)		0.02
Difference between Predicted/Actual Mortality (%)	-0.08	-0.24		
Patients Undergoing PCI with Cardiogenic Shock				
Predicted Mortality based on NCDR Risk Score %, (SE)	24.38 (0.14)	26.00 (0.43)		<0.001
Actual Mortality %, (SE)	27.92 (0.26)	26.61 (0.76)		0.11
Difference between Predicted/Actual Mortality (%)	+3.54	+0.61		