

Actions to Improve Quality: Results From a National Hospital Survey

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Annually, CMS measures the performance of more than 3000 acute care hospitals as part of the Hospital Inpatient Quality Reporting (IQR) Program with the goal of driving improved outcomes, better care, and lower costs. CMS publicly reports the hospital performance results on the CMS Hospital Compare website.¹⁻⁴ To further encourage improvement, CMS adjusts hospitals' reimbursements to reflect the facilities' performance on measures used by programs such as the Hospital Value-Based Purchasing (HVBP) Program, Hospital-Acquired Condition Reduction Program, and Hospital Readmissions Reduction Program.⁵⁻⁷ The collective measurement, reporting, and payment activities aim to encourage hospital quality improvement (QI) interventions or changes, which include efforts to change the structure, process, and/or outcomes of care using an organizational or structural change.⁸ QI also encompasses the combined efforts of providers, patients and families, payers, and other stakeholders to continually improve outcomes, system performance, and education.⁹ Previous studies showed that several QI changes improved hospital quality. For example, adopting electronic health record (EHR) systems was associated with reduced readmissions.^{10,11} EHR use was also associated with improved performance on measures of overall process of care,¹² patient satisfaction,^{13,14} venous thromboembolism prevention,¹⁵ and mortality,¹⁴ but not ischemic stroke or surgical care.^{16,17} Another study found that hospitals receiving assistance from Medicare QI Organizations had greater improvement on 19 of 21 hospital quality measures.¹⁸ Most hospitals have implemented Lean practice improvement strategies (with variable intensity and maturity), and most reported Lean practices to be helpful in improving performance.^{19,20} However, although hospital leaders reported efforts to reduce readmissions in response to the Hospital Readmission Reduction Program,¹⁰ there has been limited study on whether hospitals are undertaking a wide variety of QI actions in response to CMS programs and whether those efforts are associated with improved quality performance.

Our study sought to develop national estimates of the number and type of QI changes (among 23 options) that hospitals reported making in response to CMS measurement programs using a

ABSTRACT

OBJECTIVES: CMS measures and reports hospital performance to drive quality improvement (QI), but information on actions that hospitals have taken in response to quality measurement is lacking. We aimed to develop national estimates of QI actions undertaken by hospitals and to explore their relationship to performance on CMS quality measures.

STUDY DESIGN: Nationally representative cross-sectional survey of acute care hospitals in 2016 (n = 1313 respondents; 64% response rate).

METHODS: We assessed 23 possible QI changes. Using multivariate linear regression, we estimated the relationship between reported QI changes and performance on composite measures derived from 26 Hospital Inpatient Quality Reporting Program measures (scaled 0-100), controlling for case mix and facility characteristics.

RESULTS: Hospitals reported implementing a mean of 17 QI changes (median [interquartile range], 17 [15-20]). Large hospitals reported significantly higher adoption rates than small hospitals for 18 QI changes. Most hospitals that reported making QI changes (63%-96% for the 23 changes) responded that the specific change made helped improve performance. In multivariate regression analyses, adoption of 92% of QI changes (90th percentile among hospitals), compared with adoption of 50% of QI changes (10th percentile), was associated with a 2.3-point higher overall performance score (95% CI, 0.7-4.0) and higher process (8.7 points; 95% CI, 5.7-11.7) and patient experience (3.0 points; 95% CI, 0.1-5.9) composite scores.

CONCLUSIONS: Hospitals reported widespread adoption of QI changes in response to CMS quality measurement and reporting. Higher QI adoption rates were associated with modestly higher process, patient experience, and overall performance composite scores.

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cross-sectional national survey of nonfederal acute care hospitals.²¹ To investigate whether reported QI changes were associated with improvements in performance on quality scores, we described hospitals' self-assessments of whether QI changes were helpful in improving performance and explored the association between hospital-reported QI change adoption and performance on composite measures derived from 26 CMS quality measures.^{21,22}

TAKEAWAY POINTS

Hospitals reported widespread adoption of quality improvement (QI) changes to improve on CMS quality measures, and higher QI adoption was associated with higher process, experience, and overall quality performance scores.

- ▶ Most hospitals (ranging from 63% to 96% for the 23 changes) that reported making QI changes responded that the specific change made helped improve performance.
- ▶ The strongest association between QI adoption and performance was seen with clinical process measures.
- ▶ Given that CMS measurement programs have shifted away from process measures toward outcomes, hospitals need to determine which QI actions provide the greatest impact on improving outcomes.

METHODS

We used data from the 2016 National Hospital Provider Survey, which we conducted for CMS as part of its 2018 National Impact Assessment of CMS Quality Measures.²¹ The survey assessed how hospitals were responding to CMS quality measurement, reporting, and payment initiatives. We developed the survey content based on a review of the hospital QI literature, formative interviews with hospitals, and iterative pilot testing to ensure that respondents correctly interpreted the terminology and intent of the survey questions.²¹ Based on the literature review and formative interviews,^{6,10-17,19,20,23-26} we identified 23 QI changes that we grouped into 7 categories: organizational culture, health information technology (IT), care process redesign, provider incentives, changes to staffing levels or responsibilities, performance monitoring, and measure-specific QI initiatives and technical assistance. (See [eAppendix A](#) for survey questions [eAppendices available at [ajmc.com](#)].) The survey asked hospitals to report whether they had implemented any of the 23 potential QI changes to improve performance on CMS quality measures and whether the reported changes were perceived to be helpful in improving performance on the CMS measures.^{21,22}

The survey was sent to a nationally representative sample of US nonfederal acute care hospitals that reported Hospital IQR Program quality measures to be displayed on CMS Hospital Compare as of December 2015.^{2,27} We excluded hospitals without sufficient performance data for computing an overall performance score ($n = 138$) and hospitals that faced significantly different CMS quality reporting requirements: critical access hospitals ($n = 1264$), hospitals in US territories ($n = 54$), children's hospitals ($n = 22$), and veterans hospitals ($n = 129$). After these exclusions, the universe eligible for sampling included 3198 hospitals, of which we sampled 2045. We applied a stratified random sample design that used as strata bed count (< 100 , 101-299, and ≥ 300 beds, based on the Medicare Provider of Services File from December 2015) and quality performance (described below), given that QI efforts might vary based on hospital size (a proxy for greater resources) and quality.²⁸

Because no overall composite performance measure existed for all eligible hospitals to stratify hospital performance as low, medium, or high performing for sampling, we constructed an overall quality performance score using an approach similar to the fiscal year (FY) 2016 Total Performance Score (TPS) used by

CMS for its HVBP Program.²⁹ We used 26 CMS quality measures from 4 measure domains used by CMS in 2016: clinical processes, outcomes (including patient safety outcomes), patient experience (from the Hospital Consumer Assessment of Healthcare Providers and Systems survey), and efficiency.¹ (See [Table 1](#) for quality measures and performance domains.) We transformed each measure score into a percentile, which reduces the influence of outliers³⁰; we then calculated composite domain scores by taking the mean of the transformed measure scores within each of the 4 domains. Eligible hospitals had to have at least 2 measures each in at least 3 domains, which is less stringent than the FY 2016 TPS, which required at least 4 measures in 2 domains. We computed a weighted average of the 4 domain scores using the FY 2016 TPS weights: 10% for clinical processes, 40% for outcomes, and 25% each for patient experience and efficiency. The overall composite performance measure was highly correlated (correlation coefficient = 0.83) with the HVBP Program TPS but allowed 157 additional hospitals to be included in the universe for sampling.

We fielded the survey between June 1, 2016, and January 6, 2017, targeting senior quality leaders responsible for quality measurement (eg, leaders with titles such as vice president for quality).^{21,22} Each sampled hospital's quality leader was invited by email to complete a web-based survey, drawing on the individual's understanding of quality measurement and improvement activities at the hospital. To increase response rates, we sent phone and email reminders and mailed paper surveys to nonresponders³¹⁻³⁵; we also designed the survey to be completed in less than 1 hour to reduce respondent burden, although this limited our ability to determine the intensity of QI implementation.

Analysis

For analysis, respondents needed to have completed at least 7 substantive items. To generate nationally representative estimates, we applied sampling weights, which are the product of nonresponse weights and design weights (ie, weights that account for the stratified sampling design).³⁶ We used logistic regression to derive nonresponse weights, based on the following hospital-level characteristics from the Medicare Master Beneficiary Summary File, the Medicare Provider of Services File, and Hierarchical

TABLE 1. Measures Included in Quality Performance Composites

Measure name
Efficiency measure
Spending per hospital patient with Medicare (Medicare spending per beneficiary)
Patient experience measures
Patients who reported that their doctors “always” communicated well
Patients who reported that their room and bathroom were “always” clean
Patients who reported that their nurses “always” communicated well
Patients who reported that they “always” received help as soon as they wanted
Patients who reported that their pain was “always” well controlled
Patients who reported that staff “always” explained about medicines before giving it to them
Patients who reported that YES, they were given information about what to do during their recovery at home
Patients who gave their hospital a rating of 9 or 10 on a scale from 0 (lowest) to 10 (highest)
Patients who reported that the area around their room was “always” quiet at night
Outcome measures
Central line–associated bloodstream infection (intensive care unit and select wards)
Catheter-associated urinary tract infections (intensive care unit and select wards)
Surgical site infections—colon surgery
Surgical site infections—abdominal hysterectomy
Acute myocardial infarction 30-day mortality rate
Heart failure 30-day mortality rate
Pneumonia 30-day mortality rate
Complication/patient safety for selected indicators (Patient Safety Indicator–90 composite)
Clinical process-of-care measures
Fibrinolytic therapy received within 30 minutes of hospital arrival
Influenza immunization
Initial antibiotic selection for community-acquired pneumonia in immunocompetent patient
Surgery patients on β -blocker therapy prior to arrival who received a β -blocker during the perioperative period
Prophylactic antibiotic selection for surgical patients
Prophylactic antibiotics discontinued within 24 hours after surgery end time
Urinary catheter removed on postoperative day 1 or postoperative day 2 with day of surgery being day 0
Surgery patients who received appropriate venous thromboembolism prophylaxis within 24 hours prior to surgery to 24 hours after surgery

Condition Category (HCC) file (all represent administrative data collected by CMS in 2015): mean age, mean HCC community risk score, proportion Black, proportion Hispanic, proportion female, proportion dually eligible for Medicare and Medicaid, proportion with end-stage renal disease, proportion enrolled for disability, mean income, nonprofit status, urban status (metropolitan/mid-size city, based on the hospital’s zip code), facility size, major teaching status, disproportionate share hospital (DSH) quintile,³⁷ and cardiac surgery capabilities.

We estimated adoption rates of each of the 23 QI changes in the overall hospital population. In addition, we calculated weighted means within subgroups defined by size and quality performance,

and we used F tests to test for equality of the means among subgroups being compared.

Next, we explored whether adoption of QI changes was associated with performance. We first calculated the proportions of hospitals (among those adopting each change) that reported that the change was “definitely or somewhat” helpful in improving performance on 1 or more measures. We then used multivariate linear regression analyses to estimate the relationship between QI changes reported and hospital performance. We controlled for differences across hospitals in case mix, patient socioeconomic characteristics, and facility characteristics described above; we also controlled for having at least 1 (self-reported) competitor hospital. These features have previously been used to account for performance variation independent of QI efforts.^{18,24,38-40}

In the multivariate analysis, the outcome was the overall composite performance score recomputed using August 2016 Hospital Compare data to align the time frame of survey responses with performance scores available to survey respondents. The primary explanatory variable of interest was the proportion of all 23 potential QI changes that hospitals reported adopting. Our primary analysis results can be interpreted as the association between adopting all QI changes and the percentage increase in performance, accounting for patient or facility characteristics that might affect performance independent of QI actions. To facilitate interpretation of the findings, we also estimated the change in performance associated with a hospital moving from the 10th percentile of QI changes adopted to the 90th percentile.

Additionally, we estimated the association between the proportion of QI changes adopted and each of the 4 performance composite

domains (clinical processes, outcomes, patient experience, and efficiency). Each analysis controlled for the same patient and hospital characteristics as the primary multivariate analysis described above.

Analyses were performed in SAS version 9.4 (SAS Institute) and R version 3.4.0 (R Foundation for Statistical Computing).

RESULTS

The survey response rate was 64.2% (n = 1313 responses from 2045 sampled hospitals); no significant differences in response rates were observed by hospital size or quality performance. **Table 2** shows unweighted characteristics of respondents.

QI Change Adoption Rates

More than 99% of hospitals reported implementing at least 1 QI change, with a median of 17 (interquartile range, 15-20 QI changes). Among the 23 potential QI changes, the most frequently adopted were providing routine feedback to physicians and other clinical staff on performance and implementing standardized care protocols, which were each reported by 97% of hospitals. In addition, 95% of hospitals reported implementing a culture of safety. In contrast, only 29% of hospitals described implementing changes to deployment of nursing staff (Table 3).

In subgroup analyses, large hospitals reported significantly higher adoption rates than small hospitals for 18 of the 23 QI changes, but no QI changes were adopted at higher rates among small hospitals compared with large hospitals (Table 4). For example, 51% of large hospitals reported implementing pay based on performance for clinical staff, compared with 30% of small hospitals; 64% of large hospitals reported implementing internal incentives for senior leaders, compared with 34% of small hospitals. Hospitals in the highest DSH quintile reported significantly higher adoption rates than hospitals in the lowest quintile for 19 QI changes; no individual QI change was adopted at a higher rate among hospitals in the lowest DSH quintile (results not shown). QI change adoption was not significantly greater among hospitals in the high-performance stratum compared with those in the low- and medium-performance strata (eAppendix B).

Perceived Helpfulness of QI Changes in Improving Performance

High proportions of hospitals that reported making individual QI changes (ranging from 63% to 96% for the 23 changes) perceived the changes to be “definitely or somewhat” helpful in improving performance on 1 or more CMS measures (Table 3). The 2 QI changes that hospitals perceived to be most helpful were the implementation of standardized care protocols (96%) and QI initiatives for specific measures (96%).

Association Between QI Changes Undertaken and Quality Performance

Implementation of all 23 QI changes (vs no changes) was associated with a 5.9-point higher composite measure of performance (95% CI, 1.7-10.0 points) (Figure). For context, the range for the overall hospital performance composite was 13.2 to 92.2 points, and an increase of 5.9 points would shift a hospital at the 50th percentile to the 62nd percentile of performance. We also estimated that adoption of 92% of QI changes (90th percentile among hospitals), compared with adoption of 50% of QI changes (10th percentile), was associated with a 2.3-point higher overall performance score (95% CI, 0.7-4.0 points).

The Figure also shows results examining the associations between QI changes made by hospitals and the 4 subcomposite domains of performance: clinical processes, outcomes, patient experience, and efficiency. The clinical processes domain showed a 22-point increase (95% CI, 14.3-29.6 points) in scores associated with implementing all QI changes vs no changes. Increasing adoption of QI changes from

TABLE 2. Distribution of Survey Respondents

Hospital characteristic	Respondents (n)
Size	
Large	329
Medium	506
Small	478
Quality	
High	412
Medium	508
Low	393
Mean beneficiary HCC score^a	
0.664-2.012	262
> 2.012-2.538	788
> 2.538-3.869	263
Proportion dually eligible^a	
0-0.220	263
> 0.220-0.469	788
> 0.469-1	262
Census region	
Midwest	347
Northeast	200
South	537
West	229
Urbanicity^b	
Rural	160
Urban	1150
Ownership	
For profit	289
Government	244
Nonprofit	780

HCC, hierarchical condition category.

^aContinuous variables in this table were categorized using the bottom-20 percentiles, 20th to 80th percentiles, and top-20 percentiles of respondents.

^bFacilities with missing information (<2% of sampled population) not shown. Counts represent raw (unweighted) characteristics among respondents.

the 10th percentile (50% of changes) to the 90th percentile (92% of changes) was associated with an 8.7-point increase in performance (95% CI, 5.7-11.7 points) on the clinical processes composite.

We found that implementing all changes (vs none) was associated with a 7.6-point increase in the patient experience composite score (95% CI, 0.3-14.8 points) and a statistically nonsignificant 5.4-point increase in the outcomes composite score (95% CI, -0.4 to 11.3 points). These increases can be translated into shifts from the 50th percentile to the 61st and 63rd percentiles of their respective composite measure domains. Increasing adoption of QI changes from the 10th percentile (50% of changes) to the 90th percentile (92% of changes) was associated with smaller increases: an increase in performance of 3.0 points (95% CI, 0.1-5.9 points) on the patient experience composite and 2.2 points (95% CI, -0.2 to 4.5 points) on the outcomes composite score.

TABLE 3. QI Changes Reported by Hospitals

QI change	% of hospitals reporting adoption of QI change	% of hospitals ^a reporting change as helpful in improving performance on CMS quality measures
Organizational culture		
Culture of safety	95	85
Learning organization	79	90
Performance monitoring		
Routine feedback on performance to staff	97	87
System for tracking patient outcomes	77	88
Health IT		
Electronic tools for staff	95	88
Electronic health record	91	76
Exchange information with community providers	62	63
Care process redesign		
Standardized care protocols	97	96
Adopted Deming/Lean, Six Sigma, and/or PDSA	90	93
Protocols to support collaboration	89	84
Interdisciplinary rounds	89	91
Postdischarge continuity program	74	77
Employed appropriateness criteria	68	86
Tools to identify high-risk patients	67	80
Other improvement actions		
QI initiatives for specific measures	95	96
Staff training on QI strategies	90	91
Obtained assistance on reporting from QIO	52	85
Changes to staffing levels or responsibilities		
Provider champions	82	90
Added staff dedicated to QI	39	88
Changes to deployment of nursing staff	29	78
Provider incentives		
Staff awards tied to quality performance	53	79
Internal incentives for senior leaders	51	75
Pay based on performance for clinical staff	43	77

IT, information technology; PDSA, Plan-Do-Study-Act; QI, quality improvement; QIO, QI Organization.

^aRepresents percentage of hospitals perceiving the changes to be helpful in improving performance on the CMS measures, among those adopting the change.

Source: Authors' analysis of 2016 National Hospital Provider Survey.

generally considered to be disadvantaged and might seem less likely to adopt high-cost QI changes, such hospitals are also often large hospitals and may have additional resources for implementing QI changes.¹⁹

In investigating the association between having adopted QI changes and quality performance, we found that the majority of hospitals adopting each QI change reported the change to have been helpful in improving their performance on CMS quality measures. Although the latter findings are self-reported, in quantitative multivariate analyses we found that greater adoption of QI changes was associated with statistically significant but modestly higher performance on an overall composite score. Implementing QI changes was strongly associated with better performance on clinical process measures and with smaller improvements on outcome and patient experience measures. There were no significant improvements on the efficiency and outcome measures. It is possible that QI changes reported by hospitals (such as care protocols and health IT order entry prompts) are better suited for improving usage of clinical processes of care rather than improving clinical outcomes and efficiency, which is consistent with findings of prior studies suggesting that providers improve performance on process measures more easily than on other measure types.^{5,41} Hospitals that have already implemented half of the 23 QI changes might experience only modest performance improvements with additional QI change adoption compared with hospitals that have not yet adopted any QI changes. In addition, improving overall performance might become more challenging as process measures are deemphasized in programs such as the HVBP Program. However, other QI improvement strategies beyond those measured in the survey

or more robust implementations of QI strategies may show a relationship with performance on outcome and efficiency measures.²⁹

Previous studies identified wide use of several QI changes (especially implementation of health IT capabilities and organizational changes) and showed modest associations between some QI changes and performance on individual performance measures.^{12,23,24,42} For example, the results of one study found organizational features such as computerized physician order entry and a focus on identifying system errors to be more prevalent in high-performing hospitals compared with low-performing hospitals, but it did not evaluate the effects of multiple simultaneous interventions.²⁴ Another study's

DISCUSSION

We found that hospitals report having adopted a substantial number of QI changes in response to CMS quality measurement initiatives, with the median hospital adopting 17 of 23 potential QI changes. Larger hospitals were more likely to report having adopted a greater number of QI changes, which may be due to having more resources to make investments (such as EHR implementation) and greater structural capacity. We also found that hospitals in the highest DSH quintile adopted QI changes at higher rates than those in the lowest quintile. Although hospitals in higher DSH quintiles are

TABLE 4. Variations in the Adoption of QI Changes by Hospital Size

QI change	Small (1-100 beds)	Medium (101-299 beds)	Large (≥ 300 beds)	P for difference between strata
Organizational culture				
Culture of safety	91	97	96	<.001
Learning organization	73	80	85	<.001
Performance monitoring				
Routine feedback on performance to staff	95	98	97	.040
System for tracking patient outcomes	65	82	83	<.001
Health IT				
Electronic tools for staff	93	95	97	.044
Electronic health record	91	90	93	.367
Exchange information with community providers	58	61	68	.028
Care process redesign				
Standardized care protocols	94	98	97	.004
Adopted Deming/Lean, Six Sigma, and/or PDSA	78	95	96	<.001
Protocols to support collaboration	83	92	92	<.001
Interdisciplinary rounds	79	94	91	<.001
Postdischarge continuity program	68	75	80	.001
Employed appropriateness criteria	63	69	71	.058
Tools to identify high-risk patients	60	69	73	.001
Other improvement actions				
QI initiatives for specific measures	89	98	98	<.001
Staff training on QI strategies	88	91	92	.212
Obtained assistance on reporting from QIO	50	52	55	.470
Changes to staffing levels or responsibilities				
Provider champions	69	86	92	<.001
Added staff dedicated to QI	32	40	45	.003
Changes to deployment of nursing staff	28	27	32	.297
Provider incentives				
Staff awards tied to quality performance	42	54	65	<.001
Internal incentives for senior leaders	34	57	64	<.001
Pay based on performance for clinical staff	30	48	51	<.001

IT, information technology; PDSA, Plan-Do-Study-Act; QI, quality improvement; QIO, QI Organization.

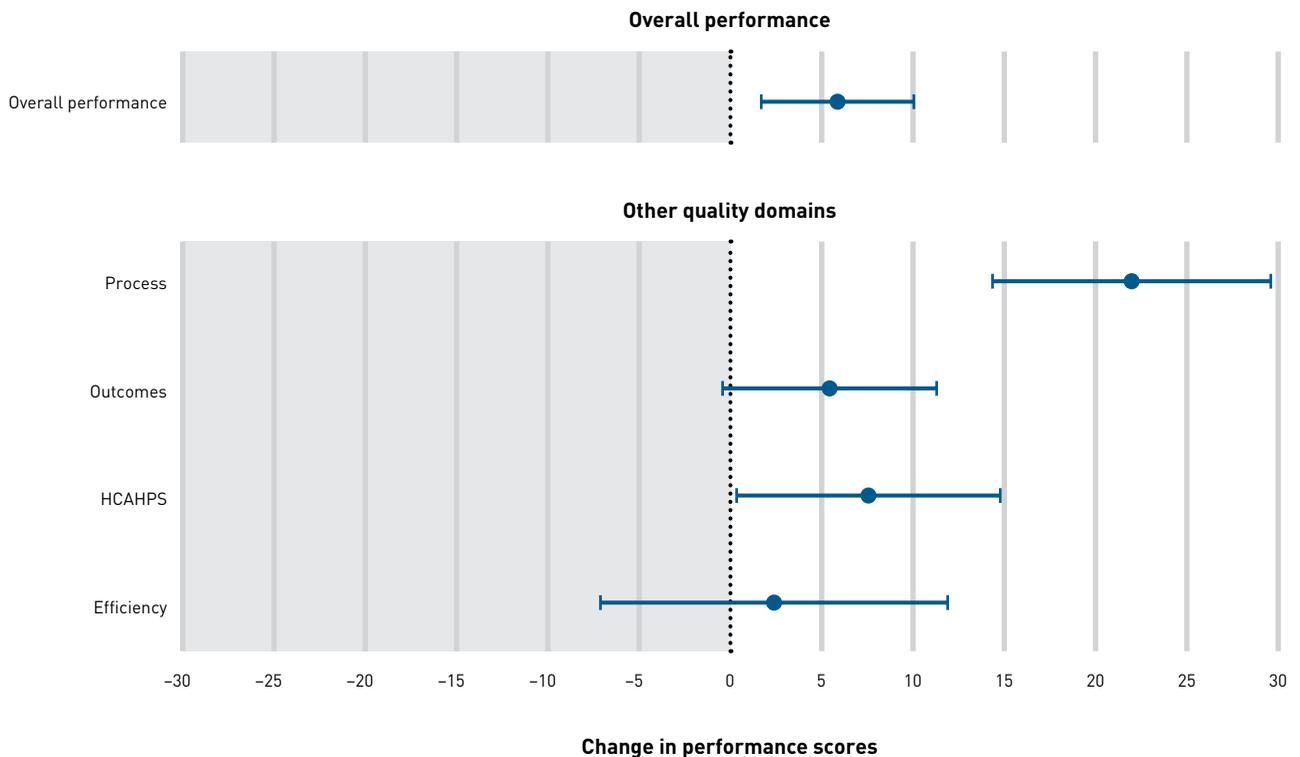
Source: Authors' analysis of the 2016 National Hospital Provider Survey.

results noted that direct employment of physicians (which represents a QI change related to staffing) was not associated with improved quality.⁴³ Our findings add to the literature by describing the extent to which hospitals nationwide are using multiple QI changes to influence their performance and by showing an association between implementation of QI changes and quality performance.

Limitations

This study has several limitations. First, the survey captured a cross-sectional (rather than longitudinal) perspective on changes self-reported by hospitals. As a result, the associations between QI changes and outcomes are exploratory; they cannot show definitive causal relationships between QI changes and improved performance. Second, our estimates of QI changes adopted do not capture variation in the duration or intensity of QI implementation by hospitals, so we

may have underestimated the benefits of full QI implementation.¹⁹ Third, we did not control for case-specific volume or financial resources, which are associated with quality performance^{25,40,44}; however, we controlled for hospital size and urbanicity, which are related. Fourth, although it was the best method available, DSH quintile does not precisely identify safety-net hospitals; safety-net hospitals may face barriers to implementing QI changes that were not identified in the results. Fifth, our study does not address the overall cost-effectiveness of QI activities. Hospitals would incur substantial costs if they were implementing a substantial number of QI changes directed toward quality measures, which might reduce resources available in potentially more clinically important areas.^{21,45,46} Finally, the study uses self-reported data, so QI adoption may be lower than reported due to social desirability bias, and the perceived helpfulness of QI changes may have been overestimated.

FIGURE. Changes in Overall Performance and Performance in Quality Domains Associated With QI Changes Made by Hospitals*

HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems; QI, quality improvement.

*Performance scores (for clinical domains and for the overall score) are scaled 0 to 100. The figure depicts the estimated difference in performance associated with a hypothetical facility shifting from 0% QI change adoption to complete QI change adoption. The estimate is depicted using a dot, and the 95% CI is represented by the bar around each estimate. Gray shading indicates decline in performance. Adoption of QI changes is associated with statistically significant improvements in performance if the entire CI is greater than 0.

Source: Authors' analysis of the 2016 National Hospital Provider Survey and hospital quality measure scores from CMS Hospital Compare, the Medicare Master Beneficiary Summary File, and Medicare Part A [hospital] claims data.

To mitigate bias, we assured respondents of confidentiality. In addition, another study (using the same survey data) identified potential unintended consequences of measurement, which implies that respondents were not subject to significant social desirability bias.²¹

CONCLUSIONS

Using quality measures, CMS has encouraged hospitals to make QI changes to improve clinical care and outcomes. In this study, hospitals reported broad investments in QI changes, and most reported each change to be helpful. Furthermore, implementation of substantially more QI changes was associated with modestly better performance on CMS quality measures. Although QI changes were associated with improved clinical outcomes and patient experience, their strongest association was with clinical process measures. Given that CMS measurement programs for hospitals have shifted away from process measures toward outcomes of care, hospitals will need to identify QI changes that are more effective for

improving outcomes. Analyses that identify the costs and benefits from individual QI actions or combinations thereof could help guide hospital investment of limited resources. ■

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revision of the manuscript for important intellectual content (KDS, MWR, AAT, KNC, AMC, CLD); statistical analysis (KDS, MWR, AAT, CLD); obtaining funding (KNC, NB, MD, CLD); administrative, technical, or logistic support (KDS, KNC); and supervision (KNC, CLD).

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Supplemental Data

eAppendix A. Survey Questions on Quality Improvement Changes.

For each QI change, respondents were asked two questions, “Has your hospital made the following change or innovation to improve its performance on CMS measures?” Those hospitals responding affirmatively were asked, “If change was made, has it helped improve your hospital’s performance on one or more CMS measures?”

Organizational Culture
Implemented a “culture of safety” characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures.
Adopted practices to become a “learning organization” that encourages and supports continuous employee learning, critical thinking, and risk-taking with new ideas.
Performance Monitoring
Provided routine feedback on your hospital’s performance on CMS measures to physicians and other clinical staff.
Developed a system for tracking patient outcomes.
Health Information Technology
Implemented electronic tools to support frontline clinical staff, such as clinical decision support, condition-specific electronic alerts, automated prompts, computerized physician order entry (CPOE) or medication administration system (MAR).
Implemented an electronic health record (EHR).
Implemented health information technology functionalities that allow your hospital to routinely exchange clinical information with providers in the community (e.g., nursing homes, and ambulatory care providers).
Care Process Redesign
Implemented standardized care protocols or checklists.
Adopted care redesign/re-engineering (e.g., Deming/Lean Engineering; Six Sigma; Plan, Do, Study, Act (PDSA) improvement cycles).
Implemented or changed communication protocols to support or improve collaboration among clinicians and staff (i.e., Situation Background Assessment Recommendation (SBAR), handoff or paging protocols, etc.).
Implemented interdisciplinary rounds or team “huddles” or formation of multi-specialty patient care teams.
Implemented a post-discharge continuity of care program to prevent readmissions.
Implemented appropriateness criteria to guide physician decision making for selected procedures, imaging studies, or tests.
Implemented risk prediction tools to identify and manage high-risk patients.
Other Improvement
Implemented quality improvement initiatives targeted to specific CMS measures.
Provided training to physicians and/or nurses on quality improvement strategies.

Obtained technical assistance from CMS (i.e., a CMS Quality Improvement Organization) or from private organizations (e.g., quality improvement collaboratives, consulting firms) to collect and report CMS quality measures.
Changes in Staffing
Identified Physician/Nurse champions for quality improvement initiatives or projects.
Increased the number of staff dedicated to quality improvement or quality management.
Implemented changes to how nursing staff is deployed (e.g., change in staffing levels or work hours, use of contract or contingent staff).
Changing Provider Incentives
Gave hospital staff awards or other special recognition tied to quality performance.
Implemented an internal incentive or bonus program for senior clinical leaders and/or senior management based on performance on CMS measures.
Used performance on CMS measures as a basis for determining pay for frontline physicians or other clinical staff.

Note: *For each QI change, respondents were asked two questions, “Has your hospital made the following change or innovation to improve its performance on CMS measures?” Those hospitals responding affirmatively were asked, “If change was made, has it helped improve your hospital’s performance on one or more CMS measures?”

eAppendix B. Variation in Adoption of Quality Improvement Changes by Hospital Quality

Quality Improvement Change	Poor	Medium	Good	<i>p</i> -value ^a
Organizational Culture				
Culture of safety	94	95	94	0.617
Learning organization	79	80	78	0.745
Performance Monitoring				
Routine feedback on performance to staff	97	97	96	0.582
System for tracking patient outcomes	76	78	74	0.513
Health IT				
Electronic tools for staff	92	96	94	0.085
Electronic health record	90	92	91	0.722
Exchange info with community providers	53	65	61	0.001
Care Process Redesign				
Standardized care protocols	97	97	96	0.957
Adopted Deming/Lean, Six Sigma, PDSA ^b	93	92	82	0.000
Protocols to support collaboration	90	90	87	0.373
Interdisciplinary rounds	90	89	84	0.009
Post-discharge continuity program	70	78	68	0.003
Employed appropriateness criteria	68	68	67	0.970
Tools to identify high-risk patients	63	69	66	0.127
Other Improvement				
QI ^c initiatives for specific measures	95	97	91	0.003
Staff training on QI strategies	89	92	87	0.055
Obtained assistance on reporting from QIO ^d	52	54	47	0.079
Staffing Changes				
Provider champions	82	84	77	0.019
Added staff dedicated to QI	39	40	36	0.556
Changes to deployment of staff	33	27	30	0.142
Provider Incentives				
Staff awards tied to quality performance	49	56	48	0.016
Internal incentives for senior leaders	47	55	43	0.001
Pay based on performance for staff	36	47	37	0.001

Source: Authors' analysis of the 2016 National Hospital Provider Survey, hospital quality measure scores from CMS Hospital Compare. Notes: ^a*p*-value corresponds to difference between strata; ^bPDSA= Plan-Do-Study-Act; ^cQI = quality improvement; ^dQIO = Quality Improvement Organization.