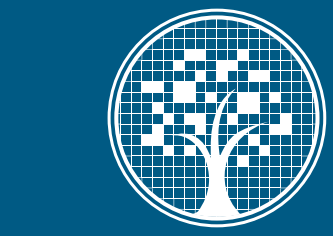

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HEALTHCARE COST AND UTILIZATION PROJECT

HCUP Methods Series

Methods Applying AHRQ Quality Indicators to Healthcare Cost and Utilization Project (HCUP) Data for the Sixth National Healthcare Quality Report

Report # 2008-05

Agency for Healthcare Research and Quality

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Methods Applying AHRQ Quality Indicators to Healthcare Cost and Utilization Project (HCUP) Data for the Sixth (2008) National Healthcare Quality Report

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The Agency for Healthcare Research and Quality (AHRQ) Quality Indicators (QIs) were applied to the HCUP hospital discharge data for several measures in the National Healthcare Quality Report (NHQR). The AHRQ QIs are measures of quality associated with processes of care that occurred in an outpatient or an inpatient setting. The QIs rely solely on hospital inpatient administrative data and, for this reason, are screens for examining quality that may indicate the need for more in-depth studies. The AHRQ QIs used for the NHQR include four sets of measures:

- Prevention Quality Indicators (PQIs)—or ambulatory care sensitive conditions—identify hospital admissions that evidence suggests could have been avoided, at least in part, through high-quality outpatient care (AHRQ, 2007).
- Inpatient Quality Indicators (IQIs) reflect quality of care inside hospitals and include measures of utilization of procedures for which there are questions of overuse, underuse, or misuse (AHRQ, 2007).
- Patient Safety Indicators (PSIs) reflect quality of care inside hospitals, by focusing on surgical complications and other iatrogenic events (AHRQ, 2007).
- Pediatric Quality Indicators (PDIs) reflect quality of care inside hospitals and identify potentially avoidable hospitalizations among children (AHRQ, 2006).

The QI measures selected for the NHQR are described in Table 1 at the end of this methods report.

The Healthcare Cost and Utilization Project (HCUP) is a family of healthcare databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by AHRQ. HCUP databases bring together the data collection efforts of State data organizations, hospital associations, private data organizations, and the Federal government to create a national information resource of discharge-level health care data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, State and local market levels.

Two HCUP discharge datasets were used for the NHQR:

- The HCUP Nationwide Inpatient Sample (NIS), a nationally stratified *sample* of hospitals (with all of their discharges) from States that contribute data to the NIS dataset (37 States in the 2005 NIS).

- The HCUP State Inpatient Databases (SID), a *census* of hospitals (with all of their discharges) from 37 participating States in 2005.

For 2005, the NIS contains roughly 8.0 million discharges from more than 1,000 hospitals and the SID contains about 32.4 million discharges (approximately 83 percent of the 39.2 million discharges in the United States). Data from 1994, 1997, and 2000-2005 were used in this report. Limited reporting was done at the state-specific level. For the list of data organizations that contribute to the HCUP databases, see Table 2 at the end of this methods report.

To apply the AHRQ Quality Indicators to HCUP hospital discharge data for the NHQR, several steps were taken: (1) QI software review and modification, (2) acquisition of population-based data, (3) general preparation of HCUP data, and (4) identification of statistical methods. These steps, described briefly below, are presented in greater detail in the *Technical Specifications for HCUP Measures in the 2008 National Healthcare Quality Report and the National Healthcare Disparities Report* (Barrett, Houchens, Coffey, et al., 2008), available from AHRQ on request.

1. **QI Software Review and Modification.** For this report, we started with the following QI software versions: PQI Version 3.1 IQI Version 3.1, PSI Version 3.1, and PDI Version 3.1. Because each of these software modules was developed for State and hospital-level rates, rather than national rates, some changes to the QI calculations were necessary. (For details, see Barrett, Houchens, Coffey, et al., 2008.) We also added two indicators particularly relevant to the structure of the NHQR for patients age 65 years and older: immunization-preventable influenza and adult asthma admissions.

2. **Acquisition of Population-Based Data.** The next step was to acquire data for the numerator and denominator populations for the QIs. A QI is a measure of an event that occurs in a hospital, requiring a numerator count of the event of interest and a denominator count of the population (within the hospital or within the geographic area) to which the event relates.

   For the numerator counts of the AHRQ QIs, we used the HCUP NIS to create national estimates and used the SID for state-level estimates. For the denominator counts, we identified two sources for all reporting categories and for all adjustment categories listed in the HCUP-based tables. The HCUP data were used for State- and national-level discharge denominator counts for QIs that related to *providers.* Population ZIP-Code-level counts from Claritas (a vendor that compiles and adds value to the U.S. Bureau of Census data) were used for denominator counts for QIs that related to *geographic areas*. Claritas uses intra-census methods to estimate household and demographic statistics for geographic areas (Claritas, Inc., 2005). We also used the Claritas population data for risk adjustment by age and gender for the area-based QIs.

3. **Preparation of HCUP Data.** Next, the HCUP SID were modified to create analytic files consistent with the NIS and consistent across States.

   - *Subset to Community Hospital*s. For the SID, we selected community[1] hospitals and

[1] *Community* hospitals are defined by the AHA as "non-Federal, short-term, general, and other specialty hospitals, excluding hospital units of institutions." Specialty hospitals included among community hospitals are obstetrics-gynecology, ear-nose-throat, short-term rehabilitation, orthopedic, and pediatric institutions. Also included are public hospitals and academic medical centers. Excluded are short-term rehabilitation hospitals (beginning with 1998 HCUP data), long-term hospitals, psychiatric hospitals, and alcoholism/chemical dependency treatment facilities.

eliminated rehabilitation hospitals.

- *Weight for Missing Hospitals*. Because some statewide data organizations do not report data for all community hospitals in the State, we weighted hospitals in the SID to the State's universe of hospitals in the American Hospital Association Annual Survey Database based on hospital characteristics.
- *Weight for Missing Quarters*. Discharges from hospitals operating for the entire year but not contributing data for one or more quarters were weighted up to annual estimates for that institution in the SID.

In addition the following issues had to be resolved in the NIS and SID before applying the QI algorithms:

- *Impute for Missing Characteristics*. For missing age, gender, ZIP Code, and payer data that occurred on a small proportion of discharge records, we used a "hot deck" imputation method (which draws donors from strata of similar hospitals and patients) to assign values while preserving the variance within the data.
- *Assign Additional Measures for Reporting*. We assigned median household income using the Claritas ZIP Code data linked to patient's ZIP Code in the SID. For the 2008 NHQR, we added reporting by the National Center for Health Statistics (NCHS) county-level classification of urban-rural location, which includes gradations of metropolitan, micropolitan, and non-core counties by population size.

The four AHRQ QI program modules were applied to the prepared SID data using all available diagnoses and procedures reported by each State. The QI indicators from the SID were then linked to the corresponding discharge records on the NIS. During this linkage, any additional information for reporting described above was also added to the NIS.

4. **Statistical Methods.** Identification of statistical issues included the following: age-gender adjustment for all QIs; severity/comorbidity adjustment for the discharge-based IQIs, PSIs, and PDIs; and derivation of standard errors and appropriate hypothesis tests.

   - *Age-Gender Adjustment.* For the PQIs and area-based IQIs, PSIs, and PDIs, age-gender adjustments were made for age and gender differences across population subgroups and were based on methods of direct standardization (Fleiss, 1973). Age was categorized into 18 five-year increments (described in Table 3, Age Groupings for Risk Adjustment). Although the AHRQ QI software uses a similar approach to adjust the area-based QIs, we relied on direct standardization because of the additional reporting categories and population denominators required in the NHQR.
   - *Age, Gender, Severity, and Comorbidity Adjustment*.

     For the discharge-based *PSI*s, adjustments were made for age, gender, age-gender interaction, DRG cluster, and comorbidity using the regression-based standardization that is part of the AHRQ PSI software.

     For the discharge-based *IQIs*, adjustments were made for age, gender, age-gender interaction, and 3M™ All Patient Refined Diagnosis Related Groups (APR-DRGs) risk of mortality or severity score using the regression-based standardization that is part of the AHRQ IQI software.

     For the discharge-based *PDIs*, adjustments were made for age, gender, DRG and MDC clusters, and comorbidity using the regression-based standardization that is part of the AHRQ PDI software. Measure-specific stratification by risk group, clinical category, and procedure type was also applied.

- *Standard Errors and Hypothesis Tests*. Standard error calculations for the rates were based on the HCUP report entitled *Calculating Nationwide Inpatient Sample (NIS) Variances* (Houchens, et al., 2005). There is no sampling error associated with Claritas census population counts; therefore, appropriate statistics were obtained through the Statistical Analysis System (SAS) procedure called PROC SURVEYMEANS. QI estimates were included in the NHQR if they reached a threshold defined by a relative standard error less than 30% and at least 10 unweighted cases in the denominator. Estimates that did not satisfy these criteria were set to missing. Statistical calculations are explained in Appendix A to this report and in Barrett, Houchens, Coffey, et al. (2008).

Calculating Costs Associated with Quality Indicators

The HCUP databases include information on total hospital charges. Using HCUP hospital-level cost-to-charge ratios based on hospital accounting reports from the Centers for Medicare and Medicaid Services,[2] total charges are converted to costs. Costs will tend to reflect the actual costs of production, while charges represent what the hospital billed for the stay. Hospital charges reflect the amount the hospital charged for the entire hospital stay and does not include professional (physician) fees.

Total national costs associated with potentially avoidable hospitalizations are calculated for three PQI composites – overall, acute, and chronic conditions. The total cost is the product of the number of stays for each PQI composite and the mean cost for each PQI composite. This approach compensates for stays for which charges (and thus estimated costs) are not available.

Total cost savings from reducing avoidable hospitalizations are estimated based on the risk-adjusted rates for the top 10 percent of states. The adjusted rates for the best performers are averaged. The potential reduction in cases is the expected number of U.S. cases based on the best performer average subtracted from the actual number of U.S. cases. The total cost savings is the product of the average national cost per case and the potential reduction in cases. An example using PQI 14, Uncontrolled Diabetes, is provided in Appendix B.

Caveats

Some caution should be used in interpreting the AHRQ QI statistics presented in this report. Some caveats relate to the how the QIs were applied, some relate to ICD-9-CM coding changes and inter-State differences in data collection, and others are more general issues.

Rehabilitation Hospitals: These hospitals are excluded from the 2000-2005 NIS but included in the 1994 and 1997 NIS because of the change in the NIS sampling strategy (beginning in the 1998 NIS). Patients treated in rehabilitation hospitals tend to have lower mortality rates and longer lengths of stay than patients in other community hospitals, and the completeness of reporting for rehabilitation hospitals is very uneven across the States. The elimination of rehabilitation hospitals in 2000-2005 may affect trends in the QIs however, based on previous analyses, the effect is likely small since only 3 percent of community hospitals are involved.

[2] HCUP Cost-to-Charge Ratio Files (CCR). Healthcare Cost and Utilization Project (HCUP). 1997–2005. U.S. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/db/state/costtocharge.jsp.

ICD-9-CM Coding Changes: A number of the AHRQ QIs are based on diagnoses and procedures for which ICD-9-CM coding has generally become more specific over the period of this study. Essentially all of the changes occur between 1994 and 1997. Thus, some 1994 estimates may not be comparable to the later estimates. These inconsistencies are noted in the footnotes of the NHQR tables with information on the affected ICD-9-CM code and direction of the bias when it can be determined.

Data Collection Differences among States: Organizations that collect statewide data generally collect data using the Uniform Billing format (UB-92) and, for earlier years, the Uniform Hospital Discharge Data Set (UHDDS) format. However, not every statewide data organization collects all data elements nor codes them the same way. For the NHQR, uneven availability of a few data elements underlie some estimates, as noted next.

Data Elements for Exclusions: Three data elements required for certain QIs were not available in every State: "secondary procedure day," "admission type" (elective, urgent, newborn, and emergency), and "present on admission." We modified the AHRQ QI software in instances where these data elements are used to exclude specific cases from the QI measures:

- The PSIs and PDIs that use secondary procedure day were modified to calculate indicators without considering the timing of procedures.
- For QIs that use admission type "elective" and "newborn," we imputed the missing admission type using available information. For all States except California, an admission type of "elective" was assigned if the DRG did not indicate trauma, delivery, or newborn. An admission type of "newborn" was assigned if the DRG indicated a newborn. For California, which did not provide any information on admission type, information on scheduled admissions was used to identify elective admissions and DRGs were used to identify newborn admissions.
- For QIs that use present on admission (POA), we modified the AHRQ QI software to calculate indicators without considering whether the condition was present at admission.

Number of Clinical Fields: Another data collection issue relates to the number of fields that statewide data organizations permit for reporting patients' diagnoses and procedures during the hospitalization and whether they specifically require coding of external cause-of-injury (E codes). The SID for different States contain as few as 6 or as many as 30 fields for reporting diagnoses and procedures, as shown in Table 4 at the end of this methods report. The more fields used, the more quality-related events that can be captured in the statewide databases. However, in an earlier analysis, even for States with 30 diagnosis fields available in the year 2000, 95 percent of their discharge records captured all of patients' diagnoses in 10 to 13 data elements. For States with 30 procedure fields available, 95 percent of records captured all of patients' procedures in 5 fields. Thus, limited numbers of fields available for reporting diagnoses and procedures are unlikely to have much effect on results, because all statewide data organizations participating in HCUP allow at least 9 diagnoses and 6 procedures. We decided not to artificially truncate the diagnosis and procedure fields used for the NHQR analyses, so that the full richness of the databases would be used.

E Codes: Another issue relates to external cause-of-injury reporting. Eight of the 27 Patient Safety Indicators and three of the Pediatric Quality Indicators use E code data to help identify complications of care or to exclude cases (e.g., poisonings, self-inflicted injury, trauma) from numerators and denominators, as shown in Table 5 at the end of this methods report. Although

E codes in the AHRQ PSI and PDI software have been augmented wherever possible with the related non-E codes in the ICD-9-CM system, E codes are still included in some AHRQ PSI and PDI definitions. Uneven capture of these data has the potential of affecting rates and should be kept in mind when judging the level of these events.

Effects of Adding New States to the NIS over Time: Over time HCUP has expanded through the participation of additional statewide data organizations. Because each yearly NIS is a sample of hospitals from the States participating in that year (and weighted to the universe of community hospitals nationally), potential exists for different practice patterns across States to influence national measures related to clinical practice over time.

The table below lists the States that were added to HCUP between the years used in this report.

Period	States
1994	AZ, CA, CO, CT, FL, IL, IA, KS, MD, MA, NJ, NY, OR, PA, SC, WA, WI,
1995 – 1997	Added GA, HI, MO, TN, UT
1998 – 2000	Added KY, ME, NC, TX, VA, WV
2001	Added MI, MN, NE, RI, VT
2002	Added NV, OH, SD (AZ data not available)
2003	Added AZ, IN, NH (ME data not available)
2004	Added AR (PA data not available)
2005	Added OK (VA data not available)

For the first NHQR, we calculated QI rates using two methods to test this hypothesis, first with data from the full set of States in HCUP in 2000 and second with data from the set of States in HCUP in all three years (1994, 1997, and 2000), where that subset of States was re-weighted to obtain national estimates. For most QIs, the results differed very little. These results are presented in detail in the *Technical Specifications for HCUP Measures in the National Healthcare Quality Report and the National Healthcare Disparities Report* (Barrett, Houchens, Coffey, et al., 2003), available from AHRQ on request.

Variation among State QI Rates. Variation in State rates can be caused by many factors, including differences in practice patterns, underlying disease prevalence, health behaviors, access to health insurance, income levels of the population, demographics, spending on health services, supply of health care resources, coding conventions, and so on. To understand some of the variation in State rates, we analyzed the 2001 State rates in relation to these types of factors. Appendix C shows for each Prevention Quality Indicator (PQI) included in the NHQR, the analyses performed and the result in terms of whether the factors (with each tested separately because of the limited number of observations) were positively, negatively, or not significantly related to the QIs.

In a subsequent analysis, we investigated sources of variation in Patient Safety Indicator (PSI) rates across States using 2004 data. Appendix D contains the executive summary from the report, *Patient Safety in Hospitals in 2004: Toward Understanding Variation Across States*. The analysis concluded there were few state factors (such as state policy, hospital characteristics,

coding practices, and socio-demographics) with strong patterns of association to state-level variation in the nine PSI rates studied. The strongest result occurred with coding practices — the number of diagnosis fields coded. Only one in five correlations between the PSIs and state factors were statistically significant, although there is generally no pattern.

These analyses are intended to help readers understand some of the external factors that may be driving some of the State differences in PQI and PSI rates.

Table 1. AHRQ Quality Indicators Selected for the National Healthcare Quality Report

QI No.	Description
Prevention Quality Indicators	
PQI 1	Admissions for diabetes with short-term complications* (excluding obstetric admissions and transfers from other institutions) per 100,000 population, age 18 years and older * Ketoacidosis, hyperosmolarity, or coma.
PQI 3	Admissions for diabetes with long-term complications* (excluding obstetric admissions and transfers from other institutions) per 100,000 population, age 18 years and older * Renal, eye, neurological, circulatory, or other unspecified complications.
PQI 8	Admissions for congestive heart failure (excluding patients with cardiac procedures, obstetric conditions, and transfers from other institutions) per 100,000 population, age 18 years and older
PQI 14	Admissions for uncontrolled diabetes without complications* (excluding obstetric admissions and transfers from other institutions) per 100,000 population, age 18 years and older * Without short-term (ketoacidosis, hyperosmolarity, coma) or long-term (renal, eye, neurological, circulatory, other unspecified) complications.
PQI 15	Adult asthma admissions (excluding patients with cystic fibrosis or anomalies of the respiratory system, obstetric admissions, and transfers from other institutions) per 100,000 population, age 18 years and older
PQI 15 (modified)	Asthma admissions (excluding patients with cystic fibrosis or anomalies of the respiratory system, obstetric admissions and transfers from other institutions) per 100,000 population, age 65 years and older
PQI 18 (Added)	Immunization-preventable influenza admissions (excluding transfers from other institutions) per 100,000 population, age 65 years and older
Pediatric Quality Indicators	
PDI 14	Pediatric asthma admissions (excluding patients with cystic fibrosis or anomalies of the respiratory system and transfers from other institutions) per 100,000 population, ages 2-17
PDI 15	Admissions for diabetes with short-term complications* (excluding transfers from other institutions) per 100,000 population, ages 6-17 * Ketoacidosis, hyperosmolarity, or coma.
Inpatient Quality Indicators	
IQI 11	Deaths per 1,000 admissions with abdominal aortic aneurysm (AAA) repair (excluding obstetric and neonatal admissions and transfers to another hospital), age 18 years or older
IQI 12	Deaths per 1,000 admissions with coronary artery bypass graft (excluding obstetric and neonatal admissions and transfers to another hospital), age 40 and older
IQI 15	Deaths per 1,000 admissions with acute myocardial infarction (AMI) as principal diagnosis (excluding transfers to another hospital), age 18 and older
IQI 16	Deaths per 1,000 admissions with congestive heart failure (CHF) as principal diagnosis (excluding obstetric and neonatal admissions and transfers to another hospital), age 18 and older
IQI 20	Deaths per 1,000 admissions with pneumonia as principal diagnosis (excluding obstetric and neonatal admissions and transfers to another hospital), age 18 and older
IQI 30	Deaths per 1,000 adult admissions age 40 and older with percutaneous transluminal coronary angioplasties (PTCA) (excluding obstetric and neonatal admissions and transfers to another hospital)
Patient Safety Indicators	
PSI 1	Complications of anesthesia in any secondary diagnosis per 1,000 surgical discharges (excluding patients with anesthesia complications as a principal diagnosis and patients with self-inflicted injury, poisoning due to anesthetics, and active drug dependence or abuse), age 18 years or older or obstetric admissions

QI No.	Description
PSI 2	Deaths per 1,000 admissions in low mortality DRGs (DRGs with a NIS 1997 benchmark of less than 0.5% mortality, excluding trauma, immunocompromised, and cancer patients), age 18 years or older or obstetric admissions
PSI 3	Decubitus ulcers per 1,000 discharges of length 5 or more days (excluding transfers, patients admitted from long-term-care facilities, patients with diseases of the skin, subcutaneous tissue, and breast, and obstetrical admissions*), age 18 years or older * Also excludes admissions specifically for decubitus ulcers, such as cases from earlier admissions or from other hospitals.
PSI 4	Failure to rescue or deaths per 1,000 discharges having developed specified complications of care during hospitalization (excluding patients transferred in or out, patients admitted from long-term-care facilities), age 18 years to 74 years
PSI 5	Foreign body accidentally left in during procedure per 1,000 medical and surgical discharges*, age 18 years or older or obstetric admissions * Also excludes admissions specifically for treatment of foreign body left, such as cases from earlier admissions or from other hospitals.
PSI 6	Iatrogenic pneumothorax per 1,000 discharges (excluding obstetrical admissions and patients with chest trauma, thoracic surgery, lung or pleural biopsy, or cardiac surgery*), age 18 years or older * Also excludes admissions specifically for iatrogenic pneumothorax, such as cases from earlier admissions or from other hospitals. Includes barotrauma (including acute respiratory distress syndrome) and central line placement.
PSI 7	Selected infections due to medical care per 1,000 medical and surgical discharges (excluding immunocompromised and cancer patients, stays under 2 days, and admissions specifically for such infections*), age 18 years or older or obstetric admissions * Also excludes admissions specifically for such infections, such as cases from earlier admissions, from other hospitals, or from other settings.
PSI 8	Postoperative hip fracture for adults per 1,000 surgical patients age 18 years and older who were not susceptible to falling* (excluding obstetrical admissions) * That is, excluding patients with musculoskeletal disease; those admitted for seizures, syncope, stroke, coma, cardiac arrest, poisoning, trauma, delirium, psychoses, anoxic brain injury; patients with metastatic cancer, lymphoid malignancy, bone malignancy, and self-inflicted injury.
PSI 9	Postoperative hemorrhage or hematoma with surgical drainage or evacuation, not verifiable as following surgery*, per 1,000 surgical discharges (excluding obstetrical admissions), age 18 years or older * Postoperative hemorrhage or hematoma is not verifiable as following surgery because information on day of procedure is not available for all discharges. Also, excludes admissions specifically for such problems, such as cases from earlier admissions, from other hospitals, or from other settings.
PSI 10	Postoperative physiologic and metabolic derangements per 1,000 elective surgical discharges (excluding some serious disease* and obstetric admissions), age 18 years and older * That is, excluding patients with diabetic coma and patients with renal failure who also were diagnosed with AMI, cardiac arrhythmia, cardiac arrest, shock, hemorrhage, or gastrointestinal hemorrhage.
PSI 11	Postoperative respiratory failure per 1,000 elective surgical discharges with an operating room procedure (excluding patients with respiratory disease, circulatory disease, neuromuscular disorders, obstetric conditions, and admissions specifically for acute respiratory failure), age 18 years and older

QI No.	Description
PSI 12	Postoperative pulmonary embolus (PE) or deep vein thrombosis (DVT) per 1,000 surgical discharges (excluding patients admitted for DVT, obstetrics, and plication of vena cava before or after surgery*), age 18 years or older * Also excludes admissions specifically for such thromboembuli, such as cases from earlier admissions, from other hospitals, or from other settings.
PSI 13	Postoperative sepsis per 1,000 elective-surgery discharges with an operating room procedure (excluding patients admitted for infection; patients with cancer or immunocompromised states, obstetric conditions, stays under 4 days, and admissions specifically for sepsis), age 18 years or older
PSI 14	Reclosure of postoperative abdominal wound dehiscence per 1,000 abdominopelvic-surgery discharges (excluding immunocompromised patients, stays under 2 days, and obstetric conditions*), age 18 years or older * Also excludes admissions specifically for such wound dehiscence, such as cases from earlier admissions or from other hospitals.
PSI 15	Accidental puncture or laceration during procedures per 1,000 discharges (excluding obstetric admissions*), age 18 years or older * Also excludes admissions specifically for such problems, such as cases from earlier admissions or from other hospitals.
PSI 16	Transfusion reactions per 1,000 discharges, age 18 years or older or obstetric admissions* * Also excludes admissions specifically for transfusion reactions, such as cases from earlier admissions or from other hospitals.
PSI 17	Birth trauma - injury to neonate per 1,000 live births (excluding preterm and osteogenesis imperfecta births)
PSI 18	Obstetric trauma with 3rd or 4th degree lacerations per 1,000 instrument-assisted vaginal deliveries
PSI 19	Obstetric trauma with 3rd or 4th degree lacerations per 1,000 vaginal deliveries without instrument assistance
PSI 20	Obstetric trauma with 3rd or 4th degree lacerations per 1,000 Cesarean deliveries

Table 2. Sources of HCUP Data for the NHQR

State	Data Source
Arizona	Arizona Department of Health Services
Arkansas	Arkansas Department of Health
California	Office of Statewide Health Planning and Development
Colorado	Colorado Hospital Association
Connecticut	Connecticut Hospital Association
Florida	Florida Agency for Health Care Administration
Georgia	Georgia Hospital Association
Hawaii	Hawaii Health Information Corporation
Illinois	Illinois Department of Public Health
Indiana	Indiana Hospital Association
Iowa	Iowa Hospital Association
Kansas	Kansas Hospital Association
Kentucky	Kentucky Cabinet for Health and Family Services
Maryland	Health Services Cost Review Commission
Massachusetts	Division of Health Care Finance and Policy
Michigan	Michigan Health & Hospital Association
Minnesota	Minnesota Hospital Association
Missouri	Hospital Industry Data Institute
Nebraska	Nebraska Hospital Association
Nevada	Nevada Department of Health and Human Services
New Hampshire	New Hampshire Department of Health & Human Services
New Jersey	New Jersey Department of Health and Senior Services
New York	New York State Department of Health
North Carolina	North Carolina Department of Health and Human Services
Ohio	Ohio Hospital Association
Oklahoma	Oklahoma State Department of Health
Oregon	Oregon Association of Hospitals and Health Systems
Rhode Island	Rhode Island Department of Health
South Carolina	South Carolina State Budget & Control Board
South Dakota	South Dakota Association of Healthcare Organizations
Tennessee	Tennessee Hospital Association
Texas	Texas Department of State Health Services
Utah	Utah Department of Health, Office of Health Care Statistics
Vermont	Vermont Association of Hospitals and Health Systems
Washington	Washington State Department of Health
West Virginia	West Virginia Health Care Authority
Wisconsin	Wisconsin Department of Health and Family Services

Table 3. Age Groupings for Risk Adjustment

This table shows the 18 categories of patient age, in five-year increments, that are used for risk adjustment. The 36 age-gender categories for risk adjustment are constructed from the 18 age categories split into male-female gender.

Age Groups
0-4
5-9
10-14
15-17
18-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85 or older

Table 4. Number of diagnosis and procedure fields by State, 2005

State	Maximum number of diagnoses	Maximum number of procedures
Arizona	9	6
Arkansas	9	6
California	25	21
Colorado	15	15
Connecticut	30	30
Florida	10	10
Georgia	10	6
Hawaii	20	20
Illinois	9	6
Indiana	15	15
Iowa	9	6
Kansas	25	25
Kentucky	9	6
Maryland	15	15
Massachusetts	15	15
Michigan	30	30
Minnesota	9	6
Missouri	30	25
Nebraska	9	6
Nevada	15	10
New Hampshire	10	6
New Jersey	9	8
New York	15	15
North Carolina	17	7
Ohio	15	9
Oklahoma	16	16
Oregon	9	6
Rhode Island	11	11
South Carolina	10	10
South Dakota	9	6
Tennessee	9	6
Texas	25	15
Utah	9	6
Vermont	20	20
Washington	9	6
West Virginia	9	6
Wisconsin	9	6

Table 5. Use of E codes in the AHRQ Quality Indicators, Version 3.1

PSI or PDI *	Codes used for defining the numerator		Codes used for defining exclusions	
	E codes	**Similar ICD-9-CM codes**	**E codes**	**Similar ICD-9-CM codes**
PSI 1	E8551, E8763, E938n	9681-9684, 9687	Self-inflicted injury (E95nn)	None
PSI 5 PSI 21 PDI 3	E8710 – E8719	9984, 9987	None	None
PSI 8	None	None	Self-inflicted injury (E95nn); Poisoning (E85nn, E86nn, E951n, E952n, E962nn, E980n-E982n)	9600-9799
PSI 15 PSI 25 PDI 1	E8700 – E8709	9982	None	None
PSI 16 PSI 26 PDI 13	E8760	9996-9997	None	None

* All other PSIs and PDIs do not use E codes.

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Appendix A
STATISTICAL METHODS

This appendix explains the statistical methods and gives formulas for the calculations of standard errors and hypothesis tests. These statistics are derived from multiple databases: the NIS, the SID, and Claritas (a vendor that compiles and adds value to Bureau of Census data). For NIS estimates, the standard errors are calculated as described in the HCUP report entitled *Calculating Nationwide Inpatient Sample (NIS) Variances* (Houchens, et al., 2005). We will refer to this report simply as the NIS Variance Report throughout this appendix. This method takes into account the cluster and stratification aspects of the NIS sample design when calculating these statistics using the SAS procedure PROC SURVEYMEANS. For the SID we used the same procedure omitting the cluster and stratification features. For population counts based on Claritas data, there is no sampling error.

Even though the NIS contains discharges from a finite sample of hospitals and most of the SID databases contain nearly all discharges from nearly all hospitals in the state, we treat the samples as though they were drawn from an infinite population. We do not employ finite population correction factors in estimating standard errors. We take this approach because we view the outcomes as a result of myriad processes that go into treatment decisions rather than being the result of specific, fixed processes generating outcomes for a specific population and a specific year. We consider the NIS and SID to be samples from a "super-population" for purposes of variance estimation. Further, we assume the counts (of QI events) to be binomial.

1. Area Population QIs using Claritas Population Data

a. Standard error estimates for discharge rates per 100,000 population using the 2005 Claritas population data.

The observed rate was calculated as follows:

$$R = 100{,}000 \cdot \frac{\sum_{i=1}^{n} w_i x_i}{N} = 100{,}000 \cdot \frac{S}{N}. \qquad \text{(A.1)}$$

w_i and x_i, respectively, are the weight and variable of interest for patient i in the NIS or SID. To obtain the estimate of S and its standard error, SE_S, we followed instructions in the NIS Variance Report (modified for the SID, as explained above)

The population count in the denominator is a constant. Consequently, the standard error of the rate R was calculated as:

$$SE_R = 100{,}000 \ \ SE_S / N. \qquad \text{(A.2)}$$

b. Standard error estimates for age/sex adjusted inpatient rates per 100,000 population using the 2005 Claritas population data.

We adjusted rates for age and sex using the method of direct standardization (Fleiss, 1973). We estimated the observed rates for each of 36 age/sex categories (described in Appendix

C, Age Groupings for Risk Adjustment). We then calculated the weighted average of those 36 rates using weights proportional to the percentage of a standard population in each cell. Therefore, the adjusted rate represents the rate that would be expected for the observed study population if it had the same age and sex distribution as the standard population.

For the standard population we used the age and sex distribution of the U.S. as a whole according to the year 2000. In theory, differences among adjusted rates were not attributable to differences in the age and sex distributions among the comparison groups because the rates were all calculated with a common age and sex distribution.

The adjusted rate was calculated as follows (and subsequently multiplied by 100,000):

$$\mathrm{A} = \frac{\sum_{g=1}^{36} N_{g,std} \sum_{i=1}^{n(g)} \frac{w_{g,i} x_{g,i}}{N_{g,obs}}}{\sum_{g=1}^{36} N_{g,std}} = \frac{\sum_{g=1}^{36} \sum_{i=1}^{n(g)} \frac{N_{g,std}}{N_{g,obs}} w_{g,i} x_{g,i}}{N_{std}} = \frac{\sum_{g=1}^{36} \sum_{i=1}^{n(g)} w^{*}_{g,i} x_{g,i}}{N_{std}} = \frac{S*}{N_{std}}. \quad \text{(A.3)}$$

g = index for the 36 age/sex cells.
$N_{g,std}$ = Standard population for cell g (year 2000 total US population in cell g).
$N_{g,obs}$ = Observed population for cell g (year 2005 subpopulation in cell g, e.g., females, state of California, etc.).
$n(g)$ = Number in the sample for cell g.
$x_{g,i}$ = Observed quality indicator for observation i in cell g (e.g., 0 or 1 indicator).
$w_{g,i}$ = NIS or SID discharge weight for observation i in cell g.

The estimates for the numerator, S^*, and its standard error, SE_{S^*}, were calculated in similar fashion to the unadjusted estimates for the numerator S in formula A.1. The only difference was that the weight for patient i in cell g was redefined as:

$$w^{*}_{g,i} = \frac{N_{g,std}}{N_{g,obs}} \cdot w_{g,i} \quad \text{(A.4)}$$

Following instructions in the NIS Variance Report (modified for the SID, as explained above), we used PROC SURVEYMEANS to obtain the estimate of S^*, the weighted sum in the numerator using the revised weights, and the estimate SE_{S^*}, the standard error of the weighted sum S^*. The denominator is a constant. Therefore, the standard error of the adjusted rate, A, was calculated as

$$SE_A = 100{,}000 \; SE_{S^*} / N_{std}. \quad \text{(A.5)}$$

2. Provider-based QIs using Weighted Discharge Data (SID and NIS)

a. Standard error estimates for inpatient rates per 1,000 discharges using discharge counts in both the numerator and the denominator.

We calculated the observed rate as follows:

$$R = 1{,}000 \cdot \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} = 1{,}000 \cdot \frac{S}{N}. \qquad \text{(A.6)}$$

Following instructions in the HCUP NIS Variance Report (modified for the SID, as explained above), we used PROC SURVEYMEANS to obtain estimates of the weighted mean, *S/N*, and the standard error of the weighted mean, $SE_{S/N}$. We multiplied this standard error by 1,000.

b. Standard error estimates for age/sex adjusted inpatient rates per 1,000 discharges using inpatient counts in both the numerator and the denominator.

We used the full NIS sample estimates for the standard inpatient population age-sex distribution. For each of the 36 age-sex categories, we estimated the number of U.S. inpatient discharges, $\hat{N}_{g,std}$, in category g. We calculated the directly adjusted rate:

$$\mathrm{A} = 1{,}000 \cdot \frac{\sum_{g=1}^{36} \hat{N}_{g,std} \frac{\sum_{i=1}^{n(g)} w_{g,i} x_{g,i}}{\sum_{i=1}^{n(g)} w_{g,i}}}{\sum_{g=1}^{36} \hat{N}_{g,std}} = 1{,}000 \cdot \sum_{g=1}^{36} \hat{P}_{g,std} \frac{\sum_{i=1}^{n(g)} w_{g,i} x_{g,i}}{\sum_{i=1}^{n(g)} w_{g,i}}. \qquad \text{(A.7)}$$

g = index for the 36 age/sex cells.
$\hat{N}_{g,std}$ = Standard inpatient population for cell g (NIS estimate of the total inpatient population for cell g).
n(g) = Number in the sample for cell g.
$x_{g,i}$ = Observed quality indicator for observation i in cell g.
$w_{g,i}$ = NIS or SID discharge weight for observation i in cell g.

Note that $\hat{P}_{g,std} = \frac{\hat{N}_{g,std}}{\sum_{g=1}^{36} \hat{N}_{g,std}}$ is the proportion of the standard inpatient population in cell g.

Consequently, the adjusted rate is a weighted average of the cell-specific rates with cell

weights equal to $\hat{P}_{g,std}$. These cell weights are merely a convenient, reasonable standard inpatient population distribution for the direct standardization. Therefore, we treat these cell weights as constants in the variance calculations:

$$SE(A) = \sqrt{Var(A)} = 1{,}000 \cdot \sqrt{Var\left(\sum_{g=1}^{36} \hat{P}_{g,std} \frac{\sum_{i=1}^{n(g)} w_{g,i} x_{g,i}}{\sum_{i=1}^{n(g)} w_{g,i}} \right)} = 1{,}000 \cdot \sqrt{\sum_{g=1}^{36} \hat{P}^2_{g,std} \cdot Var\left(\frac{\sum_{i=1}^{n(g)} w_{g,i} x_{g,i}}{\sum_{i=1}^{n(g)} w_{g,i}} \right)}. \quad \text{(A.8)}$$

The variance of the ratio enclosed in parentheses was estimated separately for each cell g by squaring the SE calculated using the method of section 2.a:

$$SE(A) = 1{,}000 \cdot \sqrt{\sum_{g=1}^{36} \hat{P}^2_{g,std} \cdot \left\{ SE(R_g) \right\}^2}$$

$$R_g = \frac{\sum_{i=1}^{n(g)} w_{g,i} x_{g,i}}{\sum_{i=1}^{n(g)} w_{g,i}} \quad \text{(A.9)}$$

Following instructions in the HCUP NIS Variance Report (modified for the SID, as explained above), we used PROC SURVEYMEANS to obtain estimates of the weighted means, R_g, and their standard errors.

3. Significance tests.

Let R_1 and R_2 be either observed or adjusted rates calculated for comparison groups 1 and 2, respectively. Let SE_1 and SE_2 be the corresponding standard errors for the two rates. We calculated the test statistic and (two-sided) p-value:

$$t = \frac{R_1 - R_2}{\sqrt{SE_1^2 + SE_2^2}}$$

$$p = 2 * \text{Prob}(Z > |t|) \quad \text{(A.10)}$$

where Z is a standard normal variate.

Note: the following functions calculate p in SAS and EXCEL:

SAS: p = 2 * (1 - PROBNORM(ABS(t)));

EXCEL: = 2*(1- NORMDIST(ABS(t),0,1,TRUE))

Appendix B
ESTIMATING TOTAL COST SAVINGS FROM REDUCING AVOIDABLE HOSPITALIZATIONS

Step 1) Use the 2005 adjusted rates for Uncontrolled Diabetes (PQI 14) for top 10% of states and calculate the average

Vermont	3.825
Utah	3.892
Colorado	4.985
New Hampshire	5.042
Average Adjusted Rate for Top 10% of States	4.436

Step 2) Determine the expected number of U.S. cases assuming the same rate as the top 10% of states

U.S. 2005 Resident Population over 18	221,644,344
Top 10% Average	4.436
Expected U.S. cases based on top 10% rate	9,832

Step 3) Determine the actual number of U.S. cases

U.S. 2005 Resident Population over 18	221,644,344
2005 U.S. adjusted rate for PQI 14	20.446
Actual U.S. cases	45,318

Step 4) Reduction in cases if assuming top 10% rate

Actual U.S. cases	45,318
Expected U.S. cases based on top 10% rate	9,832
Reduction in cases	35,486

Step 5) Average cost per case for PQI 14 (based on the 2005 NIS)

2005 Average cost for PQI 14	$4,168

Step 6) Determine the total cost savings (product of reduction in cases and average cost)

Reduction in cases if assuming top 10% rate	35,486
2005 average cost for PQI 14	$4,168
Total Cost Savings	**$147,922,724**

Appendix C

STATE-LEVEL BIVARIATE ANALYSIS - STATE PQI RATES RELATED TO OTHER FACTORS, TAKEN ONE AT A TIME

This appendix shows the factors for which State-specific data could be found to compare to the State-specific Prevention Quality Indicators (PQI) included in the 2005 NHQR based on 2001 discharge data from the SID. State-level PQI rates are shown below with whether or not they were correlated with these factors. The results shaded in yellow below denote statistically significant correlations. The direction of the relationship and the percent of variation across States explained by the data element are also shown.

(Highlighted text denotes statistically significant results)

Key to Conclusions about Associations Found in Appendix A, Tables 1-3, column 3:

\+ = positive association, statistically significant at $p<0.05$, between QI rates and rates of the other characteristics across the states

– = negative association, statistically significant as explained above

ns = "Not Significant", denotes a statistically insignificant association.

Additional Notations:

** Number of cases reported by States was insufficient to complete analysis

*** Data unavailable for four (4) States; regressions run using remaining 29 States

State-Level Bivariate Analysis of AHRQ Prevention Quality Indicators (PQIs) based on 2001 Discharge Data Reported in the 2004 and 2005 NHQR

AHRQ Prevention Quality Indicators (PQIs)	Characteristics of State Populations	Conclusions About Associations	Percent of State Variation Explained (R-square)
PQI 1 – Adult Admissions for Short-term Diabetes Complications	Prevalence of Obesity in Adults	+	43.63%
	Adult Diabetes Prevalence (Diagnosed)	+	25.92%
	Percent of Population 65 Years and Over	ns	0.24%
	Source of Insurance: Uninsured (as a Percent of the Population)	+	12.09%
	Percent of People Below the Poverty Line in the Past 12 Months	+	33.70%
	Hospital Bed Supply (Rate/100,000)	ns	5.21%
	Race/Ethnicity: White (as a Percent of the Population)	ns	0.38%
	Race/Ethnicity: Black (as a Percent of the Population)	+	46.13%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	1.32%
	Race/Ethnicity: API (as a Percent of the Population)	-	12.52%
	Race/Ethnicity: Other (as a Percent of the Population)	ns	3.96%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	0.38%
PQI 3 – Adult Admissions for Long-term Diabetes Complications	Percent of Adult Population at Risk for Heart Disease***	+	15.28%
	Cardiac Deaths (Rate/100,000)	+	55.56%
	Prevalence of Obesity in Adults	+	28.29%
	Adult Diabetes Prevalence (Diagnosed)	+	32.36%
	Percent of Population 65 Years and Over	ns	3.18%
	Source of Insurance: Uninsured (as a Percent of the Population)	ns	8.41%
	Percent of People Below the Poverty Line in the Past 12 Months	+	26.40%
	Hospital Bed Supply (Rate/100,000)	ns	10.75%
	Race/Ethnicity: White (as a Percent of the Population)	ns	5.69%
	Race/Ethnicity: Black (as a Percent of the Population)	+	28.56%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	0.45%
	Race/Ethnicity: API (as a Percent of the Population)	ns	1.38%
	Race/Ethnicity: Other (as a Percent of the Population)	ns	8.82%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	5.69%

AHRQ Prevention Quality Indicators (PQIs)	Characteristics of State Populations	Conclusions About Associations	Percent of State Variation Explained (R-square)
PQI 4 – Pediatric Asthma Admissions	Adult Asthma Prevalence	ns	1.23%
	Emphysema Prevalence	ns	0.97%
	Chronic Bronchitis Prevalence	ns	5.38%
	Percent Reporting Cigarette Use in the Past Month	+	13.57%
	HMO Penetration	ns	2.65%
	Percent of People Below the Poverty Line in the Past 12 Months	ns	7.44%
	Percent Without Telephone Access	+	15.27%
	Source of Insurance: Uninsured (as a Percent of the Population)	ns	3.25%
	Hospital Bed Supply (Rate/100,000)	ns	4.22%
	Air Quality - Particulate Annual Mean	ns	0.96%
	Air Quality - Particulate 24 Hour Average	ns	0.64%
	Air Quality - Ozone 1 Hour Average	+	16.99%
	Race/Ethnicity: White (as a Percent of the Population)	ns	5.35%
	Race/Ethnicity: Black (as a Percent of the Population)	+	38.75%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	0.00%
	Race/Ethnicity: API (as a Percent of the Population)	ns	1.63%
	Race/Ethnicity: Other (as a Percent of the Population)	-	20.45%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	5.35%
PQI 6 – Pediatric Gastroenteritis Admissions	HMO Penetration	ns	6.86%
	Percent of People Below the Poverty Line in the Past 12 Months	+	24.91%
	Percent of Population that is Foreign-Born	ns	1.78%
	Source of Insurance: Uninsured (as a Percent of the Population)	ns	2.78%
	Hospital Bed Supply (Rate/100,000)	+	40.32%
	Race/Ethnicity: White (as a Percent of the Population)	ns	0.25%
	Race/Ethnicity: Black (as a Percent of the Population)	+	12.06%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	2.32%
	Race/Ethnicity: API (as a Percent of the Population)	ns	0.37%
	Race/Ethnicity: Other (as a Percent of the Population)	ns	10.38%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	0.25%
PQI 8 – Adult Admissions for Congestive Heart Failure	Percent of Adult Population at Risk for Heart Disease***	+	41.70%
	Cardiac Deaths (Rate/100,000)	+	76.95%
	Percent Reporting Cigarette Use in the Past Month	+	27.46%
	Percent Reporting Past Month 'Binge' Alcohol Use	ns	2.92%
	Percent of Population 65 Years and Over	ns	8.62%
	HMO Penetration	ns	0.51%

AHRQ Prevention Quality Indicators (PQIs)	Characteristics of State Populations	Conclusions About Associations	Percent of State Variation Explained (R-square)
PQI 8 – cont'd	Percent of People Below the Poverty Line in the Past 12 Months	+	18.67%
	Percent of Population that is Foreign-Born	ns	2.57%
	Physician Specialist (Rate/100,000)	ns	0.99%
	Medicare Hospital Payment per Beneficiary	+	47.98%
	Race/Ethnicity: White (as a Percent of the Population)	ns	0.33%
	Race/Ethnicity: Black (as a Percent of the Population)	+	34.20%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	3.43%
	Race/Ethnicity: API (as a Percent of the Population)	ns	4.07%
	Race/Ethnicity: Other (as a Percent of the Population)	-	25.83%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	0.33%
PQI 14 – Adult Admissions for Uncontrolled Diabetes Without Complications	Prevalence of Obesity in Adults	+	35.10%
	Adult Diabetes Prevalence (Diagnosed)	+	12.38%
	Percent of Population 65 Years and Over	ns	4.62%
	Source of Insurance: Uninsured (as a Percent of the Population)	ns	9.16%
	Percent of People Below the Poverty Line in the Past 12 Months	+	27.49%
	Hospital Bed Supply (Rate/100,000)	+	25.47%
	Race/Ethnicity: White (as a Percent of the Population)	ns	3.29%
	Race/Ethnicity: Black (as a Percent of the Population)	+	35.54%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	0.01%
	Race/Ethnicity: API (as a Percent of the Population)	ns	3.94%
	Race/Ethnicity: Other (as a Percent of the Population)	-	14.55%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	3.29%
PQI 15 – Adult Asthma Admissions	Adult Asthma Prevalence	ns	0.02%
	Emphysema Prevalence	ns	0.25%
	Chronic Bronchitis Prevalence	-	12.23%
	Percent Reporting Cigarette Use in the Past Month	+	12.29%
	HMO Penetration	ns	1.28%
	Percent of People Below the Poverty Line in the Past 12 Months	ns	6.86%
	Percent Without Telephone Access	+	15.69%
	Source of Insurance: Uninsured (as a Percent of the Population)	ns	0.05%
	Hospital Bed Supply (Rate/100,000)	ns	9.98%
	Percent of Population 65 Years and Over	+	11.24%
	Air Quality - Particulate Annual Mean	ns	2.31%
	Air Quality - Particulate 24 Hour Average	ns	1.64%
	Air Quality - Ozone 1 Hour Average	ns	8.06%
	Race/Ethnicity: White (as a Percent of the Population)	ns	6.46%

AHRQ Prevention Quality Indicators (PQIs)	Characteristics of State Populations	Conclusions About Associations	Percent of State Variation Explained (R-square)
PQI 15 – cont'd	Race/Ethnicity: Black (as a Percent of the Population)	+	27.39%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	0.60%
	Race/Ethnicity: API (as a Percent of the Population)	ns	0.19%
	Race/Ethnicity: Other (as a Percent of the Population)	-	19.90%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	6.46%
PQI 15-65 – Adult Asthma Admissions, Age 65+	Adult Asthma Prevalence	ns	4.23%
	Emphysema Prevalence	ns	3.02%
	Chronic Bronchitis Prevalence	ns	10.90%
	Percent Reporting Cigarette Use in the Past Month	ns	0.60%
	HMO Penetration	ns	0.05%
	Percent of People Below the Poverty Line in the Past 12 Months	ns	10.92%
	Percent Without Telephone Access	+	11.62%
	Source of Insurance: Uninsured (as a Percent of the Pop.)	ns	3.71%
	Hospital Bed Supply (Rate/100,000)	ns	3.69%
	Percent of Population 65 Years and Over	ns	0.37%
	Air Quality - Particulate Annual Mean	ns	0.39%
	Air Quality - Particulate 24 Hour Average	ns	0.01%
	Air Quality - Ozone 1 Hour Average	ns	2.73%
	Race/Ethnicity: White (as a Percent of the Population)	-	28.23%
	Race/Ethnicity: Black (as a Percent of the Population)	+	21.23%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	0.79%
	Race/Ethnicity: API (as a Percent of the Population)	+	12.93%
	Race/Ethnicity: Other (as a Percent of the Population)	-	14.27%
	Race/Ethnicity: Minority (as a Percent of the Population)	+	28.23%
PQI 16 - Diabetes-Related Lower Extremity Amputations	PQI 14: Adult Admissions for Uncontrolled Diabetes Without Complications	+	30.61%
	PQI 1: Adult Admissions for Short-term Diabetes Complications	+	42.17%
	PQI 3: Adult Admissions for Long-term Diabetes Complications	+	60.26%
	Percent of Adult Population at Risk for Heart Disease***	+	13.16%
	Cardiac Deaths (Rate/100,000)	+	33.45%
	Prevalence of Obesity in Adults	+	15.71%
	Adult Diabetes Prevalence (Diagnosed)	+	25.88%
	Percent of Population 65 Years and Over	ns	0.00%
	Source of Insurance: Uninsured (as a Percent of the Pop.)	ns	3.60%
	Percent of People Below the Poverty Line in the Past 12 Months	ns	8.30%

AHRQ Prevention Quality Indicators (PQIs)	Characteristics of State Populations	Conclusions About Associations	Percent of State Variation Explained (R-square)
	Hospital Bed Supply (Rate/100,000)	ns	0.61%
	HMO Penetration	ns	0.93%
PQI 16 – cont'd	Race/Ethnicity: White (as a Percent of the Population)	-	14.17%
	Race/Ethnicity: Black (as a Percent of the Population)	+	48.27%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	ns	0.54%
	Race/Ethnicity: API (as a Percent of the Population)	ns	0.62%
	Race/Ethnicity: Other (as a Percent of the Population)	-	19.00%
	Race/Ethnicity: Minority (as a Percent of the Population)	+	14.17%
(Added) - Immunization-Preventable Influenza Admissions Among Elderly	Percent of Adult Population at Risk for Heart Disease***	+	20.95%
	Cardiac Deaths (Rate/100,000)	ns	5.26%
	Emphysema Prevalence	ns	0.99%
	Chronic Bronchitis Prevalence	ns	0.89%
	Percent Reporting Cigarette Use in the Past Month	ns	6.70%
	Percent Reporting Past Month 'Binge' Alcohol Use	ns	9.58%
	Source of Insurance: Uninsured (as a Percent of the Population)	ns	1.90%
	HMO Penetration	-	17.28%
	Percent of People Below the Poverty Line in the Past 12 Months	ns	11.02%
	Race/Ethnicity: White (as a Percent of the Population)	ns	5.74%
	Race/Ethnicity: Black (as a Percent of the Population)	ns	2.27%
	Race/Ethnicity: Hispanic (as a Percent of the Population)	-	14.01%
	Race/Ethnicity: API (as a Percent of the Population)	ns	0.81%
	Race/Ethnicity: Other (as a Percent of the Population)	ns	2.90%
	Race/Ethnicity: Minority (as a Percent of the Population)	ns	5.74%

Appendix D

PATIENT SAFETY IN HOSPITALS IN 2004: TOWARD UNDERSTANDING VARIATION ACROSS STATES

By Susan Raetzman, MSPH, Elizabeth Stranges, MS, Rosanna Coffey, PhD, Marguerite Barrett, MS, Roxanne Andrews, PhD, Ernest Moy, MPH, Jeff Brady, MPH

EXECUTIVE SUMMARY

Background

The emergence of patient safety as a contemporary health issue has resulted in the development and use of measures, such as AHRQ's Patient Safety Indicators (PSI), to track progress over time in improving patient safety. National PSI rates have been made available annually in the *National Healthcare Quality Report (NHQR),* and state-level PSIs will be released in the 2007 edition of the *NHQR State Snapshots* available on the Web in early 2008. The purpose of this analysis is to explore the extent to which differences across states in PSI scores can be explained and to describe what might account for those differences. The results are intended to help HCUP Partners and AHRQ respond to inquiries about state-level PSI rate variation, which can be substantial.

Study Approach

The analysis was performed on the nine State Snapshot PSIs which will be released in the 2007 edition of the *NHQR State Snapshots;* the state PSI rates were obtained by applying AHRQ Quality Indicator software to the HCUP State Inpatient Databases (SID) dataset.[3] The PSIs for up to 37 states were compared against 58 state-level factors that can be broadly categorized as (a) state policies that are generally intended to affect the quality of health care delivered in the state; (b) hospital characteristics; (c) coding practices; and (d) other characteristics such as population and health system characteristics. To the extent possible, we included factors in the external environment and factors inside hospitals that were conceptually related to medical error, quality improvement, or specific patient safety events. Separate correlations of each PSI and each state-specific factor were conducted (i.e., for each PSI, the analyses statistically examined the relationship between the state rates and a particular state-specific factor).

Findings

Overall, we found that only about one in five correlations between the State Snapshot PSIs and potential explanatory factors were statistically significant. The number of statistically significant associations for the nine individual PSIs range widely from 0 to 21 out of a possible 60 associations, including dummy variables (Table 1). In addition, the nature of the significant PSI/factor associations is mixed in that some have plausible explanations and others do not. In the latter case, these may be artifacts of other phenomenon or the result of chance statistical significance, given that nearly 550 correlation analyses were performed (i.e., 9 PSIs times 60 independent variables).

Although there is no pattern to which associations are statistically significant or their direction at the individual PSI or factor level, a somewhat different picture is revealed when factors are aggregated. Among factor categories, the most consistent analysis results are those pertaining to the role of coding in explaining variation in state-level PSIs. Taken together, the coding

[3] For further detail, see *Methods Applying AHRQ Quality Indicators to Healthcare Cost and Utilization Project (HCUP) Data for the Fifth (2007) National Healthcare Quality Report, HCUP Methods Series Report #2007-06*.

factors accounted for one-third (33 percent) of statistically significant associations between State Snapshot PSIs and explanatory factors. The findings for this category are strengthened by the fact that associations were consistently positive in direction (i.e., increases in factor values were associated with higher PSI rates). The average number of diagnosis fields filled for discharges in 2004 yielded the largest number of statistically significant associations, suggesting that higher PSI rates sometimes may reflect greater attention to coding, not just worse health outcomes.

Discussion

The analysis of State Snapshot PSIs identified few state-level factors that showed a consistent pattern of association with the nine state-level PSI rates. We suspect that many of the factors that should influence patient safety indicators are too new in development or too remote from where safety problems occur to find strong associations in this state-level analysis. For example, state programs that proactively disseminated information to the public or providers were relatively new in the early 2000s. Also, medical errors and their prevention occur at the provider, not the state, level. With this simple and aggregated analysis, we are not surprised to find few conclusive results.

As expected, the strongest result was coding practices. In a similar analysis of state-level PSIs and Prevention Quality Indicators (PQIs) conducted in 2003 using 2000 data, one type of coding practice (use of E codes) had a strong, consistent relationship with PSIs. In the current analysis, the average number of diagnosis fields used was an important factor; more fields were associated with higher PSI rates. This suggests that states that are leading the way to safer medical practice should expand the number of diagnosis codes reported and collected. This would make room for reporting of medical errors for complex clinical patients who already have numerous conditions coded on their discharge records. More and better reporting about patient safety events is essential to learn about and make improvements in the quality of care.

One reassuring result is the lack of consistent statistical relations between patient and hospital characteristics and safety measures. This supports our earlier finings and the conventional wisdom that errors are unintentional, random events that can affect any patient and that all hospitals need to improve safety.