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EDITORIAL COMMENT

In-Hospital Risk-Adjusted Mortality Poorly Reflects PCI Quality

So Why Is it Being Used?*

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In-hospital risk-adjusted mortality from the National Cardiovascular Data Registry (NCDR) CathPCI registry poorly reflects the quality of the percutaneous coronary intervention (PCI) procedure. So why is it being used to assess PCI quality?

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In this issue of *JACC: Cardiovascular Interventions*, Doll et al. (1) demonstrate that risk-adjusted mortality is a poor indicator of the quality of the PCI procedure. In this study, the authors evaluated in-hospital risk-standardized mortality rates (RSMR) in 3,760 operators performing 2,352,174 PCI procedures from the NCDR CathPCI registry. RSMR was defined as the observed-to-expected mortality ratio multiplied by the mean population mortality over a 5-year period, and high RSMR outliers were arbitrarily defined as greater than 2 SD above the mean. High RSMR outliers had an observed mortality of 2.2%, whereas nonoutliers had a 1.5% mortality. Importantly, there was significant instability in the RSMR metric over time, with wide year-to-year variability. High RSMR outliers over 5 years were classified as annual outliers only a minority of the time (1.53 years of the 5 years) and nonoutliers also classified at times as high yearly outliers. Most importantly, when a sensitivity analysis was performed excluding patients presenting with emergency or salvage PCI, cardiogenic shock, and/or cardiac arrest, 55% of the high RSMR outliers were reclassified as nonoutliers when these sick patients were removed. Finally, the very small differences in complications of stroke, dissection, and perforations were unlikely to explain the differences in mortality between outliers and nonoutliers.

In total, these findings suggest RSMR poorly reflects the quality of the PCI procedure because it is highly variable over time, depends on the inclusion/exclusion of emergent procedures, and is not significantly influenced by complications or processes of care. The instability of RSMR over time results from wide confidence intervals, rare mortality events, and low volumes of procedures. Moreover, no explanation was provided for the variations in RSMR over time, as variations may reflect the random play of chance rather than actual variations in procedure quality. Importantly, this analysis did not apply to the majority of operators in the United States, as 63% of operators were excluded from this analysis due to low annual volume as inclusion would only magnify the influence of chance and isolated deaths. Finally, this analysis would suggest 6.5% (about 1 in 15) of U.S. interventional cardiologists are "poor-quality outliers," which is really just grading on a curve without demonstrating that these outliers are actually providing worse care than nonoutliers. Although this analysis focused on the problems with RSMR at the operator level, these same issues should arise evaluating risk-adjusted mortality at the hospital level because most hospitals have just a few operators.

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Although mortality after PCI is important, the NCDR's risk-adjusted mortality metric does not seem to be a scientifically valid indicator of the quality of the PCI procedure. This is because in-hospital mortality after PCI is uncommon (1.5%), and the absolute differences between outliers and nonoutliers is so small (about 0.7%) that random chance and unmeasured variables are more likely to explain variations rather than differences in the quality of the procedure (1). Moreover, using RSMR as a quality metric inappropriately implies that the majority of the mortality outcome is linked to the quality of the PCI procedure. However, the majority (79% to 93%) of in-hospital deaths after PCI are either mostly or entirely unpreventable, with only a few (7% to 8%) deaths directly related to the PCI procedure (2,3). Although risk-adjustment is designed to "level the playing field" in mortality comparisons, risk adjustment is imperfect, and physicians often do not trust that the methodology will account for rare events or noncaptured confounders that are highly prognostic of adverse outcomes (4). Certainly this could be case in the present study by Doll et al. (1) because the high RSMR outliers also treated underinsured nonwhite patients and used more bare-metal stents (a marker of "sick" and poor patients) than nonoutliers, suggesting that unmeasured comorbidities may also contribute to the higher than expected mortality (1).

Using risk-adjusted mortality in quality reporting inadvertently incentivize risk averse behaviors and withholding of treatment to some of the most vulnerable patients with cardiac arrest and cardiogenic shock. Massachusetts and New York publically report PCI mortality and ranked 47th and 49th for use of PCI in out-of-hospital cardiac arrest and/or cardiogenic shock (5). Moreover, the adjusted total mortality for patients presenting with ST-segment elevation myocardial infarction (STEMI) was 35% higher in states with public reporting, which appeared to be due to lower use of angiography and PCI (5). Furthermore, labeling an institution as a high mortality outlier promotes further risk-averse behaviors and reduces the risk profile of patients in the subsequent years through the exclusion of high-risk patients (6). Based on such concerns, the New York State Department of Health excluded cardiogenic shock from risk-adjusted mortality reporting, and there was an immediate increase in the number of PCI cases for shock in the following years with improved adjusted mortality (7). Later, New York excluded patients with cardiac arrest with anoxic encephalopathy for similar reasons.

Our professional societies recommend against the NCDR's risk-adjusted mortality metric. The American Heart Association recommends that out-of-hospital cardiac arrest "cases should be tracked but not publicly reported or used for overall PCI performance ranking" (8). Similar recommendations are noted in the 2013 STEMI guidelines, which state "It is important for organizations that collect and publicly report STEMI and PCI data to consider resuscitated out-of-hospital cardiac arrest patients separately from their hospital and individual operator quality 'scorecards' because such patients, even with optimal care, have a much higher mortality rate" (9). The majority of interventional cardiologists in the United States agree with these recommendations and believe cardiogenic shock and surgical turndowns should be excluded as well (4,10). Despite these concerns, high-risk populations are included in the NCDR risk-adjusted mortality metric. Perhaps this is related to the fact that when emergency procedures are excluded, in-hospital mortality drops to only 0.4%, only magnifying the problem that differences are just the play of chance (1).

In conclusion, the present study by Doll et al. (1) suggests the NCDR's in-hospital risk-adjusted mortality is an imprecise and probably inaccurate reflection of the quality of a PCI procedure. Moreover, reporting mortality after PCI can promote risk-averse behaviors. Despite this, the NCDR's in-hospital risk-adjusted mortality has been endorsed for public reporting and is currently used in value-based purchasing programs such as the Quality-In-Sights: Hospital Incentive Program (11). It is hoped that future policy will reconcile this disconnect. Until we have disease-based registries that capture all patients (not just patients with PCI procedures), the NCDR's in-hospital risk-adjusted mortality should not be used in value-based purchasing or public reporting unless patients with cardiac arrest, cardiogenic shock, and surgical turndowns are excluded to minimize risk aversion (4,10). Perhaps if risk-adjusted mortality was measured on the basis of clinical presentation, included all patients regardless of treatment strategy, and evaluated over longer periods of time rather than in-hospital, then risk-adjusted mortality would better inform about the quality of care physicians and hospitals provide for patients with coronary artery disease.

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