Linking Quality and Cost:
An Analysis of the Hospital Quality Information Initiative Measures

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TABLE OF CONTENTS

Page

Executive Summary

In 2002 the U.S. Department of Health and Human Services, in conjunction with the Hospital Quality Alliance, released performance measures for their Hospital Quality Initiative for three conditions – heart attack care (AMI), heart failure care and pneumonia care. Unlike many of the other quality indicators available, these measures do not indicate whether a particular outcome occurred, but rather whether or not a certain protocol was performed during a hospital stay. A high level of compliance with performing these protocols determines a hospital's ranking as compared to other facilities.

Data collected for the Hospital Quality Initiative was made public in 2004. The data used in this paper was based on data released as of the third quarter of 2005. While many hospitals are cooperating with the Initiative, many are currently not yet reporting data or are reporting data for only a few of the performance measures. Therefore, while the results of this analysis may be indicative of what the relationship between the Health Quality Initiative measures and hospital reimbursement levels may be, more data will need to be analyzed in order to make final conclusions.

With the data available, a strong relationship between the performance measures in the Health Quality Initiative and hospital reimbursement could not be established. Part of this may be due to the limited scope of the performance measures in that they only measure protocols for three conditions. However, isolating the allowed charges for just the cases admitted in the three conditions of the performance measures (AMI, heart failure and pneumonia) does not bring about substantial improvement in their mathematical relationship.

Pay for performance, where the allowed charge is based on the attainment of certain quality measures, is expected to become more prevalent in the health care industry. This data suggests that the performance measures in the Health Quality Initiative are not highly correlated with allowed charges with even lower correlation between the performance measures and billed charges and cost. If a relationship cannot be established, it will be difficult for insurers to design a reimbursement scheme based on quality that can be credible to providers of care, payers and the public.

Background

The purpose of this paper is to determine whether a mathematical relationship exists between hospital quality and hospital billed or allowed charges or other measures using quality data as defined by the U.S. Department of Health and Human Services (DHHS) along with the Hospital Quality Alliance (HQA) for their Hospital Quality Initiative and to communicate findings and observations after this program has been implemented.

In December 2002, DHHS and HQA created a website, Hospital Compare (www.hospitalcompare.hhs.gov) to promote reporting on aspects of quality hospital care. The information shown on this website is based on a sub-group of inpatient conditions and measures a hospital's performance rates of recommended care for certain quality measures within each condition. The quality measures include:

- Eight measures related to heart attack care
    - Percent of patients given ACE inhibitor or ARB for left ventricular systolic dysfunction (LVSD)
    - Percent of patients given aspirin at arrival
    - Percent of patients given aspirin at discharge
    - Percent of patients given beta blocker at arrival
    - Percent of patients given beta blocker at discharge
    - Percent of patients given percutaneous coronary interventions (PCI) within 120 minutes of arrival
    - Percent of patients given smoking cessation advice/counseling
    - Percent of patients given thrombolytic medication within 30 minutes of arrival
- Four measures related to heart failure care
    - Percent of patients given ACE inhibitor or ARB for left ventricular systolic dysfunction (LVSD)

- Percent of patients given assessment of left ventricular function (LVF)
- Percent of patients given discharge instructions
- Percent of patients given smoking cessation advice/counseling

- Six measures related to pneumonia care

  - Percent of patients assessed and given pneumococcal vaccination
  - Percent of patients given initial antibiotic(s) within 4 hours after arrival
  - Percent of patients given oxygenation assessment
  - Percent of patients given smoking cessation advice/counseling
  - Percent of patients given the most appropriate initial antibiotics(s)[1]
  - Percent of patients having a blood culture performed prior to first antibiotic received in hospital

- Two measures related to surgical infection prevention

  - Percent of surgery patients who received preventive antibiotic(s) one hour before incision[1]
  - Percent of surgery patients whose preventive antibiotic(s) are stopped within 24 hours after surgery[1]

These quality measures are primarily for acute care hospitals – only because these conditions do not usually occur in psychiatric, rehabilitation or long term acute care hospitals. Prior to the introduction of the surgical infection prevention measures, children's admissions were not collected. DHHS and HQA plan to expand the number of measures in the future and possibly to extend them to define quality measures for non-acute facilities.

The DHHS/HQA performance measures are based on information that can be collected from inpatient medical records. To date, hospitals have been voluntarily supplying the data to the Initiative and the data is being made available to the public on the website cited above.

[1] New measure introduced in September 2005. Not used in this study.

Charge data by admission is publicly available from two data sources – Medpar (Medicare Provider Analysis and Review) and various state agencies that collect inpatient claims data from hospitals. Both sources have limitations. Medpar data contains primarily Medicare fee for service admissions, whereas the state databases include all payers, but are limited by the number of states releasing the data and only contain billed, but not allowed (discounted), charges. Medicare data includes both billed and Medicare allowed charges.

Data

Data from the Health Quality Initiative for the first half of 2004 by hospital was made available from the Hospital Compare web site. Medpar data was obtained for fiscal year 2004 from CMS. Cost/charge ratios and geographic adjustment factors for each hospital are published annually by CMS in the Federal Register. All charges in this study were case-mix, severity and geographically adjusted. Therefore, the charges are weighted using the hospital's own mix of services, so that a hospital that does more difficult cases has its charge measured against higher charging, more complicated cases. State data was obtained from various state agencies for 17 states that make their data public at the admission level for calendar year 2003. (See Appendix 1 for a listing of participating states.) All non-acute care hospitals were excluded from the study since the quality indicators are based on high frequency acute care cases. Only medical/surgical cases were compared. All psychological/substance abuse and rehabilitation cases were excluded. Critical Access hospitals (per Medicare definitions) were included in this analysis.

CMS' provider ID was used to link the quality performance measures to the charge data. For Medpar, 4,105 hospitals were successfully linked. For the state databases, 1,919 hospitals were mapped. The DHHS/HQA web site does not attribute credibility to any hospital that has less than 25 cases eligible to be measured for any indicator. Therefore, all hospitals with less than 25 cases for any indicator were excluded from the correlation analysis. Many hospitals submitted data for only one or a few of the indicators. Table 1 shows the percentage of hospitals excluded by either not supplying any data or having less than 25 cases:

Table 1

Medicare
Percentage of Matched Hospitals Excluded

Condition	Quality Indicator	No Data	<25 Cases	Total
Heart Attack (AMI) Care[2]	ACE Inhibitor for LVSD	30.5%	52.6%	83.1%
Heart Attack (AMI) Care	Adult Smoking Cessation Advice/Counseling	53.9%	35.2%	89.1%
Heart Attack (AMI) Care	Aspirin at Arrival	12.7%	35.9%	48.6%
Heart Attack (AMI) Care	Aspirin at Discharge	15.5%	46.4%	61.9%
Heart Attack (AMI) Care	Beta Blocker at Arrival	12.9%	38.2%	51.1%
Heart Attack (AMI) Care	Beta Blocker at Discharge	15.2%	45.5%	60.7%
Heart Attack (AMI) Care	PTCA Received Within 90 Minutes of Arrival	91.3%	8.2%	98.5%
Heart Attack (AMI) Care	Thrombolytic Agent Received Within 30 Minutes of Arrival[3]	90.1%	9.9%	100.0%
Heart Failure Care	ACE Inhibitor for LVSD	11.6%	42.2%	53.8%
Heart Failure Care	Adult Smoking Cessation Advice/Counseling	33.9%	58.9%	92.8%
Heart Failure Care	Assessment of Left Ventricular Function	6.6%	18.3%	24.9%
Heart Failure Care	Discharge Instructions	27.7%	29.3%	57.0%
Pneumonia Care	Adult Smoking Cessation Advice/Counseling	30.5%	61.9%	92.4%
Pneumonia Care	Blood Cultures Performed Before First Antibiotic Received	27.8%	24.7%	52.5%
Pneumonia Care	Initial Antibiotic Timing	5.7%	11.7%	17.4%
Pneumonia Care	Oxygenation Assessment	5.6%	11.2%	16.8%
Pneumonia Care	Pneumococcal Vaccination	6.3%	19.7%	26.0%

For many of these indicators, the number of hospitals that could be used in this analysis is not very high. Conclusions that can be drawn from such indicators are limited.

[2] Acute Myocardial Infarction

[3] Measure deleted in further tables. No hospitals met the minimum threshold level of 25 cases.

Data Analysis

For the acute care and critical access hospitals that matched in both the Quality database and the Medpar database with sufficient volume (>25 cases), a Pearson[4] correlation coefficient was calculated between a hospital's performance rate (the proportion of cases where a hospital provided the recommended process of care) and Medicare billed, allowed and cost data. Correlation measures the strength of the mathematical relationship between the two values being compared.[5]

Table 2 summarizes the correlation of the quality to measures of a hospital's overall billed charge, allowed charge and cost on a per day and per admission basis for all medical/surgical admissions in a facility. An asterisk indicates that the mathematical relationship between the quality indicator and charge or cost is statistically significant at the P< .05 level, the standard level used to indicate statistical significance. Two asterisks indicate a highly significant result, P< .0001. All charges and costs have been case-mix, severity and geographically adjusted to make an apple to apples comparison.

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[4] Pearson Correlation Coefficient =

$$r = \frac{\sum w_i (x_i - \bar{x}_w)(y_i - \bar{y}_w)}{\sqrt{\sum w_i (x_i - \bar{x}_w)^2 \sum w_i (y_i - \bar{y}_w)^2}}$$

where

$$\bar{x}_w = \sum w_i x_i \Big/ \sum w_i$$

$$\bar{y}_w = \sum w_i x_i \Big/ \sum w_i$$

w_i = *number of cases in hospital i in Health Quality Initiative*

x_i = *performance rate for hospital i*

y_i = *hospital average billed charge, allowed charge or cost*

[5] The correlation coefficient ranges from -1 to +1. A correlation of +1 implies that as one measure increases, the other measure increases with certainty (you can exactly predict its value). Likewise, a coefficient of -1 implies that as one measure increases, the other measure decreases with certainty. A coefficient of 0 implies no mathematical relationship between the two measures.

Table 2
Correlation Comparison of Quality Indicators to Medicare Charge and Cost Data
Medical/Surgical Hospital Category

Quality Indicator (Condition)	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD (AMI)	.021	-.007	.186**	.104*	.086*	.018
Aspirin at Arrival (AMI)	.032	-.010	.156**	.043*	.011	.007
Aspirin at Discharge (AMI)	-.028	-.079*	.208**	.082*	-.026	-.031
Beta Blocker at Arrival (AMI)	.006	-.023	.147**	.055*	.013	.010
Beta Blocker at Discharge (AMI)	-.035	-.079*	.211**	.088*	-.034	-.038
PTCA Received Within 90 Minutes of Arrival (AMI)	-.452*	-.483*	.186	.048	.248	.244
Adult Smoking Cessation Advice/Counseling (AMI)	-.011	-.083	-.016	-.182*	.022	-.106*
ACE Inhibitor for LVSD (HF)	-.016	-.022	.209**	.202**	-.004	-.005
Assessment of Left Ventricular Function (HF)	.029	.033	.083**	.126**	.020*	.022*
Discharge Instructions (HF)	-.094**	-.123**	-.022	-.126**	-.051*	-.053*
Adult Smoking Cessation Advice/Counseling (HF)	.019	-.056	-.050	-.223**	-.101	-.104
Blood Cultures Performed Before First Antibiotic Received (Pneu)	-.015	-.024	-.103**	-.170**	.029	.027
Initial Antibiotic Timing (Pneu)	-.059*	-.143**	-.024	-.354**	.018	.005
Oxygenation Assessment (Pneu)	.037*	-.001	.064*	-.038**	.008	.005
Pneumococcal Vaccination (Pneu)	-.104**	-.121**	-.034	-.159**	-.019	-.024
Adult Smoking Cessation Advice/Counseling (Pneu)	.035	.011	-.094	-.189**	-.127*	-.206*

For almost every indicator, the relationship between the allowed charge per case and the quality indicator was statistically significant. For the AMI indicators, the higher the performance measure, the higher the average allowed charge. For the pneumonia indicators the higher the performance measure, the lower the average allowed charge. The heart failure indicators produced mixed results. However, for the AMI indicators, the allowed charge per day was often highly significant. The other indicators are significantly correlated only sporadically. While some of these indicators are statistically significant, their correlations are not high enough that any regression models based on these correlations would produce usable predictions of costs or charges. On the other hand, it can be concluded that the quality initiative does have some relationship on allowed charges on a limited

basis. The results might be different if an overall quality indicator existed. The individual performance indicators are generally related to only a small portion of total hospital admissions, however, the aggregation of all indicators applies to a greater proportion of admissions. Unfortunately, the spotty reporting and low volume of quality data across hospitals at this time, precludes development of an overall measure.

Several specific APR-DRGs[6] (All Patient Refined Diagnostic Related Groups) relate closely to the quality indicators. For AMI, the charge data for two APR-DRGs were correlated with the performance measures – APR-DRG 174 (Percutaneous Cardiovascular Procedures w/AMI) and APR-DRG 190 (Acute Myocardial Infarction). For the Heart Failure indicators APR-DRG 194 (Heart Failure) was used and for the Pneumonia quality indicator APR-DRG 139 (Pneumonia) was used. The results are summarized in Table 3.

Table 3
Correlation Comparison of Quality Indicators to Medicare Charge and Cost Data
Charges by APR-DRG

APR-DRG 174

Quality Indicator (Condition)	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD (AMI)	.035	-.112	.195**	.122*	.100*	.013
Aspirin at Arrival (AMI)	.019	-.006	.081*	.034	.010	.006
Aspirin at Discharge (AMI)	-.068*	-.125**	.186**	.078*	-.042	-.050
Beta Blocker at Arrival (AMI)	.004	-.023	.141**	.096*	.017	.013
Beta Blocker at Discharge (AMI)	-.051	-.027*	.164**	.099*	-.042	-.048
PTCA Received Within 90 Minutes of Arrival (AMI)	-.071	-.337*	.473	.045	.537*	.482*
Adult Smoking Cessation Advice/Counseling (AMI)	-.008	-.055	-.002	-.164*	.027	-.065*

APR-DRG 190

Quality Indicator (Condition)	Billed Charge/	Billed Charge/	Allowed Charge/	Allowed Charge/	Cost/ Day	Cost/ Case

[6] All copyrights in and to APR-DRGs are owned by 3M. All rights reserved.

	Day	Case	Day	Case		
ACE Inhibitor for LVSD (AMI)	.046	.022	.185**	.113*	.125*	.054
Aspirin at Arrival (AMI)	.040	.012	.147**	.086**	.011	.009
Aspirin at Discharge (AMI)	-.020	-.046	.189**	.125**	-.027	-.030
Beta Blocker at Arrival (AMI)	.005	-.014	.119**	.060*	.013	.011
Beta Blocker at Discharge (AMI)	-.034	-.054*	.172**	.106**	-.035	-.038
PTCA Received Within 90 Minutes of Arrival (AMI)	-.503*	-.519*	.259	.084	.129	.018
Adult Smoking Cessation Advice/Counseling (AMI)	-.030	-.059	-.007	-.095*	.007	-.056

Heart Failure

Quality Indicator (Condition)	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD (HF)	.005	-.031	.251**	.194**	-.004	-.006
Assessment of Left Ventricular Function (HF)	.041	.042*	.091**	.139**	.021	.023
Discharge Instructions (HF)	-.092*	-.089*	-.062*	-.110**	-.051*	-.052*
Adult Smoking Cessation Advice/Counseling (HF)	-.001	-.013	-.103	-.159*	-.101	-.102

Pneumonia

Quality Indicator (Condition)	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
Blood Cultures Performed Before First Antibiotic Received (Pneu)	-.028.	-.025	-.129**	-.188**	.027	.026
Initial Antibiotic Timing (Pneu)	-.077**	-.122**	-.121**	-.346**	.015	.005
Oxygenation Assessment (Pneu)	.028	-.025	.076**	-..051*	.006	.000
Pneumococcal Vaccination (Pneu)	-.116**	-.106**	-.083**	-.153**	-.021	-.024
Adult Smoking Cessation Advice/Counseling (Pneu)	.053	.049	-.108	-.189*	-.090	-.103

The correlations using charges by specific APR-DRG in most cases are slightly higher than the total charges, but the significance and interpretation of the results are similar.

There are reasons why the correlations in Tables 2 and 3 are not higher. In the future, changes that may occur in the health care system may drive up (or down) the correlations for some of the indicators. Some of these are discussed in the Conclusions section of this report. However, in this analysis there is considerable statistical noise in the range of the allowed charges due to other factors. Even after adjusting the charges for case-mix, severity and geographic differences, charges between hospitals, based on 2004 Medpar data and using only facilities with over 1,000 admissions allowed charges, varied from a low of 0.48 times the average charge to a high of 2.00 times the average allowed charge/day. This represents a ratio of 4 to 1. Medicare allowed charges should be more stable than billed charges because they are based on the Medicare fixed pricing algorithm for each DRG with some add-ons for outliers, disproportionate share (DS) and indirect medical education (IME) allowances. They do have some geographic differences for wages included, however. Even removing the three allowed charge add-ons (outliers, DS and IME), the charges/day range from .76 to 1.94 of the average allowed charge. The fluctuation in charges alone can account for some of the reason why the correlation between the performance measures and charges is not higher. By removing the outliers, DS and IME allowances from the correlation analysis, the results are not materially changed. Other factors that can influence the correlation are readmission rates that CMS does not routinely release to the public and mortality immediately following a patient's release from the hospital, which is also not available in the database used in this analysis.

Because the charge correlations are not high, additional factors affecting hospital charges, which may be obscuring the results, were examined. One of these factors is a hospital's efficiency on managing length of stay. Milliman has developed the LOS Efficiency Index™, a tool that identifies efficient facilities by deriving benchmark length of stay for facilities based on their own mix of services using statistical models which reflect clinical input. The LOS Efficiency Index quantifies potentially avoidable days at the facility level. This is derived by defining a benchmark length of stay from actual performance of all facilities for the same type of cases for each APR-DRG and severity (with sufficient volume) and rolling up the days in excess of the benchmark based on the hospital's own

mix of services. The correlation between the Medical/Surgical Efficiency Index percentage of days avoidable and the Performance Measures is shown in Table 4.

Table 4
Correlation of Quality Indicators to the LOS Efficiency Index™ Avoidable Days

Quality Indicator	Correlation Coefficient
ACE Inhibitor for LVSD (AMI)	-.127**
Aspirin at Arrival (AMI)	-.148**
Aspirin at Discharge (AMI)	-.164**
Beta Blocker at Arrival (AMI)	-.096**
Beta Blocker at Discharge (AMI)	-.167**
PTCA Received Within 90 Minutes of Arrival (AMI)	-.096**
Adult Smoking Cessation Advice/Counseling (AMI)	-.188**
ACE Inhibitor for LVSD (HF)	-.009
Assessment of Left Ventricular Function (HF)	-.102**
Discharge Instructions (HF)	-.136**
Adult Smoking Cessation Advice/Counseling (HF)	-.210*
Blood Cultures Performed Before First Antibiotic Received (Pneu)	-.036
Initial Antibiotic Timing (Pneu)	-.187**
Oxygenation Assessment (Pneu)	-.147**
Pneumococcal Vaccination (Pneu)	-.071**
Adult Smoking Cessation Advice/Counseling (Pneu)	-.112*

The table illustrates that hospitals with fewer potentially avoidable days are more strongly correlated to higher performance measures in the DHHS/HQA database.

It would be expected that more efficient hospitals would have a shorter length of stay, excluding other factors, and a higher charge/cost per day because the first few days of an admission have a higher charge/day. In order to test additional relationships to the Health Quality Initiative performance measures, allowed charges were adjusted for LOS Efficiency Index % avoidable days.

We efficiency adjusted the allowed charges per day so that an inefficient facility would have a higher charge per day than an efficient facility if they were at the same original charge level. The efficiency adjustment to the charges is shown below[7]. The charges were adjusted for efficiency at each APR-DRG that is most closely associated with the quality indicator. The efficiency Adjusted charges were correlated to the performance measures and these results are summarized in Table 5.

Table 5
Correlation Comparison of Quality Indicators to Efficiency Adjusted Allowed Charge per Day

APR-DRG 190

Quality Indicator (Condition)	Correlation Coefficient
ACE Inhibitor for LVSD (AMI)	.100*
Aspirin at Arrival (AMI)	.044*
Aspirin at Discharge (AMI)	.096*
Beta Blocker at Arrival (AMI)	.047*
Beta Blocker at Discharge (AMI)	.080*
PTCA Received Within 90 Minutes of Arrival (AMI)	.126
Adult Smoking Cessation Advice/Counseling (AMI)	-.092

APR-DRG 174

Quality Indicator (Condition)	Correlation Coefficient
ACE Inhibitor for LVSD (AMI)	.124*
Aspirin at Arrival (AMI)	.024*
Aspirin at Discharge (AMI)	.100*
Beta Blocker at Arrival (AMI)	.098*
Beta Blocker at Discharge (AMI)	.113**
PTCA Received Within 90 Minutes of Arrival (AMI)	.214
Adult Smoking Cessation Advice/Counseling (AMI)	-.101

[7] Adjusted Allowed Charge/Day = Allowed Charge/Day x (1-LOS % Days Avoidable $_{U.S.}$/1-LOS % Days Avoidable $_{Hospital}$).

APR-DRG 194

Quality Indicator (Condition)	Correlation Coefficient
ACE Inhibitor for LVSD (HF)	.217**
Assessment of Left Ventricular Function (HF)	.049*
Discharge Instructions (HF)	-.124**
Adult Smoking Cessation Advice/Counseling (HF)	-.186*

APR-DRG 139

Quality Indicator (Condition)	Correlation Coefficient
Blood Cultures Performed Before First Antibiotic Received (Pneu)	-.166
Initial Antibiotic Timing (Pneu)	-.301**
Oxygenation Assessment (Pneu)	-.054*
Pneumococcal Vaccination (Pneu)	-.135**
Adult Smoking Cessation Advice/Counseling (Pneu)	-.190*

Efficiency adjusting the charges does not, in general, change the pattern of the results shown in Tables 2 & 3.

Several additional correlation analyses were run on different cuts of the data. For example, one was based on the size of the hospitals – small, medium and large. A hospital was designated as small if it had fewer than 1,000 Medicare admissions. A medium sized hospital had 1,000-5,000 Medicare admissions. A large hospital had more than 5,000 Medicare admissions. The results are summarized in Appendix 2 correlating charges billed, allowed and cost broken out by the APR-DRG that most closely relates to the quality indicator. Categorizing the hospitals by size generally produces higher correlations, particularly between the performance measure and allowed charges/case or day. However, because the number of hospitals in each category is sometimes small, the correlation within those categories must be higher to produce a statistically significant result. While these correlations are higher than the results shown in Tables 2 and 3, the correlations are still not sufficiently high to use to build reasonably high predictive models ($R^2 > 0.5$). The general patterns of the correlations in the medium and large hospitals are very similar to the results shown in Tables 2 and 3. Similar results were achieved in other more detailed analyses.

Commercial vs. Medicare Charges

The presented results are based on comparing Medicare billed and allowed charges and the performance indicators. It is difficult to extend these results to the Commercial insured market because the only charge data available is based on billed charges and it is Commercial allowed charges that would be of most interest to study. For the 17 states where timely data is provided to corporate for-profit users, the billed charges/case show a correlation between Medicare and Commercial of .957; and on a billed charge/day basis a correlation of .947. The correlations are based on only medical and surgical admissions excluding psychiatric, substance abuse, rehab and maternity admissions because the quality performance measures are not based on these types of admissions and are done by comparing hospital charges. Because the relationship between Medicare and Commercial billed charges is so high and because Commercial discounts tend to move in the same general direction as Medicare discounts (areas with high Medicare discounts tend to have high Commercial discounts, although they are usually at different levels), the Commercial allowed charges should be expected to produce similar correlations to those produced by the Medicare allowed charges. For Commercial billed charges in the 17 states, an analysis of the correlations to the performance measures is quite similar to the results obtained using all Medicare data. The results are summarized in Table 6.

Table 6
Correlation Comparison of Quality Indicators to Medicare and Commercial Billed Charges

Quality Indicator	Commercial		Medicare	
	Billed Charge/ Day	Billed Charge/ Case	Billed Charge/ Day	Billed Charge/ Case
ACE Inhibitor for LVSD (AMI)	.054	.050	.021	-.007
Aspirin at Arrival (AMI)	.024	.005	.032	-.010
Aspirin at Discharge (AMI)	-.029	-.046	-.028	-.079
Beta Blocker at Arrival (AMI)	-.054	-.050	.006	-.023
Beta Blocker at Discharge (AMI)	-.070	-.071	-.035	-.079
PTCA Received Within 90 Minutes of Arrival (AMI)	-.370	-.471	-.452	-.483

Quality Indicator	Commercial		Medicare	
	Billed Charge/ Day	Billed Charge/ Case	Billed Charge/ Day	Billed Charge/ Case
ACE Inhibitor for LVSD (AMI)	.054	.050	.021	-.007
Adult Smoking Cessation Advice/Counseling (AMI)	-.015	-.039	-.011	-.083
ACE Inhibitor for LVSD (HF)	-.017	-.001	-.016	-.022
Assessment of Left Ventricular Function (HF)	.007	.014	.029	.033
Discharge Instructions (HF)	-.043	-.059	-.094	-.123
Adult Smoking Cessation Advice/Counseling (HF)	.003	-.068	.019	-.056
Blood Cultures Performed Before First Antibiotic Received (Pneu)	-.035	-.037	-.015	-.024
Initial Antibiotic Timing (Pneu)	-.023	-.070	-.059	-.143
Oxygenation Assessment (Pneu)	.050	-.003	.037	-.001
Pneumococcal Vaccination (Pneu)	-.103	-.096	-.104	-.121
Adult Smoking Cessation Advice/Counseling (Pneu)	.013	.023	.035	.011

Because of the similarity in the results between Medicare and Commercial data where it is available, it would be expected the conclusions drawn in this study based on Medicare data only would be similar if based on Commercial data or a combination of Medicare and Commercial data.

Health Quality Initiative and Other Hospital Quality Indicators

Several other organizations have set up their own hospital quality measures. The three other prominent initiatives include the Agency for Healthcare Research and Quality (AHRQ), the Leapfrog Group and HealthGrades. All of these initiatives have been in existence longer than the DHHS/HQA Health Quality Initiative and each has a different approach to measuring hospital quality.

In the 1990s, the AHRQ, a division of the Department of Health and Human Services, responded to requests from state data organizations and hospital associations and developed a set of quality measures. These measures used the type of information routinely collected by hospitals on an admission-by-admission basis on UB 92 forms – diagnoses, procedures, patient age, patient gender,

source of admission and discharge status. The research for determining the indicators to include was conducted by UCSF (University of California San Francisco) -Stanford University EPC (Evidence Based Practice Center).

The major constraint placed on the researchers was that the measures could only be based on data common to most of the hospital discharge files compiled by the states. This resulted in the development of three AHRQ Quality Indicator Modules:

- Prevention Quality Indicators (16 indicators)
- Inpatient Quality Indicators (30 indicators)
- Patient Safety Indicators (20 indicators)

A detailed listing of the indicators is contained in Appendix 3.[8]

In analyzing hospital quality and efficiency, the Patient Safety Indicators seem most appropriate to use to compare to the DHHS/HQA performance measures. The AHRQ Inpatient Quality Indicators are largely based on mortality indicators which are very low in frequency and highly volatile and were excluded from this analysis. The AHRQ Prevention Quality Indicators are collected at a higher geographic level than facility and since the purpose of this analysis was to compare facility data, they were excluded from the analysis. To limit the size of the comparative analysis, the Patient Safety Indicators have been summarized into four major categories:

Category Groupings	AHRQ Categories
Post-Operative Complications	Hip Fracture
	Hemorrhage or Hematoma
	Physiological Metabolic Derangement
	Respiratory Failure
	Pulmonary Embolism or Deep Vein Thrombosis
	Sepsis
	Wound Dehiscence

[8] For more detailed information on these indicators see www.qualityindicators.ahrq.gov.

Category Groupings	AHRQ Categories
Medical Accidents	Foreign Body Left in During Procedure
	Accidental Puncture or Laceration
Acquired Conditions	Decubitus Ulcer
	Iatrogenic Pneumothorax
	Infection Due to Medical Care
Mortality and Other	Complications of Anesthesia
	Death in Low Mortality DRGs
	Transfusion Reaction

The category groupings were combined by summing the outcomes for each indicator in the numerator and the populations at risk for each indicator in the denominator. In some category groupings the population at risk may be included in multiple indicators. In effect, this summation gives a higher weight to a QI category with a larger population at risk. The populations at risk for Medical Accidents and some of the Mortality and Other categories are very large while the populations at risk for the Post-Operative Complications and Acquired Conditions are relatively small by comparison.

The AHRQ measures are quite different from those measured by the Health Quality Initiative. The performance measures in the Health Quality Initiative are striving toward a hospital having 100% compliance with the defined performance measures. The Patient Safety Indicators ideally would have no occurrences of defined negative outcomes at a facility. A correlation analysis of the AHRQ measures and the Health Quality Initiative should produce negatively correlated results. They are summarized in Table 7:

Table 7
Correlation Comparison of Health Quality Initiative to AHRQ Patient Safety Indicators

Quality Indicator	Mortality	Acquired Conditions	Medical Accidents	Post Operative Complications
ACE Inhibitor for LVSD (AMI)	-.025	-.001	.156**	.063
Aspirin at Arrival (AMI)	-.042	-.066*	.205**	-.056*
Aspirin at Discharge (AMI)	-.156**	-.124**	.266**	-.098**
Beta Blocker at Arrival (AMI)	-.063*	.006	.137**	.024
Beta Blocker at Discharge (AMI)	-.151**	-.073*	.207**	-.030
PTCA Received Within 90 Minutes of Arrival (AMI)	-.097	-.383	.203	-.085
Adult Smoking Cessation Advice/Counseling (AMI)	-.180*	-.149*	.007	-.129*
ACE Inhibitor for LVSD (HF)	.095**	.023	.065*	.061*
Assessment of Left Ventricular Function (HF)	.008	.062*	.230**	.147**
Discharge Instructions (HF)	-.124**	-.146**	.024	-.080**
Adult Smoking Cessation Advice/Counseling (HF)	-.203*	-.106	.052	-.111
Blood Cultures Performed Before First Antibiotic Received (Pneu)	-.167**	-.134**	.009	-.087**
Initial Antibiotic Timing (Pneu)	-.316**	-.260**	-.107**	-.175**
Oxygenation Assessment (Pneu)	-.040*	-.024**	.127**	-.021
Pneumococcal Vaccination (Pneu)	-.099**	-.142**	-.029	-.111**
Adult Smoking Cessation Advice/Counseling (Pneu)	-.126*	-.164*	-.070	-.082

With the exception of Medical Accidents, the anticipated result was achieved. Health Quality Initiative Indicators with high performance levels correlate significantly to AHRQ Quality Indicators with low negative quality outcomes. Although counterintuitive, Medical Accidents are inversely related to Post Operative Complications and Acquired Conditions in the AHRQ data. However, the Medical Accident results are consistent with prior analyses. Many of the quality indicators in Table 7 are statistically significant correlated and negatively correlated, implying that high performance levels in the DHHS/HQA quality indicators are highly related to AHRQ measures with low levels of Post Operative Complications and Acquired Conditions. This implies that while the AHRQ Patient

Safety Indicators and the Health Quality Initiative approach measuring quality differently, the two methods enhance each other in measuring a facility's overall quality.

The Leapfrog Group[9] was founded in 1999 by the Business Round Table and is a voluntary program designed to encourage employers to make "leaps" in patient safety and reward hospitals that implement significant safety improvements. Their initial efforts focused on three measures:

- Computer order entry of prescription drugs by physicians (CPOE)
- Evidence based hospital referral, i.e. sending patients to hospitals who perform the highest volume of particularly complex procedures.
- ICU staffing with physicians who have credentials in critical care medicine.

In April 2004, Leapfrog endorsed the National Quality Forum's 27 Safe Practices and from this has developed a Leapfrog Safe Practices score. Facility's participation in Leapfrog is completely voluntary and highly regional. As of October 2005, 952 hospitals were participating in the program.

HealthGrades[10] provides limited data to consumers and focuses more on marketing its products to hospital executives and insurers. Their measures are based on a compilation of three years of Medpar data for non-OB cases and state data in 18 states for OB cases and are split into three categories – mortality, complications after a procedure and OB/women's health.

Hospitals are rated as a) one-star (poor) – in the lower 15%, b) three-star (as expected) – in the middle 70% or c) five-star (best) – in the upper 15%. According to HealthGrades, their rankings are based on risk adjusted logistic actual to expected regression models developed for each measure.

There are drawbacks in using both Leapfrog and HealthGrades data. Leapfrog results are voluntarily contributed and limited in scope and to regions that the data covers. Also, for two of the three original Leapfrog measures (CPOE and ICU staffing), the hospital has to be contacted directly to obtain the information. Even though HealthGrades uses three years of data for each facility, its measures rely heavily on mortality results. As with the AHRQ Inpatient Quality Indicators,

[9] For detailed information see www.leapfroggroup.org.

[10] For detailed information see www.healthgrades.com.

mortality is usually a low frequency and a highly volatile indicator. For example, if one death is expected in a facility and two actually occurred, the facility's mortality rate would be twice the expected mortality rate.

The difference between the AHRQ and HealthGrades quality measures and the Health Quality Initiative performance measures is that the AHRQ and HealthGrades measure specific outcomes at a facility whereas the Health Quality Initiative measures whether or not a specific protocol occurred. The Hospital Quality Initiative's level of compliance to the performance measure should bring about favorable outcomes, but outcomes are not measured explicitly.

Conclusions

In many instances, the case-mix, severity, geographically adjusted allowed charges per day and per case are statistically significantly correlated with the performance indicators, but produce low correlation values in the range of -0.2 to 0.2. For the pneumonia indicators, lower allowed charging hospitals tended to have higher quality. The opposite result occurred for the AMI indicators. High charging hospitals were more highly correlated to high quality hospitals. Heart Failure indicators were a mixture of both. Going forward, after these initiatives are fully implemented and the fixed start-up expenses absorbed, the quality initiatives should produce a lower case-mix and severity of services which, at a fixed price schedule, should produce lower lengths of stay and lower charges. At that point, some of these correlation results may change. However, no firm conclusions as the extent of any change, if any, can be drawn at this time. Comparing the Efficiency Index to the quality indicators shows that more efficient hospitals tended to have higher quality.

Pay for performance (P4P) is one of the objectives that health care executives from all sectors -- hospitals, insurers, large employers and government health agencies would like to see adopted and is in the forefront of consideration for potential change in reimbursement strategies. P4P rewards providers who provide quality care in a cost effective manner. A recent survey by Thomson Medstat revealed that 85% of respondents to their survey of health care executives believe that P4P

is or could be valuable to their organization.[11] In order to compensate providers based on pre-defined levels of quality, a relationship between quality and reimbursement should be able to be established. The results of this paper suggest that at present this relationship does not exist between the measures in the Health Quality Initiative and actual reimbursement.

Several forces in the health insurance industry that could make the correlations higher or lower in the future include:

- **Increasing the number of facilities reimbursed on a pay for performance basis**. This is currently being done at a limited number of facilities. Insurers are considering expanding this method of reimbursement. Usually one of the performance measures, on which the reimbursement is based, is quality. Therefore, it seems reasonable to assume that if quality determines part of a facility's reimbursement, the correlation between reimbursement and quality should increase.

- **Supplying report cards to consumers**. Many insurers feel that if consumers have easily available charge and quality information, consumers can make informed decisions about where to get care. Information that is readily available right now is based on a limited number of procedures and conditions. Most consumers are not even aware that these indicators exist. To date, no one has published quality and charges together.

- **Resistance to sharing of quality information to the public**. Many physicians/facilities are reluctant to share quality information with the public, especially if they may look bad. Pressure from insurers, employers and the public could ease some of this resistance.[12]

- **Increasing computer technology at facilities.** Most studies show that electronic medical records decrease the number of medical errors in a facility. While the initial cost of

[11] Pay-for-Performance Concept Gaining Traction in Healthcare, Survey Finds, Managed Care Weekly Digest, May 24, 2006.

[12] Specialty Hospitals, Price Competition and the Medical Arms Race, PricewaterhouseCoopers, January 10, 2006.

converting to an electronic process may be high, the savings from reduced errors and consequently length of stay and cost per admission may be significant.

Other factors that may influence why the quality indicators and charge correlations are not higher include:

- **Labor shortages at many facilities.** Recent studies suggest that increasing nursing staffing may bring about improvements in patient safety and quality. However, the increase in labor costs could drive up the amount charged for a stay, but fewer adverse outcomes could reduce the length of stay. One recent study suggests that not even increasing the number of nurses, but increasing the registered nurse/licensed practical nurse ratio could reduce adverse outcomes by almost 60,000 and reduce hospital days by over 1.5 million with no added cost. Avoided deaths would be reduced by almost 5,000.[13]

- **Specialty Hospitals.** Specialty hospitals, particularly for cardiac care, have been opened in a number of areas. Many times these facilities are physician owned. Concern has been expressed by the AHA and CMS that physicians steer their patients to the specialty hospitals where the physicians control the charges and are charging at higher levels than other facilities for the same services. Several studies are pending on this issue.[14]

The Quality Indicators are limited in scope. At this point, they only represent quality for four conditions and only three of those conditions were used in this study due to data issues – AMI, Heart Failure and Pneumonia. The correlations may improve when DHHS/HQA measures the quality of more conditions, but the correlations will probably never be strong enough that you can predict a hospital's quality by knowing its reimbursement and vice versa because of the forces mentioned above. But, it can be concluded that the introduction of the quality initiatives does have some impact on hospital reimbursement -- in some cases positive and in some cases negative.

[13] Nurse Staffing in Hospitals: Is There a Business Case for Quality, Health Tracking, January/February 2006.

[14] Do Hospitals Promote Price Competition, Center for Studying Health System Change, Issue Brief No. 103, January 2006.

Although the number of facilities participating in the Initiative is high (4,105), the number of hospitals that actually supplied complete data for this analysis is low. In some cases, only one performance measure was submitted from a hospital. (see Table 1 for the percentage of hospitals contributing no data by performance measure). We did see some evidence of bias in which facilities submitted data. Generally, larger facilities are participating. Facilities in the Mountain and West North Central region are underrepresented. Facilities in these regions tend to be smaller than average. Smaller than average hospitals tend to have slightly lower correlation, so adding these facilities to the data in the future could reduce the correlations shown. DHHS/HQA intends to update the data on their web site quarterly. Their most recent update was in March, 2006. Many facilities have signed up to participate in this initiative and the number of hospitals who submit their data is likely to grow rapidly. This analysis should be more valuable as the data increases and the participation rates in all of the indicators increase.

This study indicates that quality measures focused on a small subset of hospital admissions cannot be used to predict much about overall facility costs. In the future, it may be more appropriate to measure the specific performance measures against specific services being affected by them. However, the impact on catastrophic claims and fluctuations due to a relatively small number of admissions in some facilities may prevent any emergence of a strong mathematical relationship because these conditions tend to skew correlation. It may be necessary to initiate longitudinal studies of these smaller sets of admissions to gain a better perspective on the impact of the performance measures on the costs. It may be possible that charge differences could be occurring at a more specific level of detail than at the facility level. Physician or revenue code level detail may provide more meaningful correlations, but on a more detailed level than attempted in this analysis. Poor discharge planning, which can add several days and subsequent additional cost onto an admission, could also mask some of the correlation that could be present when looking at more specific data.

For the reasons cited above, hospital reimbursements and the quality measures in the Hospital Quality Initiative are not very highly correlated. Some further analysis needs to be done on a more complete set of data from the Health Quality Initiative before final conclusions on this relationship can be determined. Because of increased efforts in the health care industry to adopt P4P programs, it is essential to understand this relationship and the relationship of other quality measures to

hospital reimbursement in order to make informed decisions on how to structure a reimbursement scheme.

Additional References

1. Klein, S. Quality Matters: Performance Matters, *The Commonwealth Fund*, December 2005 Volume 14.
2. Sommers, J.P. PhD. Estimates of Health Care Expenditures for the 10 Largest States, 2003, *Medical Expenditure Panel Survey*, Statistical Brief #106, December 2005.
3. 2005 Annual Report Health Care Quality Improvement and Efficiency, *The Commonwealth Fund*, December 2005.
4. Cookson, J.P. Health Care Variability, *The Actuary*, Volume 2, Issue 1, February/March 2005.
5. Rattray, M.C. M.D., Andrianos, J. M.B.A., Stam, D. T. B.A., Quality Implications of Efficiency-Based Clinician Profiling, 2004, http://www.regence.com/research/docs/qualityImplicationsEfficiencyBasedClinicianProfiling.pdf.
6. Rattray, M.C. M.D., Andrianos, J. M.B.A., Stam, D.T. B.A., Revisiting Implications of Efficiency-Based Clinician Profiling, 2005, http://www.regence.com/research/docs/qualityImplications EfficiencyBasedClinicianProfiling.pdf.
7. Pay for Performance: Rewarding Improvements in the Quality of Health Care, *Issue Brief, American Academy of Actuaries*, October 2005

Appendix 1

State Databases Used in This Report

Arizona

California

Florida

Iowa

Maine

Maryland

Massachusetts

Nevada

New Jersey

New York

Pennsylvania

Texas

Utah

Vermont

Virginia

Washington

Wisconsin

Appendix 2

Correlation Comparison by Size of Hospital

Small Hospital – APR-DRG 174 (No Data)

Small Hospital – APR-DRG 190

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	-.001	-.186	-.076	-.219	-.127	-.264
Aspirin at Arrival	.466	.667	-.119	.057	.263	.567
Aspirin at Discharge	-.096	-.271	.323	-.115	-.124	-.324
Beta Blocker at Arrival	.351	.577	-.260	.604	.101	.481

Small Hospital – Heart Failure

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	.108	.161	.389	.706	.543	.587
Assessment of Left Ventricular Function	.183	.187	.106	.225	.212	.269
Discharge Instructions	-.644	-.641	-.035	-.189	-.333	-.363

Small Hospital – Pneumonia

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
Blood Cultures Performed Before First Antibiotic Received	-.210	-.016	-.086	-.040	-.102	-.004
Initial Antibiotic Timing	-.167	-.189	-.072	-.206	-.065	-.142
Oxygenation Assessment	.096	.042	.105	.011	.089	.013
Pneumococcal Vaccination	-.135	-.177	.084	-.003	.030	-.053

Medium Hospital – APR-DRG 174

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	-.017	.003	.208	.226	.029	.054
Aspirin at Arrival	.006	.018	.036	.072	.011	.010
Aspirin at Discharge	-.046	-.072	.077	.026	-.078	-.081
Beta Blocker at Arrival	.004	-.003	.094	.080	.024	.022
Beta Blocker at Discharge	-.015	-.009	.057	.066	-.074	-.075
Adult Smoking Cessation Advice/Counseling	-.179	-.251	-.069	-.277	.020	-.039

Medium Hospital – APR-DRG 190

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	.027	.061	.255	.275	.085	.128
Aspirin at Arrival	.035	.011	.147	.109	.014	.013
Aspirin at Discharge	.008	-.040	.154	.066	-.039	-.041
Beta Blocker at Arrival	-.037	-.041	.067	.050	.017	.017
Beta Blocker at Discharge	-.042	-.054	.088	.043	-.055	-.056
Adult Smoking Cessation Advice/Counseling	-.287	-.222	-.037	-.095	-.020	.046

Medium Hospital – Heart Failure

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	-.060	-.081	.254	.225	-.009	-.011
Assessment of Left Ventricular Function	.029	.026	.085	.115	.035	.036
Discharge Instructions	-.059	-.043	-.073	-.111	-.070	-.070
Adult Smoking Cessation Advice/Counseling	.061	.080	-.215	-.034	-.171	-.172

Medium Hospital – Pneumonia

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
Blood Cultures Performed Before First Antibiotic Received	-.058	-.049	-.099	-.171	.037	.035
Initial Antibiotic Timing	-.100	-.136	-.176	.386	.013	.006
Oxygenation Assessment	.020	-.030	.048	-.087	.007	.003
Pneumococcal Vaccination	-.157	-.147	-.074	-.152	-.027	-.029
Adult Smoking Cessation Advice/Counseling	.041	-.053	.011	-.250	-.025	-.223

Large Hospital – APR-DRG 174

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	.043	-.018	.188	.094	.119	.009
Aspirin at Arrival	.015	-.021	.091	.007	.075	.101
Aspirin at Discharge	-.086	-.156	.223	.090	.112	-.023
Beta Blocker at Arrival	-.002	-.038	.151	.097	.108	.041
Beta Blocker at Discharge	-.064	-.122	.199	.101	.115	.008
PTCA Received Within 90 Minutes of Arrival	-.065	-.350	.469	.003	.502	.421
Adult Smoking Cessation Advice/Counseling	.048	-.022	.015	-.154	.045	-.069

Large Hospital – APR-DRG 190

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	.041	.006	.165	.073	.132	.034
Aspirin at Arrival	.031	-.008	.129	.032	.122	.034
Aspirin at Discharge	-.062	-.077	.207	.151	.108	.040
Beta Blocker at Arrival	.008	-.019	.135	.048	.110	.025
Beta Blocker at Discharge	-.053	-.077	.208	.127	.121	.031
PTCA Received Within 90 Minutes of Arrival	-.465	-.475	.235	.127	.157	.094
Adult Smoking Cessation Advice/Counseling	.016	-.029	.007	-.095	.022	-059

Large Hospital – Heart Failure

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
ACE Inhibitor for LVSD	.047	.005	.241	.161	.091	-.018
Assessment of Left Ventricular Function	.006	-.020	.164	.114	.081	.007
Discharge Instructions	-.108	-.124	-.049	-.016	.051	-.000
Adult Smoking Cessation Advice/Counseling	.000	-.021	-.035	-.065	-.025	-.057

Large Hospital – Pneumonia

Quality Indicator	Billed Charge/ Day	Billed Charge/ Case	Allowed Charge/ Day	Allowed Charge/ Case	Cost/ Day	Cost/ Case
Blood Cultures Performed Before First Antibiotic Received	.012	.007	-.166	-.213	-.013	-.022
Initial Antibiotic Timing	-.052	-.059	-.185	-.295	.005	-.023
Oxygenation Assessment	-.032	-.075	.081	-.021	.040	-.068
Pneumococcal Vaccination	-.063	-.040	-.138	-.173	-.070	-.046
Adult Smoking Cessation Advice/Counseling	.065	.087	-.153	-.171	-.098	-.040

Appendix 3
AHRQ Quality Indicators

- Prevention Quality Indicators (summarized at the MSA level or higher)

  - Bacterial pneumonia admission rate
  - Dehydration admission rate
  - Pediatric gastroenteritis admission rate
  - Urinary tract infection admission rate
  - Perforated appendix admission rate
  - Low birth weight rate
  - Angina without procedure admission rate
  - Congestive heart failure admission rate
  - Hypertension admission rate
  - Adult asthma admission rate
  - Pediatric asthma admission rate
  - Chronic obstructive pulmonary disease admission rate
  - Uncontrolled diabetes admission rate
  - Diabetes – short-term complications admission rate
  - Diabetes – long-term complications admission rate
  - Rate of lower extremity amputation among patients with diabetes

- Inpatient Quality Indicators

  - Esophageal resection volume
  - Pancreatic resection volume
  - Pediatric heart surgery volume
  - Abdominal aortic aneurysm repair volume
  - Carotid endarterectomy volume
  - Esophageal resection mortality rate

- Pancreatic resection mortality rate
- Pediatric heart surgery mortality rate
- Abdominal aortic aneurysm repair mortality rate
- Coronary artery bypass graft mortality rate
- Craniotomy mortality rate
- Hip replacement mortality rate
- Acute myocardial infarction mortality rate
- Congestive heart failure mortality rate
- Acute stroke mortality rate
- Gastrointestinal hemorrhage mortality rate
- Hip fracture mortality rate
- Pneumonia mortality rate
- Cesarean section delivery rate
- Vaginal birth after Cesarean section
- Laparoscopic cholecystectomy rate
- Incidental appendectomy in the elderly rate
- Bilateral cardiac catheterization rate
- Coronary bypass graft rate
- Percutaneous transluminal coronary angioplasty rate
- Hysterectomy rate
- Laminectomy or spinal fusion rate

- Patient Safety Indicators

  - Complications of anesthesia
  - Death in low mortality DRGs
  - Decubitus ulcer
  - Failure to rescue
  - Foreign body left during procedure
  - Iatrogenic pneumothorax
  - Selected infections due to medical care

- Postoperative hemorrhage or hematoma
- Postoperative hip fracture
- Postoperative physiologic and metabolic derangement
- Postoperative pulmonary embolism or deep vein thrombosis
- Postoperative respiratory failure
- Postoperative sepsis
- Postoperative wound dehiscence
- Accidental puncture or laceration
- Transfusion reaction
- Birth trauma – injury to neonate
- Obstetric trauma – Cesarean delivery
- Obstetric trauma – vaginal delivery with instrument
- Obstetric trauma – vaginal delivery without instrument