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# Hospital Performance on PCI Process and Outcomes Measures

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**Abstract**

**Background**: The Physician Consortium for Performance Improvement recently proposed percutaneous coronary intervention (PCI) specific process measures. However, information about hospital performance on these measures and the association of PCI process and outcomes measures is not available.

**Methods and Results**: We linked the NCDR CathPCI Registry with Medicare claims data to assess hospital performance on established PCI process measures (aspirin, thienopyridines, and statins on discharge; door-to-balloon time; referral to cardiac rehabilitation), newly proposed PCI process measures (documentation of contrast dose, glomerular filtration rate, and PCI indication; appropriate indication for elective PCI; use of embolic protection device), and a composite of all process measures. We calculated weighted pair-wise correlations between each set of process metrics and performed weighted correlation analyses to assess the association between composite measure performance with corresponding 30-day risk-standardized mortality and readmission rates. We reported the variance in risk-standardized 30-day outcome rates explained by process measures. We analyzed 1,268,860 PCIs from 1,331 hospitals. For many process measures, median hospital performance exceeded 90%. We found strong correlations between medication-specific process measures ($p < 0.01$) and weak correlations between hospital performance on the newly proposed and established process measures. The composite process measure explained only 1.3% and 2.0% of the observed variation in mortality and readmission rates respectively.

**Conclusions**: Hospital performance on many PCI-specific process measures demonstrated little opportunity for improvement and explained only a small percentage of hospital variation in 30-day outcomes. Efforts to measure and improve hospital quality for PCI patients should focus on both process and outcome measures.

**Key words:** Percutaneous coronary interventions, process measures, outcomes, readmissions

**Introduction**

The past decade has seen a dramatic increase in efforts to measure and report the quality of care delivered to patients undergoing percutaneous coronary intervention (PCI) [1, 2]. A number of PCI-related process measures already exist [3], and there are ongoing efforts both to expand the number of process measures and implement outcomes measures to characterize the quality of care for patients undergoing PCI. Specifically, the Physician Consortium for Performance Improvement (PCPI) in partnership with professional societies including American College of Cardiology (ACC), American Heart Association (AHA), Society for Cardiovascular Angiography and Interventions (SCAI) have recently proposed a set of 11 PCI-related process measures [4] In addition, the ACC has developed risk-standardized measures of hospital 30-day mortality and readmission following PCI [5, 6]. However, we have little information as to how hospitals currently perform on these measures and whether process and outcomes measures capture distinct or overlapping domains of quality. Every performance measure carries an opportunity cost in terms of the resources needed to collect the data and the efforts required to improve performance [7-10]. Expanding the portfolio of measures may be warranted if a new measure provides a more comprehensive assessment of hospital quality. However, the extent to which the new measures achieve this goal has not been demonstrated.

To date, no study has examined hospital performance on PCI process and outcomes measures. To address this gap in knowledge, we used data from the ACC's National Cardiovascular Data Registry (NCDR) CathPCI Registry to describe variation in hospital performance and examine the extent to which hospital performance on PCI-related measures are correlated. Specifically, we identified the association of hospital performance on existing process measures with the PCPI's proposed process measures. We then examined whether hospital quality as determined by process measures performance was correlated with hospital performance on 30-day mortality and readmission.

**Methods**

Data sources

With more than 1600 participating hospitals, the NCDR CathPCI registry, cosponsored by the ACC and the SCAI, is the largest registry of elective and emergency PCIs in the United States [11]. The registry collects data on patient demographics, procedural and clinical variables, and in-hospital outcomes using standardized definitions [12]. For this study, we used registry data reflecting PCIs performed between January 1, 2010 and December 31, 2011. To calculate the risk-standardized 30-day mortality and readmission rates, we linked registry data with corresponding Medicare claims data using direct patient identifiers, including name, date of birth, and social security number. Information regarding 30-day patient readmissions and mortality were obtained using Medicare's Inpatient and Outpatient Standard Analytical Files and enrollment database. Among patients with more than one PCI performed during a hospitalization, we only included information from the initial procedure.

Study design and population

We performed a cross-sectional analysis of all hospitals in the registry that reported at least 25 PCI procedures during the study time period. As a result, we excluded 122 low volume hospitals, leaving a total of 1,331 hospitals for analysis. To ensure that our estimates of hospital performance on specific measures were reliable, we further required that each hospital have at least 25 procedures for each individual measure. Accordingly, the number of hospitals included in the calculation of each measure varies.

Process Measures

We classified PCI process metrics into existing National Quality Forum (NQF)-endorsed PCI-related process measures and the newer set of measures proposed by the PCPI. The NQF-endorsed measures included the following: aspirin at discharge, thienopyridines at discharge, statins at discharge, door-to-balloon time under ninety minutes for patients presenting to the Emergency Department (ED) or under 120 minutes for patients transferred to a facility, and referral to cardiac rehabilitation after PCI. Among the 11 new process measures proposed by the PCPI in 2013, we were able to calculate the following using data elements currently collected by the registry: comprehensive documentation of criteria needed to determine procedural appropriateness, appropriate indications for elective PCI, use of embolic protection devices in

saphenous vein bypass grafts, documentation of contrast dose, documentation of a pre-procedural assessment of renal function (GFR calculation), optimal post-procedural medical therapy (defined as aspirin, $P2Y_{12}$ inhibitors, and statins for all patients upon discharge unless otherwise contraindicated), and referral to cardiac rehabilitation. There were several measures proposed by the PCPI that could not be assessed given the available elements in the registry: documentation of radiation dose, and whether or not a patient's ability to tolerate and adhere to dual antiplatelet therapy had been evaluated**.** Furthermore, we did not consider physician and hospital PCI volume as potential measures, as all hospitals participating in the NCDR registry routinely receive information about procedural volumes.

For each measure, we identified whether patients were eligible for that metric and aggregated patient-level results to calculate the hospital performance in the indicated performance measure. Measure-specific inclusion and exclusion criteria were applied to each case to ensure that the population used to define performance was appropriate. For door-to-balloon times, we used different thresholds for ST Segment Elevation Myocardial Infarction (STEMI) patients who presented through the emergency department (≤90 minutes) and those transferred from another acute care facility (≤120 minutes) [13]. For the documentation of indications for PCI process measure, we classified a procedure as correctly documented based on recommendations from the PCPI which included the following: documentation of priority of diagnoses (ACS vs. elective), presence and severity of angina symptoms, use of antianginal medical therapies within 2 weeks before the procedure, significance of angiographic stenosis on coronary angiography for treated lesion, and presence, results, and timing of noninvasive stress test, fractional flow reserve, or intravascular ultrasound. For the measure of the proportion of elective PCIs considered appropriate, we defined it in a manner consistent with the PCPI guidelines which is the sum of the total number of appropriate and uncertain cases (as opposed to inappropriate or unmappable) among all non-ACS PCIs defined in a manner consistent with 2012 appropriate usage criteria [14]. Finally, we created composite measures defined as the total number of process measures patients received over the total number of eligible performance measures for patients treated at that hospital. The first composite measure was restricted to the current NQF-endorsed PCI process measures,

and the second composite measure included both the current and proposed PCPI measures [10].

Outcome measures

We calculated hospital-specific risk standardized 30-day readmission and mortality rates in a manner consistent with NQF-approved mortality and readmission measures [15, 16]. Specifically, for mortality, and consistent with the NQF approved measures, we used separate models to calculate hospitals' risk-standardized 30-day mortality for a) patients with STEMI or cardiogenic shock, and b) patients without STEMI and without cardiogenic shock [16]. All outcomes models use hierarchical logistic regression, which takes into account clustering of patients within hospitals and use pre-procedural clinical characteristics of patients for risk adjustment.

Statistical Analysis

Crude rates, defined as the number of times a specific process measure was performed on a patient over the total number of eligible patients at that hospital, were calculated for all process measures. To analyze the association between hospital performance on current and emerging process metrics, we used the hospital performance estimates for each process measure to calculate a set of pair-wise correlations.

In our analysis of the relationship between hospital performance on current and emerging process measures with performance on outcome metrics, we used correlation analyses to determine the association of hospital risk-standardized 30-day mortality and readmission rates with corresponding hospital composite score estimates of both the emerging and existing process measures. We repeated our analyses, first limiting the composite measure to current process measures, and again limiting to medication-specific measures. In each analysis, we calculated both correlation coefficients and the proportion of the hospital-specific variation in risk-standardized outcomes explained by performance on the composite measures. This variation is the square of the correlation coefficient and is calculated as a percentage. We performed secondary analyses to assess the robustness of

our findings, restricting the calculation of hospital performance on process measures to Medicare beneficiaries.

Analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC). Since different numbers of patients have eligibility for the process measures at each hospital, analyses were weighted by the total number of patients from that hospital who were included in the calculation of the specific process measure. For each correlation, we tested the null hypothesis that there is no correlation between measures, adjusting *p* values for multiple comparisons using the Sidak correction [17]. All analyses were conducted with an overall familywise error rate of .05. The Yale University Human Investigations Committee approved analyses of this limited NCDR data set.

**Results**

Hospital performance on process and outcomes measures

A total of 1,268,860 PCI procedures performed at 1331 hospitals between January 2010 and December 2011 met criteria for inclusion. Hospital performance on each of the current process measures, proposed PCPI process measures, and the composite measure are shown in Figure 1. Among the current process measures, there was relatively little variation in hospital performance on the discharge medications, with median hospital performance above 90%. We observed a larger gap in performance with regards to timely primary PCI (median 78.9% IQR 71.2% to 85.1%) and referral to cardiac rehabilitation (median 60.7% IQR 18.4% to 87.2%). Among the PCPI proposed measures, hospital performance on measures of documentation was uniformly high: contrast dose (median 99.7% IQR 98.3% to 100%), GFR (median 97.0% IQR 92.8% to 98.8%), and PCI indications (median 99.8%, IQR 99.2% to 100%). Larger variation was observed for use of embolic protection devices (median 16.5% IQR 3.6% to 33.9%) and the proportion of non-ACS PCIs considered appropriate or uncertain (median 50.0% IQR 38.3% to 61.2%). Variation in hospital 30-day mortality and readmission rates was modest (Table 1).

Correlation of existing process measures

We found moderate to strong correlations (correlation coefficient > 0.40; $p < .05$) between the discharge medication-related process measures, particularly between aspirin and thienopyridines at discharge (Table 2). None of the discharge medication-related process measures for medications were significantly correlated with the proportion of patients who received timely primary PCI. Referral to cardiac rehabilitation was significantly correlated with other existing process measures (all correlation coefficients > 0.10; $p < .05$). Referral to cardiac rehabilitation was strongly correlated with the overall composite measure (correlation coefficient > 0.90; $p < .01$) and was responsible for most of the variation seen in the composite measure.

Correlation of existing and emerging process measures

There were no significant correlations found among the PCPI's proposed process measures (all correlation coefficient < 0.10; all $p > .05$) (Table 2). However, both the use of embolic devices in saphenous vein grafts and the proportion of appropriate elective PCIs were significantly correlated with the discharge medication process measures. Furthermore, all of the existing and emerging process measures with the exception of documentation of contrast dose were significantly correlated with the overall composite measure consisting of both existing and emerging process metrics.

Correlations of process measures with hospital-level outcome measures

The overall composite measure was statistically significantly associated with both RSRR and RSMR for No STEMI/No shock patients, but it was not correlated with RSMR for STEMI/shock patients (Table 3). The prescriptions of aspirin and thienopyridines at discharge were significantly correlated with all three outcomes measures. The individual process metrics explained 0.1% to 1.9% of hospital variation in 30-day RSRR, 0% to 2.3% in 30-day RSMR for STEMI/Shock patients, and 0% to 5.8% in 30-day RSMR for NSTEMI/No shock patients (Table 4). Hospital performance on the overall composite measure explained relatively little of the observed variation in 30-day outcomes--ranging from 0.7% for RSMR in STEMI patients to 2.0% in RSRR. Hospital performance on outcomes measures was similar when grouped by quintiles of performance on the

composite process measure (Figure 2). Secondary analyses demonstrated similar findings when we restricted the calculation of hospital process measures to include only Medicare beneficiaries and when we restricted analyses to the current process measures and the discharge medication-specific process measures.



**Discussion**

In this cross-sectional analysis of the NCDR CathPCI registry, we found that the majority of hospitals performed well on existing PCI-related process measures. The additional PCI process measures proposed by PCPI were not strongly correlated with the existing process measures, but even among these, there was little variation among hospitals and thus limited opportunity for improvement. In addition, hospitals' performance on existing and proposed process measures were only weakly correlated with hospitals' 30-day risk-standardized mortality and readmission rates. Although the associations were often statistically significant, hospital performance on PCI-specific process metrics explained only between 0.0% and 5.8% of observed variation in risk standardized mortality rates and between 0.0% and 2.0% of risk standardized readmission rates. These findings suggest that process and outcome measures capture complementary and not overlapping domains of quality.

With the exception of the medication-specific process measures, there is relatively little correlation between existing and proposed PCI process measures. This finding is consistent with prior studies suggesting that distinct strategies are needed to improve performance across different assessments of hospital quality [10, 18-20]. However, our findings raise questions as to whether there is enough of a gap in current performance to justify further investment in the proposed PCPI metrics. We found that hospital performance on many of the proposed PCPI measures is generally high, with the large majority of hospitals successfully meeting these metrics more than 90% of the time. The measurement and reporting of process measures carry opportunity cost, and implementation of the proposed process measures may have a limited potential to improve patient outcomes. Our findings highlight the difficulty of identifying novel process measures

that identify practice variations that are associated with patient outcomes. In the absence of novel PCI-related process measures, it may be worth focusing quality measurement efforts on expanding the portfolio of outcomes measures such as rates of bleeding, acute kidney injury, and patient-report health status following PCI [21-23].

With an increasing number of performance metrics, NQF has recommended consideration of composite measures to provide a more comprehensive picture of quality [24]. Several composite measures already exist in NQF's portfolio of endorsed measures for other areas of focus such as AMI and CHF [24-25]. Given the increased number of PCI-related process measures, there may be advantages to creating a composite measure [26]. Nevertheless, we found that much of the variation in the composite measures reflected variations in referral to cardiac rehabilitation, bringing into question the efficacy of a composite measure for PCI.

Our results indicate that there is variation in 30-day risk standardized readmission and mortality rates across hospitals that perform PCI and demonstrate the continued opportunity to improve the outcomes of patients undergoing these procedures. Although previous analyses have examined the association between AMI outcome metrics and process measures and others have identified specific clinical profiles and risk factors of PCI patients that predict outcomes, our study is the first to characterize the relatively weak relationship between *PCI-specific* process and PCI outcome measures [10, 27-28]. Our findings are relevant as there are ongoing efforts to increase quality of care specifically for PCI patients. Furthermore, our analysis of recent performance on the PCPI PCI process measures suggests that despite this effort, there is a continued need to identify impactful process measures and potentially to shift focus to outcomes measures to include not only mortality and readmissions but also other relevant outcomes such as rates of acute kidney injury and bleeding [21-22]. The absence of a strong association does not necessarily indicate that there is no role for process measures in assessing the quality of care provided to PCI patients. Indeed, many of these measures have both face validity and substantial evidence supporting their impact on individual patients. Nevertheless, the fact that most process measures demonstrate little variation and are not strongly associated with outcomes suggests the need to identify additional care processes for which there is a sufficiently large gap in care to warrant their collection. Evidence-based processes,

including the proposed PCPI measures, may be necessary but not sufficient to drive improvements in the outcomes of PCI patients.

Our study highlights the complementary role of process and outcome measures in assessing hospital quality and illustrates that high performance alone on process measures does not guarantee optimal outcomes. In fact, one can argue that a hospital's ability to drive improvements in outcomes can be limited given the heterogeneity and number of factors influencing outcomes that are outside a hospital's control. On the other hand, there is growing evidence suggesting that there are implementable hospital strategies to improve quality of care that are associated with lower mortality and readmissions rates.

For example, prior studies have shown that improvements in hospital systems such as organizational culture including interdisciplinary rounding during hospitalization and at discharge, and optimization of patient care transitions were associated with improved 30-day outcomes [29-31]. Similarly, other qualitative studies have shown that high-performing hospitals have specific organizational strategies and enabling structures that distinguish them including: active communication and coordination among care givers; senior management level engagement and support; and an organizational commitment to developing and maintaining a focus on delivering high quality care [32-33]. These strategies emphasize that efforts to improve outcomes need to be multi-faceted, involving a level of complexity that may not be captured by well-described processes such as discharge medications. Developing effective ways to promote the uptake of these strategies and structures at PCI hospitals will be needed to improve the outcomes of PCI patients and reduce variation in PCI outcomes across hospitals.

There are several limitations to our study that warrant consideration. First, our patient population was derived from a single registry, and our results may not be generalizable to all PCI centers in the U.S. However, the registry captures over 95% of PCI procedures performed in the US, and we believe our data sample is likely representative of the US experience. In addition, given the data elements available in the registry, we were not able to characterize hospital performance on all of PCPI's proposed process measures, and it is possible that the additional measures or a composite measure reflecting all existing and proposed PCI process measures would be more strongly associated with 30-

day outcome measures. Furthermore, our outcomes data were restricted to Medicare beneficiaries and may not be representative of the US population overall.

In summary, hospital performance on current and emerging PCI-metrics only explain a small amount of the variation in 30-day risk-standardized mortality and readmission rates. This fact highlights that these three sets of markers are all capturing distinct aspects of hospital quality. Additional efforts are needed to better how characterize how hospitals can utilize these distinct markers of quality to improve hospital performance.

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**Table 1. Hospital performance on 30-day outcomes in 2010-2011***

| Variable | N | 5th percentile | 25th percentile | Median | 75th percentile | 95th percentile |
|---|---|---|---|---|---|---|
| Risk Standardized Readmission Rate | 1076 | 10.0 | 11.1 | 11.8 | 12.7 | 14.2 |
| Risk-Standardized Mortality Rate (STEMI or Shock) | 743 | 9.5 | 10.9 | 12.1 | 13.4 | 16.1 |
| Risk-Standardized Mortality Rate (No STEMI and No Shock) | 1059 | 1.3 | 1.6 | 1.7 | 2.0 | 2.6 |

* Hospitals were only considered eligible for each measure if they had more than 25 patients

**STEMI =** ST-elevation myocardial infarction. **NSTEMI** = Non-ST segment elevation myocardial infarction.

## Table 2.

## Correlation coefficients for hospital performance on PCI process measures * ‡

| | Aspirin At Discharge | Thieno-Pyridines At Discharge | Statin At Discharge | Proportion DTB Time <=90 mins | Referral To Cardiac Rehab | Documentation of contrast dose | Proportion of PCIs with embolic devices | Proportion of PCIs with GFR documentation | Proportion of PCIs with comprehensive documentations for PCI | Proportion Of Appropriate Elective PCIs performed |
|---|---|---|---|---|---|---|---|---|---|---|
| Thienopyridines at Discharge | *0.713* | | | | | | | | | |
| Statin at Discharge | *0.597* | *0.486* | | | | | | | | |
| Proportion DTB Time <=90 and <=120 mins for transfers | 0.063 | 0.070 | 0.092 | | | | | | | |
| Referral To Cardiac Rehab | *0.194* | *0.139* | *0.181* | *0.111* | | | | | | |
| Documentation of contrast dose | 0.033 | 0.023 | 0.000 | -0.002 | 0.019 | | | | | |
| Use Of Embolic Device | *0.247* | *0.182* | *0.215* | -0.043 | *0.125* | -0.046 | | | | |
| Proportion of PCIs with GFR documentation | 0.084 | -0.005 | 0.114 | 0.081 | 0.016 | 0.055 | 0.041 | | | |
| Proportion of PCIs with comprehensive documentations of indication | 0.037 | *0.115* | 0.074 | 0.087 | 0.082 | 0.032 | 0.098 | 0.030 | | |
| Proportion Of Elective PCIs Considered Appropriate or Uncertain† | *0.149* | *0.202* | *0.125* | 0.079 | 0.018 | 0.031 | -0.009 | 0.052 | -0.041 | |
| Overall proportion of existing process measures met | *0.377* | *0.303* | *0.384* | *0.151* | *0.972* | | | | | |
| Overall Proportion Of Existing and Emerging Process Measures Met | *0.397* | *0.338* | *0.423* | *0.180* | *0.909* | 0.044 | *0.206* | *0.154* | *0.303* | *0.205* |

* Hospitals with considered eligible only if they had more than 25 patients for each of the individual process measures

† Not included in overall composite measure

‡ Weighted by number of eligible patients in each hospital

*Italicized data points indicates significance ($p < .01$) after adjusting for multiple comparisons*

**PCI** = Percutaneous coronary intervention. **DTB** = Door-to-balloon. **GFR** = Glomerular filtration rate.

Table 3.

Correlation coefficients for 30-day risk-standardized readmission rates and mortality rates with hospital performance on PCI process measures* ‡

| | Aspirin at Discharge | Thieno-Pyridines at Discharge | Statin at Discharge | Proportion DTB Time <=90 mins | Referral to Cardiac Rehab | Documentation of contrast dose | Proportion of PCIs with embolic devices | Proportion of PCIs with GFR documentation | Proportion of PCIs with comprehensive documentations | Proportion of Appropriate Elective PCIs performed† | Overall Proportion of Existing Process | Overall Proportion of Existing and Emerging Process Measures Met |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Risk-Standardized Readmission Rate | *-0.120* | *-0.131* | *-0.139* | -0.062 | -0.100 | -0.007 | -0.048 | -0.032 | -0.059 | -0.047 | *-0.128* | *-0.132* |
| Risk-Standardized Mortality Rate (STEMI) | *-0.135* | *-0.153* | -0.116 | -0.069 | -0.074 | -0.003 | -0.013 | -0.098 | 0.022 | 0.036 | -0.103 | -0.103 |
| Risk-Standardized Mortality Rate (NSTEMI) | *-0.223* | *-0.143* | *-0.240* | 0.026 | -0.063 | 0.009 | *-0.134* | -0.009 | -0.035 | 0.008 | *-0.115* | *-0.122* |

* Hospitals were considered eligible only if they had more than 25 patients for each of the individual process measures

† Not included in overall composite measure

‡ Weighted by number of eligible patients in each hospital

*Italic* = Statistically significant correlation

**PCI** = Percutaneous coronary intervention. **DTB** = Door-to-balloon. **GFR** = Glomerular filtration rate. **STEMI** = ST-elevation myocardial infarction. **NSTEMI** = Non-ST segment elevation myocardial infarction.

Table 4.

Percent variance in hospital-level 30-day outcome measures for PCI process measures*

| Variable | RSRR % | RSMR % (STEMI) | RSMR % (NSTEMI) |
|---|---|---|---|
| Aspirin at discharge | 1.5 | 1.8 | 5.0 |
| Thienopyridines at Discharge | 1.7 | 2.3 | 2.0 |
| Statin at Discharge | 1.9 | 1.3 | 5.8 |
| Timely Primary PCI | 0.4 | 0.5 | 0.1 |
| Referral To Cardiac Rehab | 1.0 | 0.6 | 0.4 |
| Documentation of contrast dose | 0.0 | 0.0 | 0.0 |
| Use Of Embolic Device | 0.2 | 0.0 | 1.8 |
| Documentation of PCIs with GFR documentation | 0.1 | 1.0 | 0.0 |
| Documentation of PCI indications | 0.4 | 0.0 | 0.1 |
| Proportion Of Appropriate Elective PCIs Performed | 0.2 | 0.1 | 0.1 |
| Overall Proportion of Existing and Emerging Process Measures Met | 2.0 | 0.7 | 1.3 |

* Hospitals were considered eligible only if they had more than 25 patients for each of the individual process measures

**PCI** = Percutaneous coronary intervention. **RSRR** = Risk-standardized readmission rate. **RSMR =** Risk-standardized mortality rate. **STEMI =** ST-elevation myocardial infarction. **NSTEMI** = Non-ST segment elevation myocardial infarction. **GFR** = Glomerular

filtration rate.

**Figure Legends:**

**Figure 1.** Hospital performance on proposed PCI process measures. Hospital performance on many of the process measures, including appropriate medications at discharge as well as documentation of contrast dose and GFR documentation was close to having process metric performance nearing 100%. Hospital performance on referral to cardiac rehabilitation, use of embolic devices, proportion of PCIs with documentation of PCI eligibility, and proportion of elective PCIs consider appropriate or uncertain exhibit room for improvement. **Central band** represents median, **box hinges** represent the first and the third quintiles, and **whiskers** extend to the 5% and 95% percentile. **PCI** = percutaneous coronary intervention. **NQF** = National Quality Forum. **PCPI** = Physician Consortium for Performance Improvement. **DTB** = door-to-balloon. **Mins** = minutes. **GFR** = glomerular filtration rate.

**Figure 2.** Risk-standardized outcomes based on performance on PCI process metrics. Box-and-whiskers plot of hospital performance on 30-day risk-standardized readmissions and mortality rates in STEMI/Cardiogenic shock (Figure 2a) and non-STEMI/no cardiogenic shock (Figure 2b) patients as stratified by quintiles of hospital performance on overall proportion of PCI process measures met. There is minimal variation in hospital performance on readmission (Figure 2c) and mortality rates in relationship to respective quintiles of hospital performance on overall PCI process measures met. **Central band** represents median, **box hinges** represent the first and the third quintiles, and **whiskers** extend to 1.5 times the interquartile range. **Diamonds** represent the means and **circles** represent outlier hospitals. **STEMI** = ST-elevation myocardial infarction.