Relationship Between Performance Measurement and Accreditation: Implications for Quality of Care and Patient Safety

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This study examined the association between the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) accreditation scores and the Agency for Healthcare Research and Quality's Inpatient Quality Indicators and Patient Safety Indicators (IQIs/PSIs). JCAHO accreditation data from 1997 to 1999 were matched with institutional IQI/PSI performance from 24 states in the Healthcare Cost and Utilization Project. Most institutions scored high on JCAHO measures despite IQI/PSI performance variation with no significant relationship between them. Principal component analysis found 1 factor each of the IQIs/PSIs that explained the majority of variance on the IQIs/PSIs. Worse performance on the PSI factor was associated with worse performance on JCAHO scores (*P* = .02). No significant relationships existed between JCAHO categorical accreditation decisions and IQI/PSI performance. Few relationships exist between JCAHO scores and IQI/PSI performance. There is a need to continuously reevaluate all measurement tools to ensure they are providing the public with reliable, consistent information about health care quality and safety. (Am J Med Qual 2005;20:239-252)

Keywords: safety; quality of health care/statistics and numerical data; medical error; inpatients; hospitals

Quality and safety of health care is a multidimensional construct depending on one's vantage point as a policy maker, purchaser, payor, researcher, or patient. The science of comprehensively measuring and understanding quality and safety is relatively imma-

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ture, using a variety of approaches. Despite this, performance data are increasingly being made public and used to influence consumer choices in health care and even restrict access. In one approach, the accreditation score and status hospitals receive from the Joint Commission on Accreditation of Healthcare Organizations' (JCAHO's) surveyors are commonly used as a surrogate assessment for quality and safety of health care.[1] Accredited hospitals and health systems market this information, and the Centers for Medicare and Medicaid Services requires JCAHO accreditation or state accreditation for participation in Medicare. Nonetheless, it is relatively unknown to what extent JCAHO accreditation is truly associated with the quality and safety of clinical care and improved patient outcomes.[2-9] Despite this gap, hospitals have been expending significant resources for the JCAHO survey in direct costs and spending considerable resources preparing for and conducting JCAHO surveys.[10-15] An alternative approach to quality measurement is to develop and monitor empiric measures of quality and safety that can be collected retrospectively from the medical records or discharge data or prospectively during routine care. Recent efforts at the Agency for Healthcare Research and Quality (AHRQ) to develop empiric measures of quality and safety from multistate discharge data have focused on revamping the original Healthcare Cost and Utilization Project Quality Indicators (HCUP). Two components of these new indicators, the Inpatient Quality Indicators (IQIs) and the Patient Safety Indicators (PSIs), are particularly relevant to in-hospital quality of care.[16]

To help advance the science of quality and safety measurement and to inform decisions on use of health care resources on valid measures, the relationship between various approaches to quality and safety measurement need to be better understood. The key issue at hand is if the data are good enough for promoting real quality improvement and helping consumers make choices. Given the broad perception that JCAHO accreditation is a surrogate for quality and safety, it is important to better understand the association between JCAHO accreditation and evidence-based measures of quality and safety of health care. The objective of this study was to help advance this understanding by critically examining the association between JCAHO accreditation scores and the evidence-based AHRQ IQIs and PSIs.

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METHODS

JCAHO Accreditation and Performance Score Data

Hospital accreditation and performance data for the years 1997 to 1999 were obtained from the JCAHO. Since any given hospital is surveyed once every 3 years, this sample includes all United States hospitals accredited by the JCAHO. These data included hospital identifying information, year of accreditation, and survey performance scores for all 46 "grid" areas reported by the JCAHO, as well as the resultant overall score and accreditation decision[17] (Table 1). During the JCAHO accreditation site visit, survey team members score each hospital on how well it meets the more than 500 standards in the *Accreditation Manual for Hospitals*. Related standards at the time of this study were grouped into 46 performance (grid) areas, each of which was scored. Then, using input from the 46 grid areas, overall hospital performance was ranked on a scale from 0 to 100. During the time period of this study, possible accreditation decisions included the following mutually exclusive categories: accreditation with commendation, accreditation without type 1 recommendation, accreditation with type 1 recommendation, conditional accreditation, preliminary denial of accreditation, accreditation denied, and unaccredited.

AHRQ IQIs and PSIs

The AHRQ IQIs were developed to reflect quality of care inside hospitals and to use a publicly available software program that uses discharge data in which diagnoses and procedures are coded according to the International Classification of Diseases, Ninth Revision, Clinical Modification system.[18] They include in-

Table 1

Performance Areas and Grid Elements Used for Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Surveys and Accreditation

JCAHO Performance Area	JCAHO Grid Elements in Performance Area
Patient rights and organization ethics	Patient rights. Organization ethics.
Assessment of patients	Initial assessment procedures. Pathology and clinical laboratory services. Reassessment procedures. Processes for patient care decisions. Relevant policies. Needs assessment for specific patient populations.
Care of patients	Planning and providing care. Anesthesia care. Medication use. Nutrition care. Operative procedures. Rehabilitation care. Special procedures.
Education	Patient and family education.
Continuum of care	Continuity of care.
Improving organizational performance	Improvement planning. Design of new services. Measurement of processes and outcomes. Assessment of data. Improvement of performance.
Leadership	Strategic planning. Departmental leadership. Integrating and coordinating services. Leader's role in improving performance.
Management of the environment of care	Design of the environment. Implementation of safety plans. Monitoring safety plans. Social environment.
Management of human resources	Human resources planning. Orienting, training, and educating staff. Assessing staff competence. Managing staff requests.
Management of information	Information management planning. Availability of patient-specific information. Data collection and analysis. Literature to support decision making. Use of comparative information.
Infection control	Infection control.
Governance	Governance.
Management	Management.
Medical staff	Organization, bylaws, rules, and regulations. Credentialing.
Nursing	Nursing.
Special recommendations	Accreditation participation requirements.

patient mortality rates for selected medical conditions and procedures; utilization rates of procedures for which there are concerns regarding overuse, underuse, or misuse; and volumes of procedures for which there is evidence that a higher volume is associated with lower mortality. The AHRQ PSIs specifically address potential patient safety concerns that can occur during hospitalization. Appendices A and B provide definitions of the IQIs and PSIs used in this analysis.

For data years 1997 to 1999, 24 data organizations partnered with the AHRQ to create intramural State Inpatient Databases (SID) as part of the HCUP (see the Authors' Note) that could be used to identify IQI and PSI events. HCUP is a family of health care databases and related software tools and products developed through a federal-state-industry partnership and sponsored by the AHRQ. The SID contain clinical and resource use information included in a typical discharge abstract, with safeguards to protect the privacy of individual patients, physicians, and hospitals (as required by data sources). The SID contain more than 100 clinical and nonclinical variables such as principal and secondary diagnoses and procedures, admission and discharge status, patient demographics (eg, gender, age, and, for some states, race), expected payment source (eg, Medicare, Medicaid, private insurance, self-pay; for some states, additional discrete payer categories, such as managed care), total charges, and length of stay.

We used a crosswalk between JCAHO accredited hospital identification numbers for institutions in the 1997 to 1999 database and the corresponding American Hospital Association hospital identification number to merge the HCUP and JCAHO data.[19,20] We then used the IQI and PSI software to estimate the raw, adjusted, and smoothed IQI and PSI rates for each JCAHO accredited institution in 1997 to 1999. The merged data set contained IQI and PSI information from 2116 hospitals surveyed by JCAHO in 1997 to 1999 and located in states that participated in HCUP during this time period.

Statistical Analysis

Comparisons between IQI and PSI measures and JCAHO site visit performance scores were assessed using several approaches. Since many of these IQIs and PSIs had relatively low event rates, we conservatively chose to analyze only the smoothed rate estimates of the indicators for any given institution. These smoothed rates were estimated using multivariate signal extraction, a technique similar to Bayesian methods.[21] This approach estimates how much of an impact random clinical and nonclinical factors have on observed rates and indicates how persistent one could expect a provider's rate to be from year to year barring random variation inherent in small numbers of events.[21] Hospitals with fewer cases tend to be the best and worst performing on an indicator in any given year because a few cases have a large impact on rates. Therefore, the use of smoothed rates was felt to be essential to most accurately and conservatively capture the frequency of events.

From the JCAHO database, we used the overall evaluation score, derived from the 46 grid elements assessed during the survey, the accreditation categorical decision, and, in select cases, some individual grid element scores deemed particularly salient to health care quality and safety. This approach was based on JCAHO scoring methodology. First, JCAHO uses scores from the 16 performance areas, reflecting 46 grid elements (Table 1), to influence development of a final overall evaluation score (FOES), which is then translated to 1 of 8 categorical accreditation statuses. Whereas individual grid element scores are on a scale of 1 to 5 (best-worst), the FOES is based on a 100-point scale with 100 representing the highest and best possible score. The process JCAHO uses to translate grid and area scores to FOES has changed over time, all grid areas are not weighted equally, and the weighting scheme is not publicly available.[22] In addition, the JCAHO still sees a primary role for surveyor judgment in final accreditation decisions and in 1996 stated that "the scoring does not supersede or preempt surveyor judgment regarding a hospital's degree of compliance with the standards."[23] These factors limited our ability to reconstruct the importance of any one grid element score in the final determination of the FOES or accreditation status.

For our analysis, we a priori included IQIs and PSIs that had smoothed rates greater than 0 for at least 75% of the 2116 institutions. As a result, we excluded PSI 10 (postoperative physiologic or metabolic derangements) and PSI 16 (transfusion reactions), as well as IQIs 8, 9, 10, 12, 30, and 31 representing postprocedural mortality rates for esophageal resection, pancreatic resection, pediatric heart surgery, coronary artery bypass surgery, percutaneous transluminal coronary angioplasty, and carotid endarterectomy. Because each of these mortality rate IQIs is linked with another IQI measure evaluating volume of the procedure, we also deleted the associated surgical volume IQIs 1, 2, 3, 5, 6, and 7. The remaining volume indicator for abdominal aortic aneurysm repair, IQI 4, was dichotomized for purposes of this analysis, reflecting the published evidence that hospitals with at least 32 cases per year have better outcomes.[24] Therefore, our analysis included 15 IQIs and 18 PSIs.

Regression analysis on the FOES was performed on the log-transformed indicator variables. Principal component analysis also was performed on the log-transformed indicator variables, separately for the IQIs and the PSIs. The relationship between the principal components and the FOES was determined using multivariate linear regression of the components on FOES. Because of some frequently missing IQI variables at many hospitals, the principal components analysis included only IQIs 14 to 24. IQIs 4, 11, 13, and 25 were included in the exploratory analyses and indicator-specific regressions only.

Boxplots and analysis of variance (ANOVA) of the transformed indicators by categorical JCAHO accreditation status also were performed. Ordered linear logistic regression models for binary or ordinal response data using the method of maximum likelihood were done, modeling the transformed indicator variables on JCAHO accreditation status. In addition, correlations were examined between selected JCAHO grid element scores and clinically relevant IQI or PSI rates. All analyses were completed using SAS (Cary, NC), and a $P < .05$ was considered statistically significant.

RESULTS

Institutional Performance on IQIs, PSIs, and JCAHO Scores

Table 2 displays the mean rate for each of the IQIs, PSIs, and the JCAHO FOES across the hospitals included in our analysis. Because the denominator for each of the IQIs and PSIs varies based on whether institutions admitted certain types of patients or did certain types of procedures, the number of institu-

Table 2

Mean Hospital Performance on IQIs, PSIs, and JCAHO Final Overall Evaluation Scores

	Number of Institutions	Mean Rate	Standard Deviation
Inpatient quality indicator			
11 In-hospital mortality rate AAA repair, low volume	986	0.129	0.017
11 In-hospital mortality rate AAA repair, high volume	181	0.143	0.018
13 In-hospital mortality rate craniotomy	1002	0.102	0.024
14 In-hospital mortality rate hip replacement	1727	0.003	0.001
15 In-hospital mortality rate AMI	2074	0.148	0.028
16 In-hospital mortality rate CHF	2179	0.064	0.012
17 In-hospital mortality rate stroke	2171	0.162	0.033
18 In-hospital mortality rate GI hemorrhage	2137	0.040	0.005
19 In-hospital mortality rate hip fracture	1989	0.037	0.006
20 In-hospital mortality rate pneumonia	2223	0.126	0.024
21 Cesarean section delivery rate	1712	0.218	0.046
22 Vaginal birth after cesarean section rate	1687	0.313	0.106
23 Laproscopic cholecystectomy rate	2097	0.716	0.126
24 Incidental appendectomy rate	2065	0.020	0.013
25 Bilateral cardiac catherization rate	1167	0.169	0.126
Patient safety indicator			
1 Complications of anesthesia	2255	0.0007	0.0006
2 Death in low mortality DRGs	2395	0.0005	0.0006
3 Decubitus ulcer	2444	0.0216	0.0184
4 Failure to rescue	2311	0.1779	0.0266
5 Foreign body left after procedure	2450	0.0001	0.0000
6 Iatrogenic pneumothorax	2447	0.0008	0.0004
7 Infection due to medical care	2448	0.0018	0.0012
8 Postoperative hip fracture	2235	0.0008	0.0003
9 Postoperative hemorrhage	2253	0.0019	0.0005
11 Postoperative respiratory failure	2082	0.0033	0.0017
12 Postoperative pulmonary embolism/DVT	2253	0.0081	0.0029
13 Postoperative sepsis	2022	0.0101	0.0035
14 Postoperative wound dehiscence	2168	0.0020	0.0005
15 Technical difficulty	2449	0.0031	0.0015
17 Birth trauma	1697	0.0085	0.0215
18 OB trauma, vaginal with instrumentation	1627	0.2227	0.0873
19 OB trauma, vaginal without instrumentation	1708	0.0787	0.0414
JCAHO final overall evaluation scores			
FOES	2116	94.4%	1.83%

IQI = Inpatient Quality Indicator; PSI = Patient Safety Indicator; JCAHO = Joint Commission on Accreditation of Healthcare Organizations; AAA = abdominal aortic aneurysm; low volume = institutions with low annual volume of AAA repair; high volume = institutions with high annual volume of AAA repair; AMI = acute myocardial infarction; CHF = congestive heart failure; GI = gastrointestinal; DRG = diagnosis-related groups; DVT = deep venous thrombosis; OB = obstetrical; FOES = final overall evaluation score.

tions with relevant smoothed rates in this analysis varies by indicator. Figure 1 shows the percentage of hospitals with various grid element scores for each of the 46 JCAHO grid elements for the time period 1997 to 1999. On each grid element, a score of 1 (shown by white box) indicates best performance and a score of 5 (shown by black box) is worst performance. Overall, most institutions scored the best score of 1 for the majority of grid elements.

Inpatient Quality Indicators Compared to JCAHO FOES and Accreditation Decisions

Most hospitals scored high on FOES, clustering between 90% and 100%, despite broad variation in IQI performance (Figure 2). Regression analysis of each IQI indicator rate on FOES indicated that none of the IQIs appeared to be related to FOES at the $P < .05$ level of significance (Table 3).

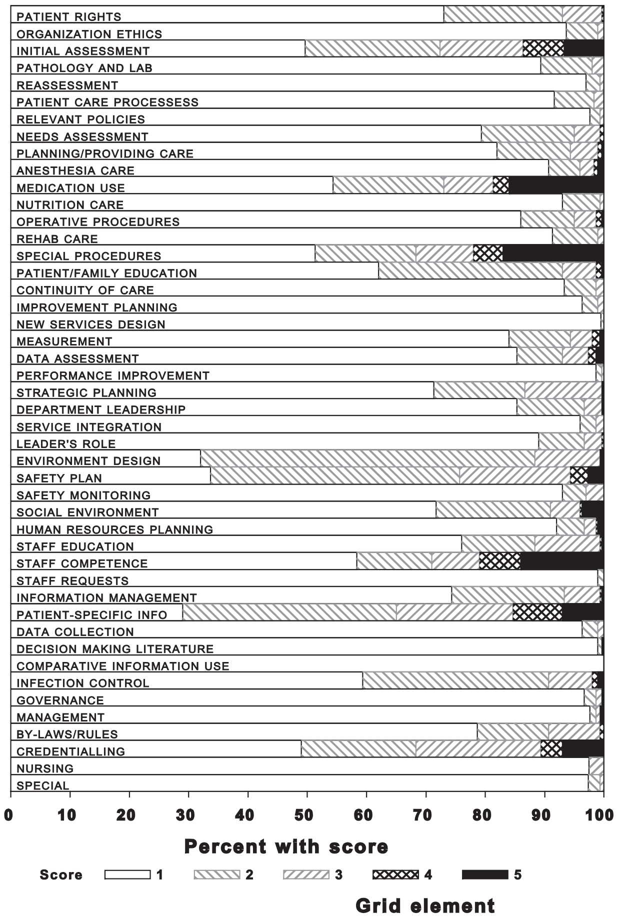

Figure 1. Percentage of hospitals with various grid element scores for each of the 46 JCAHO grid elements for the time period 1997-1999.

IQI principal component analysis identified 3 main factors that accounted for the majority of explained variance, the first of which was most promising based on statistical analysis. Factor 1 included predominantly IQIs 15 to 20, which are all postprocedural mortality rates (mortality rates after acute myocardial infarction, congestive heart failure, stroke, gastrointestinal hemorrhage, and pneumonia). Factor 2 included predominantly IQIs 21 to 22, which deal with cesarean sections and vaginal births after cesarean section. Factor 3 included mainly IQIs 14 and 23, both of which are surgically oriented by looking at mortality after hip replacement and rates of laparoscopic cholecystectomy. Regression analyses of these component factors on FOES found no relationships between any of the factors and the JCAHO FOES (Table 3).

ANOVA and ordered linear logistic regression models using the transformed IQI variables on the categorical JCAHO accreditation groupings found that only worse performance on IQI 20 (in-hospital mortality rate for pneumonia) was associated with a trend toward less favorable categorical accreditation decision ($P = .01$). There was no relationship between categorical accreditation status and the IQIs.

Patient Safety Indicators Compared to JCAHO FOES and Accreditation Decisions

Although most hospitals scored between 90% and 100% on FOES, in a pattern similar to the IQIs, there was broad variation among hospitals in performance on the PSIs (Figure 3). Regression analysis of each individual PSI on FOES revealed that worse performance on PSIs 11 and 15 (worse rates of postoperative respiratory failure and technical difficulty with care, respectively) were associated with lower FOES (Table 4; $P = .003$ and $P = .004$, respectively) In contrast, however, higher rates of iatrogenic pneumothorax (PSI 6) and higher rates of obstetrical trauma in vaginal deliveries without instrumentation were associated with better FOES ($P = .03$ and $P = .04$, respectively).

Principal component analysis of the transformed smoothed PSI rates resulted in 3 factors, the first of which was most promising based on eigenvalue. Factor 1 involved predominantly postoperative issues in PSIs 11 to 13 (respiratory failure, pulmonary embolism or deep venous thrombosis, and sepsis). Factor 2 involved predominantly PSIs 18 to 20, which focus on obstetrical trauma. Factor 3 involved mainly PSIs 1, 5, and 15, which are a diverse set of procedural difficulties as complications of anesthesia, foreign bodies left after procedures, and technical difficulties with procedures such as accidental punctures and lacerations. Regression analysis of these component factors on FOES found that worse performance on factor 1 was associated with worse FOES (Table 4; $P = .02$).

ANOVA and ordered logistic regression of the smoothed PSI rates on categorical accreditation status found that worse performance on PSI 12 (rates of postoperative pulmonary embolisms or deep venous thromboses) and PSI 19 (rates of obstetrical trauma in vaginal deliveries without instrumentation) were associated with a trend toward less favorable categorical accreditation decisions ($P = .05$ and $P = .02$, respectively). In contrast, worse performance on PSI 15 (technical difficulty with care) was associated with more favorable categorical accreditation decisions

Table 3

Regression Analyses of Individual Inpatient Quality Indicators (IQIs) on Final Overall Evaluation Score

IQI	n	β Coefficient	SE	*P*
11. In-hospital mortality AAA repair, low volume	865	0.614	0.456	.18
11. In-hospital mortality AAA repair, high volume	162	–1.527	1.023	.14
13. In-hospital mortality craniotomy	874	0.190	0.258	.46
14. In-hospital mortality hip replacement	1517	0.154	0.129	.23
15. In-hospital mortality AMI	1815	0.398	0.224	.08
16. In-hospital mortality CHF	1905	0.068	0.222	.76
17. In-hospital mortality stroke	1903	0.111	0.207	.59
18. In-hospital mortality GI hemorrhage	1870	0.438	0.340	.20
19. In-hospital mortality hip fracture	1746	0.326	0.265	.22
20. In-hospital mortality pneumonia	1941	0.005	0.214	.98
21. Cesarean section delivery	1505	0.086	0.210	.68
22. Vaginal birth after cesarean section	1484	0.146	0.116	.21
23. Laproscopic cholecystectomy	1840	0.291	0.205	.16
24. Incidental appendectomy	1812	–0.015	0.064	.82
25. Bilateral catherization	1018	0.145	0.093	.12
IQI factor 1		0.020	0.046	.66
IQI factor 2		0.011	0.047	.82
IQI factor 3		0.052	0.047	.27

n = number of institutions with data for that indicator; AAA = abdominal aortic aneurysm; low volume = institutions with low annual volume of AAA repair; high volume = institutions with high annual volume of AAA repair; AMI = acute myocardial infarction; CHF = congestive heart failure; GI = gastrointestinal.

(*P* = .004). No clear associations were found for the other PSIs and categorical accreditation decisions.

Correlational Analyses of Individual JCAHO Grid Elements and IQIs/PSIs

With the understanding that many issues weigh into the FOES and accreditation decisions, we also examined the association between individual JCAHO grid element scores and individual IQIs and PSIs that capture similar clinical issues. We first evaluated the correlation between performance on all the IQIs and PSIs and the following JCAHO grid elements that showed relatively more variation in hospital scores and that were felt to be salient to quality of care and safety: initial assessment procedures for patients, credentialing of staff, infection control, medication use, and assessment of staff competence. Across all the IQIs and PSIs, there were no significant correlations. In addition, we examined correlations between the following clinically related items: JCAHO infection control and PSI infection due to medical care, JCAHO anesthesia care and PSI complications of anesthesia, JCAHO operative procedures and PSIs for foreign body left after procedure, incidental appendectomy, and bilateral cardiac catheterizations. Each of these correlations was not significant, and all had slopes less than 0.1.

DISCUSSION

Ensuring high-quality and safe health care is one of the ultimate goals of our nation's health care system. Most recently, the federal government has launched a new initiative not only to facilitate the collection of data relevant to these goals but also to publicly disseminate hospital performance data with the objective of informing the public and invigorating quality efforts.[25] In addition, the federal government annually receives a new report titled "The National Healthcare Quality Report."[26] Both of these efforts are attempts to collect data on quality and safety, create comprehensive assessments of the health care industry, and disseminate these findings.

While the end goal is laudable, there is a clear need to objectively analyze both traditional and newly developed measures and measurement systems and determine whether they provide the public with consistent and reliable information. In this study, we have taken the most widely used national benchmark for assessing health care institutional quality, the JCAHO survey scores and accreditation decisions,

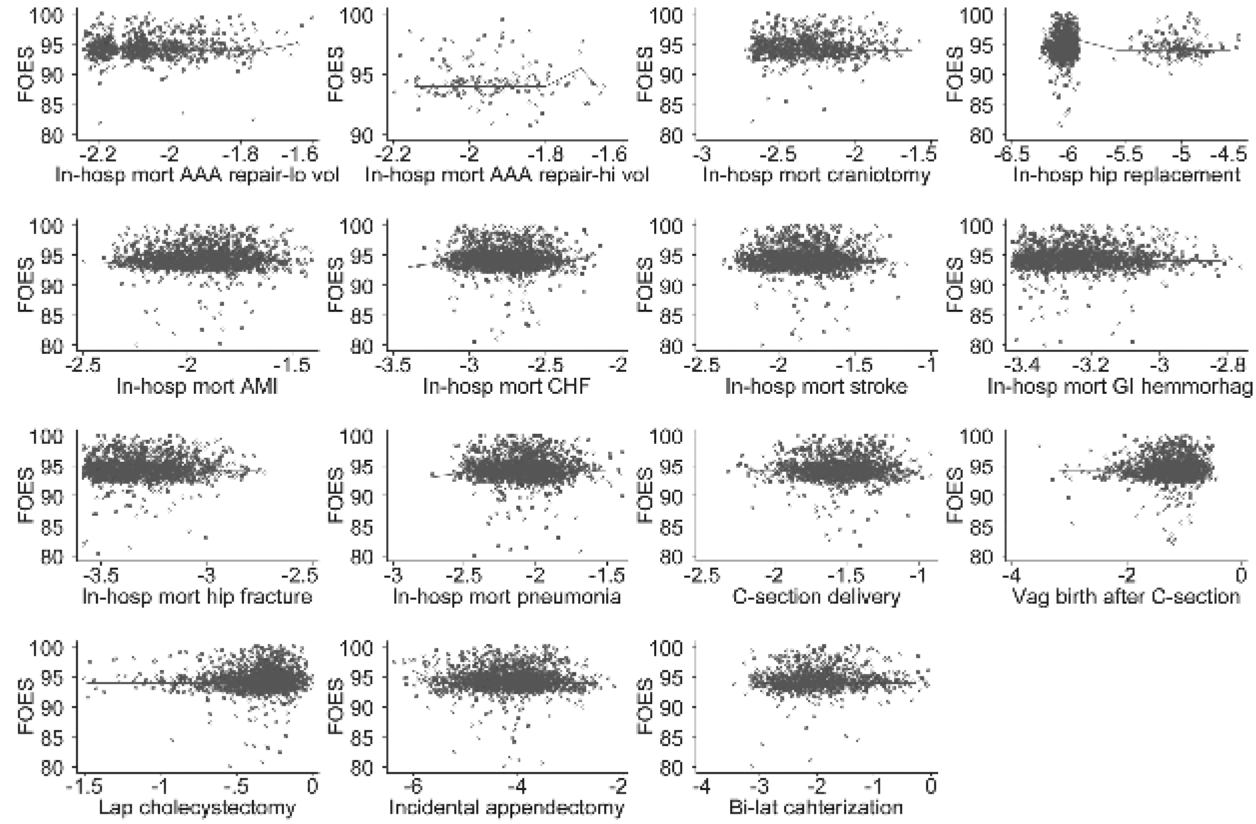

Figure 2. Relationship between Joint Commission on Accreditation of Healthcare Organizations final overall evaluation scores (FOESs) and individual institution performance on Inpatient Quality Indicators.

and compared it to newly and rigorously developed evidence-based measures of health care quality and safety. At best, we can say that there appears to be no relationship between the JCAHO survey results and these evidence-based measures of health care quality and safety. The results of this study have broad implications for public policy and suggest the need for substantial further inquiry regarding how to measure, assess, and therefore improve hospital performance.

One obvious question from this research is whether the JCAHO scores and empiric measures of quality and safety should be correlated. On one hand, if they assess both "quality and safety of care," they should be related. On the other hand, if they measure different domains of quality and safety, they may not be related. Taking the public's point of view, performance assessments with different outcomes can be confusing by providing mixed messages on which system has the highest quality and safety. Equally so, these results beg the question of what level of assessment is both necessary and sufficient for promoting health care improvements. Because quality and safety are truly multidimensional constructs, it may be better to refer to the qualities of care to encompass both quality and safety. All this being said, it is paramount that as the nation collectively tries to improve the qualities of health care, spurred onward by the Institute of Medicine reports, we critically evaluate where we are in terms of how comprehensively we are assessing and where we stand in terms of developing systems that are both necessary and sufficient to create substantive improvements across all dimensions of quality and safety.[27,28]

This study and its findings are not intended to suggest the superiority of one current approach to measurement and assessment over another. They do indicate, however, that the assessment of quality from any one perspective or using any one tool is unlikely to give the complete picture. During the period reviewed in this study, the JCAHO relied most heavily

Table 4

Regression Analyses of Individual Patient Safety Indicators (PSIs) on Final Overall Evaluation Score

PSI	n	β Coefficient	SE	*P*
01. Complications of anesthesia	1967	0.029	0.056	.60
02. Death in low-mortality DRGs	2071	0.012	0.043	.78
03. Decubitus ulcer	2112	0.004	0.063	.95
04. Failure to rescue	2007	0.112	0.274	.68
05. Foreign body left in	2115	–0.102	0.186	.58
06. Iatrogenic pneumothorax	2114	0.261	0.124	.03
07. Infection due to medical care	2114	–0.037	0.093	.69
08. Postoperative hip fracture	1951	–0.112	0.145	.44
09. Postoperative hemorrhage	1965	0.096	0.188	.61
11. Postoperative respiratory failure	1818	–0.284	0.078	.0003
12. Postoperative PE or DVT	1965	–0.210	0.114	.06
13. Postoperative sepsis	1765	–0.209	0.126	.10
14. Postoperative wound dehiscence	1895	–0.098	0.189	.60
15. Technical difficulty	2114	–0.212	0.074	.004
17. Birth trauma	1493	0.045	0.030	.13
18. OB trauma, vaginal with instrumentation	1432	–0.114	0.111	.31
19. OB trauma, vaginal without instrumentation	1502	0.165	0.079	.04
20. OB trauma, cesarean section	1495	–0.027	0.105	.80
PSI factor 1		–0.108	0.047	.02
PSI factor 2		0.026	0.047	.58
PSI factor 3		–0.010	0.047	.83

n = number of institutions with data for that indicator; DRG = diagnosis-related groups; PE = pulmonary embolism; DVT = deep venous thrombosis; OB = obstetrical.

on structural and process measures (eg, credentialing of staff) while the AHRQ IQIs and PSIs were a mix of process and outcome measures. We found that the variability among hospitals on the structural measures used by the JCAHO was relatively small, with most institutions clustering toward the top end of the scale, compared to the wide variation in processes and outcomes revealed by the IQIs and PSIs. Given the multidimensionality of quality and safety, it is plausible to consider that more robust assessment tools would involve a mix of structural, process, and outcome measures. Such an effort would in effect make JCAHO assessments and the AHRQ IQIs and PSIs complementary systems. To date, however, we do not have a good understanding nor tools to help us automatically synthesize these results into one such complementary assessment. As an example of how this may have surfaced in our study, we found that institutions with higher rates of iatrogenic pneumothorax (PSI 6) and higher rates of obstetrical trauma in vaginal deliveries without instrumentation counterintuitively tended to have better FOES. It is likely that this finding results from the fact that structural and process measures are not necessarily linked to outcomes. More important, however, our current assessment systems leave us lost as to how to synthesize these very counterintuitive findings into one global assessment of health care for each institution.

A number of alternative hypotheses could be formed to explain the patterns in JCAHO scores and IQI and PSI scores, ranging from the IQIs and PSIs simply being more sensitive to small variations in quality and performance to the high-end clustering of JCAHO scores being an indicator of the ability of American health care organizations to robustly respond to published standards. The truth is probably a mixture of both and warrants more research. That statement alone has profound implications when we keep in mind the resources expended for JCAHO accreditation and other quality assessment efforts and the still unmet need to assess quality using a mixture of structure, process, and outcome measures from a variety of perspectives.

Although relatively immature, the field of health care quality and safety measurement is rapidly expanding due to increasing pressures from entities including federal and state governments, private and public corporations attempting to make maximal use of their health care expenditures, and consumers trying to make sound health care choices. The main themes of these efforts are to use evidence-based

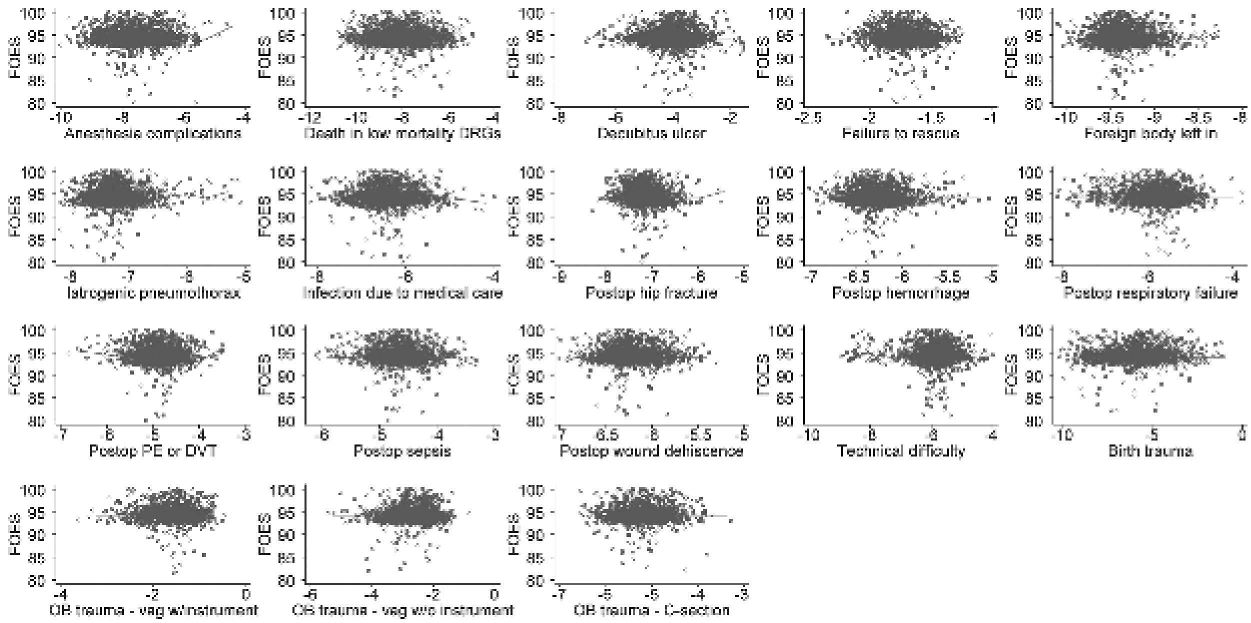

Figure 3. Relationship between JCAHO final overall evaluation scores (FOESs) and individual institution performance on Patient Safety Indicators.
DRG = diagnosis-related group; PE = pulmonary embolism; DVT = deep venous thrombosis; OB = obstetrical.

measures and to create transparency in performance. In concert with the trend from subjective toward empirical measures of health care quality, the JCAHO has altered how it interacts with health care institutions and ensures high-quality and safe care.[1] The JCAHO is moving toward evidence-based measures of quality via the ORYX initiative, self-assessment of care, use of tracer patients to selectively target individual institutions' quality reviews, and unannounced surveys to obtain more reality-based views on day-to-day care within our institutions. Although these efforts clearly seem on face value to be more likely to be both necessary and sufficient to help improve the quality and safety of care, given the results reported here, it will be important in the future to examine relationships between these types of assessments and other empirical measures of quality and safety from alternative perspectives.

We recognize several limitations to our study. First, the IQIs and PSIs rely on hospital administrative data. This is both their strength and their most significant limitation. Electronic administrative data are a readily available and relatively inexpensive source of information on a care setting that is particularly susceptible to quality and safety concerns because of the intensity of the interventions that occur there. However, administrative data provide limited clinical information and have known problems in coding accuracy, coding variation, limited ability to adjust for differences in risk, and limited insight into timing of events.[29-32] Although we must acknowledge these limitations, both the IQIs and PSIs are the end products of a rigorous development process including literature reviews for cumulative evidence, coding reviews, expert clinician input, and empirical analyses and represent the current state of the art in tools for measuring quality and safety. The strictly defined inclusion and exclusion criteria for each individual IQI and PSI in part overcomes many of the inherent limitations based on the coding of discharge data. Second, our sample included only 2116 hospitals from 24 states. While we realize this is not a complete census of all hospitals accredited by the JCAHO, we feel the large number of institutions examined here very likely provides results that are comparable for all JCAHO accredited institutions. Third, we used a relatively limited set of quality measures, 15 for IQIs and 18 for PSIs, as our empirical measures of quality. Although these measures provide a broad view of quality and evaluate medical, surgical, obstetric, and pediatric patients, we may not have used broad enough measures of quality and safety to correlate with the aspects of quality and safety assessed by the JCAHO review. However, given the multiple analyses conducted here as well as the definitions of the JCAHO grid elements and the IQIs and PSIs, it would seem plausible to expect some correlation in aspects of health care assessed by JCAHO scores and these quality measures. Fourth, we cannot comment on how JCAHO-type assessments correlate to IQI and PSI performance in institutions that do not currently participate in JCAHO accreditation. It is not difficult to imagine how different these 2 pools of institutions are given that, by and large, it is smaller and more rural institutions that do not participate in JCAHO accreditation. Last, given our cross-sectional analysis, we are unable to comment on whether individual institutional trend scores on JCAHO or IQI/PSI performance would be found to have a greater and logical relationship. It is plausible that there may be a greater link between these assessment systems viewed over time within one institution such that changes in JCAHO FOES may correlate to changes in IQI or PSI performance. We can speculate, however, that the capacity of JCAHO scores to do this would be hampered by the ceiling effect because most institutions score relatively high on JCAHO FOES.

The results of this study have potentially important policy implications. Given the finite resources that hospitals can devote to quality and safety improvement, it would be desirable to evaluate the relationships between results of the newly formulated JCAHO reviews and other measures of quality and safety. The goal again is that our measurement and assessment systems are comprehensive and are also sufficient to spawn tangible improvements in quality and safety. These relationships also should be explored with other efforts to measure and report performance such as those under way by the Centers for Medicare and Medicaid Services. It will be important both to examine the degree to which these varying approaches result in similar assessments of individual hospitals and to understand the reasons for any variation in assessment results.

In summary, we found few relationships between JCAHO accreditation site visit results and empirical measures of quality and safety using the AHRQ IQIs and PSIs. The most important message from this study is the clear need to continuously and vigorously reevaluate all performance assessment strategies to promote the highest possible levels of health care quality and safety and to provide the public with reliable and consistent information.

APPENDIX A
Definitions of Agency for Healthcare Research and Quality Inpatient Quality Indicators: Volume and Mortality Rate Indicators Only

Inpatient Quality Indicator	Numerator	Denominator	Key Exclusions
4. Abdominal aortic aneurysm repair volume	Abdominal aortic aneurysm procedure codes and a diagnosis code of abdominal aortic aneurysm	Not applicable	All records in medical diagnostic classification (MDC) 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
11. Abdominal aortic aneurysm repair mortality rate	Deaths with abdominal aortic aneurysm repair procedure codes	Records with abdominal aortic aneurysm repair procedure codes and a diagnosis code of abdominal aortic aneurysm	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
13. Craniotomy mortality rate	Deaths with craniotomy procedure codes, except for trauma	Records with craniotomy procedure codes	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
14. Hip replacement mortality rate	Deaths with partial or full hip replacement procedure codes	Records with partial or full hip replacement procedure codes, uncomplicated cases only	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
15. Acute myocardial infarction mortality rate	Deaths with principal diagnosis of acute myocardial infarction	Records with principal diagnosis of acute myocardial infarction; age 18 years or greater	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
16. Congestive heart failure mortality rate	Deaths with principal diagnosis of congestive heart failure	Records with principal diagnosis of congestive heart failure; aged 18 years or older	Records with cardiac procedure codes, patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
17. Acute stroke mortality rate	Deaths with principal diagnosis of stroke	Records with principal diagnosis of stroke; aged 18 years or older	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
18. Gastrointestinal hemorrhage mortality rate	Deaths with principal diagnosis of gastrointestinal hemorrhage	Records with principal diagnosis of gastrointestinal hemorrhage; aged 18 years or older	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
19. Hip fracture mortality rate	Deaths with principal diagnosis of hip fracture	Records with principal diagnosis of hip fracture; aged 18 years or older	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
20. Pneumonia mortality rate	Deaths with principal diagnosis of pneumonia	Records with principal diagnosis of pneumonia; aged 18 years or older	Patients transferring to another short-term hospital, all records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
21. Cesarean section utilization rate	Records with cesarean section codes	All deliveries	None
22. Vaginal birth after cesarean section delivery utilization rate	Records with vaginal births and diagnosis of previous cesarean section	All deliveries with diagnosis of previous cesarean section	None
23. Laproscopic cholecystectomy utilization rate	Records with laproscopic cholecystectomy	Records with cholecystectomy procedure code	All records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
24. Incidental appendectomy utilization rate among elderly	Incidental appendectomy procedure codes	Patients 65 years or older with intraabdominal procedure code	All records in MDC 14 (pregnancy, childbirth, puerperium) and MDC 15 (newborns and neonates)
25. Bilateral cardiac catheterization utilization rate	Procedure codes for simultaneous right and left heart catheterization	Records with heart catheterization procedure codes	Records with specified valid indications for right heart catheterization (eg, acute cor pulmonale, mitral stenosis, etc)

All diagnosis-based definitions are based on secondary diagnoses unless otherwise noted. More details on these indicators are available at http://www.qualityindicators.ahrq.gov/.

APPENDIX B
Definitions of Agency for Healthcare Research and Quality Patient Safety Indicators

Patient Safety Indicator	Numerator	Denominator	Key Exclusions
1. Complications of anesthesia	Anesthetic overdose, reaction, endotrachial tube misplacement	All surgical discharges	Poisoning due to drug dependence or abuse, self-inflicted injury
2. Death in low-mortality DRG	Discharges with disposition of "deceased"	All discharges in DRGs with less than 0.5% mortality rate based on national inpatient sample data for 1997	Trauma, immunocompromised state, cancer
3. Decubitus ulcer	Pressure ulcer	All medical and surgical discharges with >4-day stay	Hemiplegia, paraplegia, or quadriplegia; paralysis; obstetric discharge; admission from long-term care facilities
4. Failure to rescue	Discharges with a disposition of "deceased"	All discharges with potential complication of care (eg, pneumonia, deep venous thrombosis, pulmonary embolism, sepsis, acute renal failure, shock, cardiac arrest, gastrointestinal hemorrhage)	Exclusions specific to each diagnosis (eg, pneumonia excludes immunocompromised state, viral pneumonias; sepsis excludes immunocompromised state, records with primary diagnosis of infection, and records with length of stay greater than 3 days)
5. Foreign body left during procedure	Foreign body accidentally left during procedure	All medical and surgical discharges	None
6. Iatrogenic pneumothorax	Iatrogenic pneumothorax	All medical and surgical discharges	Trauma, cardiothoracic surgery, lung or pleural biopsy, obstetric discharge
7. Selected infection due to medical care	Infection following infusion, injection, or transfusion or due to vascular device or graft	All medical and surgical discharges	Cancer, immune compromise
8. Postoperative hip fracture	Postoperative in-hospital hip fracture	All surgical discharges	Musculoskeletal diseases, seizure, syncope, stroke, coma, cardiac arrest, anoxic brain injury, poisoning, delirium, trauma, self-inflicted injury, cancers metastatic to bone
9. Postoperative hemorrhage/hematoma	Postoperative hemorrhage/hematoma with surgical drainage or evacuation	All surgical discharges	Obstetric discharge
11. Postoperative respiratory failure	Postoperative acute respiratory failure	All elective surgical discharges	Respiratory or circulatory diseases, obstetric discharge
12. Postoperative pulmonary embolism or deep vein thrombosis	Postoperative deep vein thrombosis or pulmonary embolism	All surgical discharges	Obstetric discharge, principal diagnosis of deep vein thrombosis, obstetric patients
13. Postoperative sepsis	Postoperative sepsis	All elective surgical discharges with >3-day stay	Cancer, infection, immune compromise, obstetric discharge
14. Postoperative wound dehiscence	Secondary procedure to close postoperative disruption of abdominal wall	All abdominopelvic surgical discharges	Obstetric discharge
15. Technical difficulty with procedure	Accidental puncture or laceration during procedure	All medical and surgical discharges	Obstetric discharge
17. Birth trauma, injury to neonate	Intracranial hemorrhage, extraclavicular fracture, spinal injury, nerve injury (other than facial and brachial plexus), other birth trauma	All live births	Preterm infants (for intracranial hemorrhage), osteogenesis imperfecta (for fracture)
18. Obstetric trauma, vaginal with instrumentation	Principal or secondary diagnosis of fourth-degree perineal, high-vaginal, or cervical laceration or procedure to repair any of these lacerations	All vaginal deliveries with forceps or vacuum	None
19. Obstetric trauma, vaginal without instrumentation	Same as above	All vaginal deliveries without forceps or vacuum	None
20. Obstetric trauma, cesarean	Same as above plus uterine or urinary tract laceration or procedure to repair any of these lacerations	All cesarean deliveries	None

DRG = diagnosis related group. All diagnosis-based numerator definitions are based on secondary diagnoses unless otherwise noted. More details on these indicators are available at http://www.qualityindicators.ahrq.gov/.

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