

Risk Aversion and Public Reporting. Part 2: Mitigation Strategies

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Part 1 of this review summarizes the consequences of risk aversion and the observational studies and surveys relevant to this phenomenon, almost all of which are derived from cardiac surgery and interventional cardiology. In Part 2, we describe the root cause of risk aversion—the belief by providers that current risk adjustment is inadequate to account for the severity of their highest-risk patients, thereby prejudicing their publicly reported performance scores. Evidence supporting the robustness of current risk adjustment is presented, as well as nine potential strategies to further mitigate risk aversion: optimization of data source, risk models, and

performance measures; exclusion of high-risk patients; exclusion of non-procedure-related end points; separate reporting of high-risk patients; reporting by condition or diagnosis rather than by procedures; reporting at the hospital or program level rather than the physician level; collaborative, cross-disciplinary decision making; active surveillance for risk aversion; and improved stakeholder education. Of these, the first is most desirable, widely applicable, and resistant to gaming.

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As demonstrated in Part 1 of this review [1], risk aversion associated with public reporting undoubtedly exists, although its true extent remains uncertain. Empirical data and examples of this practice are derived mainly from interventional cardiology and cardiac surgery and are more consistent and convincing for the former.

In Part 2 of this review, we examine the root cause of risk aversion—the belief by providers that current risk adjustment is inadequate to account for the severity of their most critically ill patients, whose anticipated worse outcomes might prejudice their report card ratings. We also examine a variety of strategies that have been proposed or implemented to mitigate risk aversion.

Does Risk Adjustment Provide Adequate Protection?

Regardless of the actual extent of risk aversion related to public reporting, many cardiac surgeons and interventional cardiologists believe they are inadequately protected by current risk models when they accept high-risk patients. A detailed discussion of the theory and practice of statistical risk modeling for provider profiling is beyond the scope of this article, and relevant references and examples are available [2–9].

No risk model is perfectly predictive for every patient and outcome, and investigators have described numerous theoretical and practical concerns that any public reporting program should consider [10–15]. For example, not all conceivable risk factors, or combinations thereof, are captured even by the best databases, potentially introducing unmeasured confounding. Some risk factors are included in registries but may have excessive missing data that preclude their use or may be present so rarely that they cannot be modeled. Similarly, random sampling variation makes it difficult to model outcomes that occur infrequently, especially with small sample sizes (eg, individual physician reporting). Intentional upcoding of risk factors (a form of “gaming”) by registry participants or inadvertent miscoding caused by poorly specified variables may, over time, dilute the true effect of some risk model predictors by including patients whose actual clinical state does not meet the spirit of the variable. This phenomenon may also give the false impression that risk factor prevalence is increasing in the population, as observed by Green and Wintfeld [16] in the early New York experience.

Finally, in risk model development there is often a tension between models with many predictor variables, which can better accommodate patients with important but uncommon risk factors, and so-called parsimonious models, which are less time consuming and labor intensive to use but may not contain infrequently occurring risk factors. Well-constructed parsimonious models may have overall performance nearly identical to that of

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full models with more predictors. However, these may underestimate the risk of the few patients who have rare but particularly high-risk characteristics that are not included in the models. Only a few such patients could theoretically affect the risk-adjusted outcomes of a specific provider, especially during short sampling periods or with small volumes.

Given all of these potential issues, what is known about the performance of risk models used in cardiac operations and percutaneous coronary interventions (PCI)? Virtually all published risk models for these procedures have acceptable statistical calibration and discrimination, the most basic tests of risk model performance. A number of studies have also specifically examined the real world protection afforded by risk adjustment in both cardiac surgery and PCI.

Cardiac Surgery Risk Models

In early reports of the New York Cardiac Surgery Reporting System (CSRS), Hannan and colleagues [17] and Chassin and colleagues [18] demonstrated that New York coronary artery bypass grafting (CABG) risk models performed well at the patient level across all strata of expected risk. There was slight overprediction of risk for the most severely ill patients, suggesting more than adequate protection for programs accepting such patients. Importantly, both studies documented a significant negative correlation between expected mortality and risk-adjusted mortality (RAM) in each of the first 4 years of the New York CSRS; that is, programs that cared for the highest-risk patients often had the lowest RAM, and vice versa. This may reflect the excellent protection afforded by these risk models or the superior performance of programs that are willing to accept high-risk patients (a desirable matching of risk and capability), or both.

Hannan and colleagues [19] further studied the adequacy of risk adjustment using 1990 to 1992 New York CABG data from 31 hospitals and 87 surgeons. This analysis was performed for all 44,918 patients as well as a high-risk ($\geq 7.5\%$ predicted mortality risk) subset of 3,281 patients (7.3% of the total). Observed mortality for the high-risk group was 15.88% vs 1.96% for the remaining 41,637 low-risk patients, but the RAM was actually lower for high-risk patients (2.94% vs 3.02%). No hospital had significantly different RAM for low-risk patients alone vs all patients (ie, with high-risk patients included), and half of the hospitals had lower RAM for all of their CABG patients than for only their lower-risk patients. At the hospital level, RAM for all CABG patients correlated strongly with RAM for low- and high-risk patients separately. Even if a higher threshold were used to classify high-risk patients (ie, three times average, or 9%), the RAM for high-risk patients in 18 of 31 hospitals was less than the state average of 2.99%. All of these findings affirm the adequacy of risk adjustment and do not support the belief that avoiding high-risk patients would improve risk-adjusted outcomes.

Contemporary investigations have verified the protection afforded by modern risk models developed

from large clinical registries. Englum and colleagues [20] studied 494,955 patients who underwent isolated CABG between 2008 and 2010 and who were included in The Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database (ACSD). The 1,002 sites that cared for these patients were divided into quintiles by their average expected risk of operative mortality, ranging from 1.46% in quintile 1 to 2.87% in quintile 5. The overall calibration of the STS risk model in this cohort was excellent, although there was slight overprediction of death among the highest-risk 1% of patients (expected risk $>20\%$). Observed-to-expected (O/E) mortality ratios were not significantly different than unity for any but the highest-risk quintile, in which O/E was 0.80 (95% confidence interval [CI], 0.77 to 0.84), indicating better-than-expected performance. Similar findings were observed when all of a hospital's highest-risk patients during a 3-year period were analyzed as if they had occurred in 1 "nightmare year" scenario.

These analyses demonstrated that the STS CABG risk model provides adequate risk adjustment even for hospitals that care for the highest-acuity patients. They challenge the widely held notion that avoiding high-risk patients will improve a provider's risk-adjusted outcomes. Indeed, the STS CABG risk model (like many other risk models) offers some degree of "overprotection" for surgeons and hospitals caring for the highest-risk patients.

Interventional Cardiology Risk Models

Sherwood and colleagues [21] performed a similar investigation for PCI, analyzing 624,286 patients from 1,168 sites that contributed data to the American College of Cardiology National Cardiovascular Data Registry (NCDR) CathPCI data set in 2010. Using the NCDR PCI mortality risk model, they found good calibration over the wide range of predicted and observed mortality rates. Hospitals were grouped into quintiles by overall hospital expected mortality rates, and O/E ratios were estimated for each quintile. Sensitivity analyses ranked hospitals by quintiles by their percentage of shock, cardiac arrest, or other extremely high-risk ($\geq 10\%$ mortality) patients. Overall, O/E ratios for most risk quintiles were close to 1, except for the hospitals in the highest-risk quintile, for whom performance was better than expected (0.91; 95% CI, 0.87 to 0.96); results were similar for the sensitivity analyses. These hospitals also had somewhat lower RAM than the lowest-risk hospitals. When each site's highest-risk patients from 2009 to 2011 were combined into a single, simulated, exceptionally high-risk year, O/E ratios all remained approximately 1, there was no increased identification of outlier hospitals, and there was generally good agreement of O/E ratios between the extreme high-risk year and average-year values. Thus, the authors argued that current PCI risk models are adequate to cover the risk of very high-acuity patients and will not unfairly penalize providers who care for them [22].

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