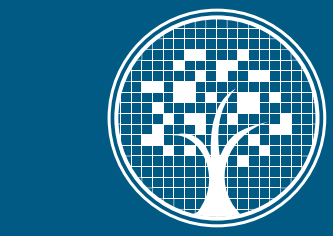

HCUP Methods Series

Methods Applying AHRQ Quality Indicators to Healthcare Cost and Utilization Project (HCUP) Data for the 2017 National Healthcare Quality and Disparities Report (QDR).

Report # 2018-01

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INTRODUCTION

The Agency for Healthcare Research and Quality (AHRQ) Quality Indicators (QIs) were applied to the Healthcare Cost and Utilization Project (HCUP) hospital discharge data for selected measures in the National Healthcare Quality and Disparities Report (QDR).[1] The report measures and tracks trends in quality and disparities in terms of patient safety, person-centered care, care coordination, effective treatment, healthy living, and care affordability — and access to health care. A focus on priority populations summarizes quality and disparities in care for populations at elevated risk for receiving poor health care, which includes HCUP-based measures related to racial, ethnic, and socioeconomic factors for priority populations, including changes over time and across the urban-rural continuum. The QDR provides a comprehensive overview of the quality of health care received by the general population and disparities in care experienced by different racial, ethnic, and socioeconomic groups. Electronic dissemination of the report was expanded and information on individual measures will be available online through a series of chartbooks.[2]

This report describes the preparation of the HCUP databases for data years 2000–2015 for use in the 2017 QDR, the steps taken to apply the AHRQ QIs to the HCUP data, and other analyses based on HCUP data that are not specific to the QIs, but are developed for use in the 2017 QDR.

AHRQ QUALITY INDICATORS

The AHRQ QIs are measures of quality associated with processes of care that occur 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 QDR (Version 4.4 based on ICD-9-CM[3] codes) 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, 2012).
- 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, 2012).
- Patient Safety Indicators (PSIs) reflect quality of care inside hospitals, by focusing on surgical complications and other iatrogenic events (AHRQ, 2012).
- Pediatric Quality Indicators (PDIs) reflect quality of care inside hospitals and identify potentially avoidable hospitalizations among children (AHRQ, 2012).

The AHRQ QI measures generated for possible inclusion in the QDR are described in Table 1 at the end of this methods report. Not all of these QIs were used in the reports. The 2017 QDR includes QI trends through data year 2015. Because of the transition from ICD-9-CM to ICD-10-

[1] Beginning with the 2014 report, findings that previously appeared in two separate reports (the *National Healthcare Quality Report* and the *National Healthcare Disparities Report*) have been integrated into a single document — the National Healthcare Quality and Disparities Report (QDR).
[2] The National Healthcare Quality & Disparities Reports and Chartbooks are available at http://www.ahrq.gov/research/findings/nhqrdr/index.html.
[3] ICD-9-CM: International Classification of Diseases, Ninth Revision, Clinical Modification.

CM/PCS[4] on October 1, 2015, only the first nine months of the 2015 HCUP data were used for the 2015 QI estimates. The following national and State-level QI estimates were constructed from the HCUP databases for the QDR:

- National inpatient trends by QI, overall and by subpopulations including community income, expected primary payer, and race/ethnicity
- State-level inpatient trends by QI, overall and by subpopulations including community income, expected primary payer, and race/ethnicity, for HCUP Partner organizations that agreed to participate in the QDR
- National trends for selected PQIs and PDIs in the emergency department setting.

PREPARATION OF HCUP DATABASES

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 are derived from administrative data and contain encounter-level, clinical and nonclinical information including all-listed diagnoses and procedures, discharge status, patient demographics, and charges for all patients, regardless of payer (e.g., Medicare, Medicaid, private insurance, uninsured), 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, patient safety, access to health care programs, and outcomes of treatments at the national, State and local market levels.

The following HCUP databases were used as the source of data for the QDR:

- The HCUP Nationwide Inpatient Sample (NIS), a nationally stratified sample of hospitals (with all of their discharges) from States that contribute data to HCUP for trends in data years 2000–2011. A similarly constructed nationally stratified sample of hospitals from HCUP States for trends in data years 2012–2015[5]
- The HCUP State Inpatient Databases (SID), a census of hospitals (with all of their discharges) from participating States in data years 2004 and 2011–2015
- The HCUP Nationwide Emergency Department Sample (NEDS), a nationally stratified sample of hospital-based emergency departments (with information for both treat-and-release visits and those resulting in a hospital admission) data years 2008–2015.

The list of HCUP Partner organizations that contribute to the HCUP databases is provided in Table 2 at the end of this methods report. The HCUP databases used for each year's national inpatient estimates are described in Table 3.

HCUP Data on Race/Ethnicity

HCUP coding includes race and ethnicity in one data element (RACE). Because of variability in the collection of race and ethnicity information in the State data, HCUP maintains a uniform set of categories based on race definitions used in the 1977 Office of Management and Budget

[4] ICD-10-CM/PCS: International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System.

[5] In data year 2012, the HCUP NIS changed its design and became a nationally stratified sample of discharges. The definition of the discharge universe was also revised to exclude long-term acute care hospitals. Because of the differences in design, the trend analyses for the QDR did not use the 2012–2015 NIS.

(OMB) Directive 15 using the combined race-ethnicity format (separate categories for Hispanic and five Non-Hispanic racial groups – White, Black, Asian or Pacific Islander, American Indian or Alaska Native (AIAN), and Other).

When a State and its hospitals collect Hispanic ethnicity *separately* from race, HCUP assigns the data to the combined race/ethnicity categorization and uses Hispanic ethnicity to override any other race category to create uniform coding across States.

There is also limited reporting of AIAN in the HCUP data. In addition, in some areas of the country care for the AIAN population is provided in Indian Health Service (IHS) hospitals, which are not included in HCUP. For these reasons, AIAN discharges were combined with "Other" races for the QDR analyses.

The resulting QDR reporting categories for the HCUP data include: White Non-Hispanic; African American Non-Hispanic; Asian/Pacific Islander Non-Hispanic; Other Non-Hispanic; and Hispanic (of any race).

Modifications to the HCUP Databases

In preparation for the QDR and its derivative products, the HCUP databases needed to be customized as indicated below:

1. The HCUP SID were modified to create analytic files consistent across States.
    - *Subset to Community Hospitals*. For the SID, we selected community hospitals[6] and 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 (AHA) 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.
2. The HCUP databases were augmented as necessary for the QDR analyses:
    - *Impute for Missing Characteristics*. For missing age, sex, race/ethnicity, ZIP Code, and expected primary 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.

[6] *Community* hospitals are defined by the AHA as " all nonfederal short-term general and special hospitals, including special childrens' hospitals, whose facilities and services are available to the public." The specialty hospitals included in the AHA definition of "community hospitals" are: obstetrics-gynecology, ear-nose-throat, short-term rehabilitation, orthopedic, and pediatric institutions. The AHA also groups public hospitals and academic medical centers with community hospitals. Starting in 2005, the AHA included long term acute care facilities in the definition of community hospitals, therefore such facilities are included in the NIS sampling frame. These facilities provide acute care services to patients who need long term hospitalization (stays of more than 25 days). Excluded from the AHA definition of "community hospitals" are long-term non-acute care hospitals, psychiatric hospitals, and alcoholism/chemical dependency treatment facilities. For the QDR analyses, we selected all AHA-defined "community hospitals" with the exception of short-term rehabilitation hospitals.

- *Assign Additional Measures for Reporting*. We assigned median household income quartile by linking Claritas ZIP Code demographic data to patient's ZIP Code in the SID. Income quartiles were defined annually based on the distribution of the population in the United States.

3. The HCUP SID were used to create QDR analysis files designed to provide national estimates for overall and priority population reporting (for all groups including race/ethnicity). Appendix A to this report provides detail on the creation of the QDR analysis files for national estimates. The SID included in each of the QDR analysis files are listed in Table 3.

4. The HCUP SID were also used for reporting overall and by priority populations within State (including community income quartile, expected primary payer, and race/ethnicity). State-level QI estimates are only reported for participating HCUP Partners that agree to release information in the QDR. Reporting by race/ethnicity was limited to SID that included this type of information. Appendix B to this report provides additional detail on the preparation of the SID for reporting by race/ethnicity.

5. The NEDS were used to calculate PQIs and PDIs in the emergency department setting. A description of the data preparation and methods used for national QI estimates from the NEDS is included in Appendix C.

STEPS TAKEN TO APPLY AHRQ QUALITY INDICATORS TO THE HCUP DATA

To apply the AHRQ Quality Indicators to HCUP hospital discharge data for the QDR, several steps were taken: (1) QI software review and modification, (2) acquisition of population-based data, (3) assignment of QIs to the HCUP databases, and (4) identification of statistical methods.

Review and Modify the AHRQ QI Software. For the 2017 QDR, we started with the following QI software versions that use ICD-9-CM codes: PQI Version 4.4, IQI Version 4.4, PSI Version 4.4, and PDI Version 4.4. Because each of these software modules was developed for State and hospital-level rates, rather than national rates, the additional step of weighting the QI estimates was necessary. A sensitivity analysis was performed using 2014 SID data to determine the best approach to developing 2015 estimates based solely on ICD-9-CM data (Barrett, 2017). Because the QI estimates developed using partial year data from January 1 through September 30, 2014 were relatively similar to the full 2014 calendar year estimates, the QDR estimates produced with 2015 data were also based on partial year data (i.e. January 1 through September 30, 2015).

In addition, we did not utilize the present on admission (POA) estimation module for the IQIs, PDIs, and PSIs since POA indicators were not uniformly available from States that contribute to the HCUP databases. Other QI-specific modifications are noted as footnotes in the tables.

We added three indicators particularly relevant to the structure of the QDR. One indicator was created for discharges age 65 years and older: immunization-preventable influenza, age 65 and over. Two additional indicators were created to facilitate longitudinal analyses by modifying the chronic and overall PQI composite measures to exclude PQI 05 for chronic obstructive pulmonary disease (COPD) and asthma for patients aged 40 years and older. Because of ICD-9-CM coding changes for COPD for data prior to 2005 rates are not compatible with rates for 2005 forward.

Acquire Population-Based Data for Denominators and Risk-Adjustment. The next step was to acquire data for the numerator and denominator populations for the QIs. The AHRQ QIs measure an event that occurs in a hospital, requiring a numerator count of the event of interest and a denominator count of the population (within a hospital or geographic area) to which the event relates.

For the numerator counts of the AHRQ QIs, we used the HCUP databases. For the denominator counts, we identified two sources for all reporting categories and for all adjustment categories listed in the HCUP-based tables.

- For QIs that related to *providers,* the HCUP data were used for national and State-level discharge denominator counts.
    - For data year 2015, numerator and denominator counts for QI rates were based on HCUP data from January 1 through September 30, 2015.
- For QIs that related to *geographic areas,* population ZIP-Code-level counts from demographic update data provided by Claritas (a vendor that compiles and adds value to the U.S. Bureau of Census data) were used for denominator counts. Claritas uses intra-census methods to estimate household and demographic statistics for geographic areas (Claritas). We also used the Claritas population data for risk adjustment by age and sex for the area-based QIs.
    - For data year 2015, numerator counts for QI rates were based on HCUP data from January 1 through September 30, 2015. Population denominators were multiplied by 0.75 to adjust for the nine-month numerator counts.

Assign QI Indicators to the HCUP Databases. 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 2000–2011 NIS.

Adapt Statistical Methods to HCUP Data. Several statistical issues needed to be addressed when applying the AHRQ QI software to the HCUP data, including: age-sex 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-Sex Risk Adjustment.* For the *PQIs* and area-based *IQIs*, *PSIs*, and *PDIs*, the observed rates were risk-adjusted for age and sex 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 4, 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 denominators for priority populations required in the QDR.
- *Age, Sex, Severity, and Comorbidity Risk Adjustment*. For the discharge-based *PSI*s, the observed rates were risk-adjusted for age, sex, age-sex interaction, diagnosis related groups (DRG) cluster, and comorbidities using the regression-based standardization that is part of the AHRQ PSI software, with the following exceptions:
    - When reporting by age, the risk adjustment includes all of the above except age.
    - When reporting by sex, the risk adjustment includes all of the above except sex.

    For the discharge-based *IQIs*, risk adjustments were made for age, sex, age-sex interaction, and the 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, with the following exceptions:

  - When reporting by age, the risk adjustment includes all of the above except age.
  - When reporting by sex, the risk adjustment includes all of the above except sex.

  For the discharge-based *PDIs*, risk adjustments were made for age, sex, DRG and major diagnostic category (MDC) clusters, and comorbidities 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, with the following exceptions:

  - When reporting by age, the risk adjustment includes all of the above except age.
  - When reporting by sex, the risk adjustment includes all of the above except sex.

- *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. Appropriate statistics for a stratified sample were obtained through the Statistical Analysis System (SAS) procedure called PROC SURVEYMEANS.
- *Masking Rates for Statistical Reliability, Data Quality, and Confidentiality*. QI estimates were included in the QDR if they reached a threshold defined by a relative standard error less than 30 percent and at least 11 unweighted cases in the denominator. Estimates that did not satisfy these criteria were masked (set to DSU, for "data statistically unreliable"). Statistical calculations are explained in Appendix D to this report.

Some caution should be used in interpreting the HCUP-based AHRQ QI statistics presented in the QDR. Limitations that relate to how the QIs were applied, ICD-9-CM coding changes over time, inter-State differences in data collection, and other issues and explained in detail in Appendix E to this report.

SPECIAL ANALYSES

Trends in National Inpatient Hospital Costs Associated with Quality Indicators

The QDR includes trends in total national costs for the select PQIs and PDIs including the composites and ambulatory care sensitive conditions such as heart failure, diabetes, and asthma. Total national costs associated with these PQIs and PDIs were calculated overall and by community income quartile and race/ethnicity.

Total charges were converted to costs using the hospital-level HCUP Cost-to-Charge Ratio Files (CCR Files) based on Hospital Cost Report data from the Centers for Medicare & Medicaid Services (CMS).[7] Costs 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 do not include professional (physician) fees. The total cost is the product of the number of stays for each QI measure and the mean cost for each QI measure. This approach compensates for stays for which charges (and thus estimated costs) are not available. Costs were adjusted to 2015 dollars for all years using the price indices for the gross

[7] HCUP Cost-to-Charge Ratio Files. Healthcare Cost and Utilization Project (HCUP). November 2017. Agency for Healthcare Research and Quality, Rockville, MD. Available: www.hcup-us.ahrq.gov/db/state/costtocharge.jsp.

domestic product (downloaded from the Bureau of Economic Analysis, U.S. Department of Commerce).

Trends in IQI and PSI Summary Measures

To examine national and State-level trends in inpatient mortality and patient safety events, risk-adjusted rates for select IQIs and PSIs were summarized. The three QDR summary measures include: (1) Mortality for *selected conditions* based on select IQIs; (2) Mortality for *selected procedures* based on select IQIs; and (3) Patient Safety based on select PSIs. These summary measures were calculated as a weighted sum of risk-adjusted rates for individual IQIs and PSIs. Additional information on the calculation of IQI and PSI Summary Measures is provided in Appendix F.

Benchmarks for State Performance for the Quality Indicators

Based on a recommendation from the Institute of Medicine's report on *Future Directions for the National Healthcare Quality and Disparities Reports*, benchmarks based on a straight average of the top 10 percent of reporting States were determined. For a benchmark to be calculated, rates for at least 30 States needed to be available.

Medicaid and Uninsured Inpatient Stays and Aggregate Hospital Costs in the United States

Information on Medicaid and uninsured inpatient stays and aggregate hospital costs in the United States for 2012–2015 were developed using the HCUP NIS. Medicaid and uninsured discharges were identified based on the expected primary payer of Medicaid, self-pay, no charge, and charity. Discharge counts and aggregate hospital costs were reported as a percentage of the total U.S and by hospital characteristics including region, ownership, teaching status, urban-rural location, and size of the hospital based on the number of beds.

National Estimates of Emergency Department Utilization

Beginning in the 2009 NHQR, the HCUP Nationwide Emergency Department Sample (NEDS) was used to examine national and regional differences in emergency department (ED) use for selected PQIs and PDIs associated with ambulatory care sensitive conditions. Age-sex adjusted rates are calculated from 2008 forward for all ED visits and those that do and do not result in an inpatient admission. Details on the use of the NEDS for reporting by QI are provided in Appendix C.

There were three additional condition-specific analyses based on the NEDS:

- Starting with data year 2007, the NEDS was used to examine national trends in ED visits for mental illness and substance use disorders. ED visits were identified by the CCS category for the first-listed diagnosis. CCS 650–659, 662, and 670 were used to define mental illness disorders. CCS 660–661 defined substance use disorders. No distinction was made between ED visits that resulted in a hospital admission and those that did not. Claritas population data was used to calculate rates per 100,000 residents by age, sex, community income, urban-rural location of patient residence, and region of the United States. Rates were not risk-adjusted.

- Starting with data year 2010, the NEDS was used to examine national trends in ED visits for dental conditions. ED visits were identified by an ICD-9-CM principal diagnosis of 520.00–523.9. No distinction was made between ED visits that resulted in a hospital admission and those that did not. Claritas population data was used to calculate rates per 100,000 residents by age, sex, community income, and urban-rural location of patient residence. Rates were not risk-adjusted.
- Starting with data year 2011, the NEDS was used to examine national trends in ED visits for severe injuries. Severity of injuries was determined using the ICD Programs for Injury Categorization (ICDPIC).[8] The ICDPIC translates ICD-9-CM diagnosis codes into several standard injury categories and/or scores, including Injury Severity Scores (ISS). The ISS are an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned Abbreviated Injury Scale (AIS) scores that are allocated to six body regions: Head, Face, Chest, Abdomen, Extremities (including pelvis), and External. AIS scores are: 1 (minor), 2 (moderate), 3 (serious), 4 (severe), 5 (critical), and 6 (not survivable). The highest AIS score in each body region is recorded. Scores from the three most severely injured body regions are squared and summed to produce the ISS. The ISS correlates linearly with mortality, morbidity, hospital stay, and other measures of severity. Some severely-injured patients are stabilized in the ED; others require hospitalization for further care. A high ISS score does not necessarily indicate the need for admission. Injuries with an ISS of 16 or greater were considered severe. An ISS of 16 or greater was assigned when at least one injury had an AIS score of 4 (severe) or at least two injuries had an AIS score of 3 (serious). ED utilization for severe injuries was reported by trauma level (trauma level I and II combined, trauma level III, and non-trauma) and by age, sex, community income, urban-rural location of patient residence, and region of the United States.

Because these three ED measures are dependent on ICD-9-CM coding, only data from January–September 2015 of the NEDS were used to calculate the numerators of the population-based rates. In addition, the population denominators were multiplied by 0.75 to adjust for the nine-month numerator counts.

[8] The ICDPIC does not calculate a severity score for late effects of injuries (ICD-9-CM diagnoses 905–909), effects of foreign body (930-939), burns (940–949), certain early complications of trauma (958), or poisoning by drugs, toxins, and other effects (960–995).

TABLES

Table 1. AHRQ Quality Indicators Applied to the HCUP Data for the National Healthcare Quality and Disparities Report (QDR)

This table includes the list of all version 4.4 AHRQ Quality Indicators (QIs) calculated using HCUP data. Not all of the AHRQ QIs listed below were included in the 2017 QDR.

QI No.	Description	Footnote
Prevention Quality Indicators[9]		
PQI 1	Admissions with diabetes with short-term complications[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, diabetes must be the principal diagnosis and short-term complications include ketoacidosis, hyperosmolarity, or coma. Transfers from other institutions are excluded.
PQI 2	Admissions with perforations or abscesses of appendix per 1,000 admissions with appendicitis[a], age 18 and over	[a] Consistent with the AHRQ PQI software, obstetric discharges and transfers from other institutions are excluded.
PQI 3	Admissions with diabetes with long-term complications[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, diabetes must be the principal diagnosis and long-term complications include renal, eye, neurological, circulatory, or other unspecified complications. Transfers from other institutions are excluded.
PQI 5	Admissions with chronic obstructive pulmonary disease (COPD)[a] or asthma per 100,000 population, age 40 and over	[a] Consistent with the AHRQ PQI software, the principal diagnosis must be COPD, asthma, or acute bronchitis with COPD as a secondary diagnosis. Transfers from other institutions are excluded.
PQI 7	Admissions with hypertension[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, hypertension must be the principal diagnosis and exclusions include the following: admissions with kidney disease with dialysis access procedures, admissions with cardiac procedures, and transfers from other institutions.
PQI 8	Admissions for heart failure (HF)[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, HF must be the principal diagnosis and exclusions include the following: admissions with cardiac procedures and transfers from other institutions.
PQI 9	Low birth weight infants per 1,000 newborns[a]	[a] Consistent with the AHRQ PQI software, exclusions include transfers from other institutions.
PQI 10	Admissions for dehydration[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, dehydration may be a principal diagnosis or a secondary diagnosis with a principal diagnosis of hyperosmolality and/or hypernatremia, gastroenteritis, or acute kidney injury. Exclusions include the following: admissions with a diagnosis code for chronic renal failure and transfers from other institutions.
PQI 11	Admissions for bacterial pneumonia[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, bacterial pneumonia must be the principal diagnosis and exclusions include the following: admissions for sickle cell disease or HB-S disease, admissions in an immunocompromised state, and transfers from other institutions.
PQI 12	Admissions for urinary tract infection (UTI)[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, UTI must be the principal diagnosis and exclusions include the following: admissions with kidney or urinary tract disorders, admissions in an immunocompromised state, and transfers from other institutions.
PQI 13	Admissions for angina without cardiac procedure[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, angina must be the principal diagnosis, and exclusions include admissions with cardiac procedures and transfers from other institutions.

[9] Indicators PQI 4 and PQI 6 are not assigned by the PQI software, version 4.4.

QI No.	Description	Footnote
PQI 14	Admissions for uncontrolled diabetes without complications[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, diabetes without complications must be the principal diagnosis and exclusions include transfers from other institutions.
PQI 15	Admissions for asthma[a] per 100,000 population, age 18 to 39	[a] Consistent with the AHRQ PQI software, asthma must be the principal diagnosis on admissions ages 18 to 39 years old, and the following cases are excluded: admissions with cystic fibrosis or anomalies of the respiratory system and transfers from other institutions.
PQI 16	Lower extremity amputations among admissions for diabetes[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PQI software, a procedure code for lower-extremity amputation and a diagnosis of diabetes must be present. Exclusions include admissions for toe amputation or traumatic amputations of the lower extremity, obstetric discharges, and transfers from other institutions.
PQI 17 (Added)	Admissions for immunization-preventable pneumococcal pneumonia[a] per 100,000 population, age 65 and over	[a] Immunization-preventable pneumococcal pneumonia may be reported as either the principal diagnosis or a secondary diagnosis. Exclusions include transfers from other institutions.
PQI 18 (Added)	Admissions for immunization-preventable influenza[a] per 100,000 population, age 65 and over	[a] Immunization-preventable influenza may be reported as either the principal diagnosis or a secondary diagnosis. Exclusions include transfers from other institutions.
PQI 90	AHRQ overall Prevention Quality Indicator (PQI) composite[a] per 100,000 population, age 18 and over	[a] Based on the twelve AHRQ PQIs for angina, asthma, bacterial pneumonia, chronic obstructive pulmonary disease, congestive heart failure, dehydration, diabetes, hypertension, and urinary tract infection.
PQI 90x (Added)	AHRQ modified[a] overall Prevention Quality Indicator (PQI) composite per 100,000 population, age 18 and over	[a] Based on the eleven AHRQ PQIs for angina, asthma, bacterial pneumonia, congestive heart failure, dehydration, diabetes, hypertension, and urinary tract infection. For consistency of longitudinal reporting, the modified overall composite does not include AHRQ PQI 5 for chronic obstructive pulmonary disease because it is affected by ICD-9-CM coding changes.
PQI 91	AHRQ acute Prevention Quality Indicator (PQI) composite[a] per 100,000 population, age 18 and over	[a] Based on the three AHRQ PQIs for bacterial pneumonia, dehydration, and urinary tract infection.
PQI 92	AHRQ chronic Prevention Quality Indicator (PQI) composite[a] per 100,000 population, age 18 and over	[a] Based on the nine AHRQ PQIs for angina, asthma, chronic obstructive pulmonary disease, congestive heart failure, diabetes, and hypertension.
PQI 92x (Added)	AHRQ modified[a] chronic Prevention Quality Indicator (PQI) composite per 100,000 population, age 18 and over	[a] Based on the eight AHRQ PQIs for angina, asthma, congestive heart failure, diabetes, and hypertension. For consistency of longitudinal reporting, the modified overall composite does not include AHRQ PQI 5 for chronic obstructive pulmonary disease because it is affected by ICD-9-CM coding changes.
Pediatric Quality Indicators[10]		
PDI 01	Admissions with accidental puncture or laceration during procedure per 1,000 medical and surgical admissions,[a] age less than 18 years	[a] The AHRQ PDI software requires that the accidental puncture or laceration be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PDI software, the following cases are excluded: obstetric admissions, admissions involving spinal surgery, normal newborns, and neonates with a birth weight less than 500 grams.

[10] Indicator PDI 4 is not assigned by the PDI software, version 4.4. Incidence measures PDI 2 (pressure ulcer), PDI 3 (foreign body), and PDI 13 (transfusion reaction) are not calculated. Volume measure PDI 7 (pediatric heart surgery) is also not calculated.

QI No.	Description	Footnote
PDI 05	Admissions with iatrogenic pneumothorax per 1,000 medical and surgical admissions,[a] age less than 18 years	[a] The AHRQ PDI software requires that the iatrogenic pneumothorax be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PDI software, the following cases are excluded: obstetric admissions, normal newborns, neonates with a birth weight less than 2500 grams, and admissions with chest trauma, pleural effusion, thoracic surgery, lung/pleural biopsy, diaphragmatic surgery repair, or cardiac surgery.
PDI 06	Deaths per 1,000 heart surgery admissions,[a] age less than 18 years	[a] Consistent with the AHRQ PDI software, exclusions include obstetric admissions; admissions with transcatheter interventions as a single cardiac procedure or performed without bypass, but with catheterization; admissions with septal defects as single cardiac procedures without bypass; admissions with an atrial septal defect or ventricular septal defect repair with patent ductus arteriosus as the only cardiac procedure; heart transplants; premature infants with patent ductus arteriosus (PDA) closure as only cardiac procedure; infants age less than 30 days with PDA closure as only cardiac procedure; transfers to another hospital; and neonates with a birth weight less than 500 grams.
PDI 08	Postoperative hemorrhage or hematoma with surgical drainage or evacuation per 1,000 elective surgical admissions,[a] age less than 18 years	[a] The AHRQ PDI software requires that the hemorrhage or hematoma complicating procedure be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. In addition, the control of the hemorrhage or hematoma is not verifiable as following surgery. Consistent with the AHRQ PDI software, the following cases are excluded: obstetric conditions, neonates with a birth weight less than 500 grams, and admissions in which the control of the hemorrhage or hematoma is the only operating room procedure or occurs before the first operating room procedure.
PDI 09	Postoperative respiratory failure per 1,000 elective-surgery admissions,[a] age less than 18 years	[a] The AHRQ PDI software requires that the respiratory failure be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. In addition, the tracheostomy is not verifiable as following surgery. Consistent with the AHRQ PDI software, the following cases are excluded: admissions with respiratory disease; circulatory disease; craniofacial anomalies with laryngeal or pharyngeal surgery, or with a procedure on face and a diagnosis of craniofacial abnormalities; admissions with a procedure for esophageal resection, lung cancer, or nose, mouth, and pharynx; admissions with degenerative neurological disorders; neuromuscular disorders; neonates with a birth weight less than 500 grams; and admissions in which the tracheostomy is the only operating room procedure.
PDI 10	Postoperative sepsis per 1,000 surgery admissions of length 4 or more days,[a] age less than 18 years	[a] The AHRQ PDI software requires that the sepsis be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. In addition, the sepsis is not verifiable as following surgery. Consistent with the AHRQ PDI software, the following cases are excluded: admissions with a principal diagnosis of infection; admissions with a procedure for appendicitis, infectious or parasitic diseases, or post-operative infections; obstetric admissions; and neonates.

QI No.	Description	Footnote
PDI 11	Reclosure of postoperative abdominal wound dehiscence per 1,000 abdominopelvic-surgery admissions of length 2 or more days,[a] age less than 18 years	[a] Reclosure of abdominal wound dehiscence is not verifiable as following surgery and may have occurred on or before the abdominopelvic procedure. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric admissions; neonates with a birth weight less than 500 grams; admissions in an immunocompromised state or having a procedure code for transplant; admissions with hepatic failure consisting of cirrhosis and hepatic coma or heatorenal syndrome; and admissions with gasroschisis or umbilical hernia repair in newborns.
PDI 12	Admissions with central venous catheter-related bloodstream infection per 1,000 medical and surgical discharges of length 2 or more days,[a] age less than 18 years	[a] The AHRQ PDI software requires that the central venous catheter-related bloodstream infection be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PDI software, the following cases are excluded: normal newborns, neonates with a birth weight less than 500 grams, and obstetric admissions.
PDI 14	Admissions for asthma[a] per 100,000 population, ages 2-17	[a] Consistent with the AHRQ PDI software, asthma must be the principal diagnosis and the following cases are excluded: admissions with cystic fibrosis or anomalies of the respiratory system, transfers from other institutions, and obstetric admissions.
PDI 15	Admissions with diabetes with short-term complications[a] per 100,000 population, ages 6-17	[a] Consistent with the AHRQ PDI software, diabetes must be the principal diagnosis and short-term complications include ketoacidosis, hyperosmolarity, or coma. Transfers from other institutions and obstetric admissions are excluded.
PDI 16	Admissions for pediatric gastroenteritis[a] per 100,000 population, ages 3 months to 17 years	[a] Consistent with the AHRQ PDI software, gastroenteritis must be the principal diagnosis or a secondary diagnosis with a principal diagnosis of dehydration. Exclusions include admissions with gastrointestinal abnormalities or bacterial gastroenteritis, transfers from other institutions, neonates if age in days is missing, and obstetric admissions.
PDI 17	Admissions with perforations or abscesses of appendix per 1,000 admissions with appendicitis,[a] ages 1-17	[a] Consistent with the AHRQ PDI software, exclusions include transfers from other institutions and obstetric admissions.
PDI 18	Admissions for urinary tract infection (UTI)[a] per 100,000 population, ages 3 months to 17 years	[a] Consistent with the AHRQ PDI software, UTI must be the principal diagnosis and the following cases are excluded: kidney or urinary tract disorders, admissions in a immunocompromised state, admissions with hepatic failure consisting of any diagnosis or cirrhosis and hepatic come or hepatorenal syndrome, neonates is age in days is missing, obstetric admissions, and transfers from other institutions.
PDI 90	AHRQ overall Pediatric Quality Indicator (PDI) composite[a] per 100,000 population, ages 6-17	[a] Consistent with the AHRQ PDI software, the overall composite is based on the four PDIs for asthma, diabetes, gastroenteritis, and urinary tract infection.
PDI 91	AHRQ acute Pediatric Quality Indicator (PDI) composite[a] per 100,000 population, ages 6-17	[a] Consistent with the AHRQ PDI software, the acute composite is based on the two PDIs for gastroenteritis and urinary tract infection.
PDI 92	AHRQ chronic Pediatric Quality Indicator (PQI) composite[a] per 100,000 population, ages 6-17	[a] Consistent with the AHRQ PDI software, the chronic composite is based on the two PDIs for asthma and diabetes.

QI No.	Description	Footnote
NQI 01	Admissions with iatrogenic pneumothorax per 1,000 medical and surgical admissions,[a] neonates weighing 500 to 2500 grams	[a] The AHRQ PDI software requires that the iatrogenic pneumothorax be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PDI software, the following cases are excluded: neonates with a birth weight less than 500 grams, admissions with chest trauma, pleural effusion, thoracic surgery, lung/pleural biopsy, diaphragmatic surgery repair, or cardiac surgery, and obstetric admissions.
NQI 02	Deaths per 1,000 newborn admissions[a]	[a] Consistent with the AHRQ PDI software, newborn admissions include babies born outside the hospital and then admitted. Exclusions include newborns weighing less than 500 grams or with any diagnosis of anencephaly, polycystic kidney, trisomy 13, or trisomy 18.
NQI 03	Admissions with blood stream infection per 1,000 medical and surgical discharges of length 2 or more days, newborns[a]	[a] The AHRQ PDI software requires that the blood stream infection be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PDI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PDI software, newborn admissions include babies born outside the hospital and then admitted; infants with a birth weight of 500 to 1499 grams or with gestational age between 24 and 30 weeks; and newborns with a birth weight greater than or equal to 1500 grams, only if the infant experienced death in-hospital, major surgery, mechanical ventilation, or transferred to an acute care facility. Exclusions include newborns weighing less than 500 grams, cases with a principal diagnosis of sepsis or infection or with a length of stay less than 2 days.
Inpatient Quality Indicators[11]		
IQI 8	Deaths per 1,000 hospital admissions with esophageal resection for cancer,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions and transfers to another hospital.
IQI 9	Deaths per 1,000 hospital admissions with pancreatic resection for cancer,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions and transfers to another hospital.
IQI 11	Deaths per 1,000 hospital admissions with abdominal aortic aneurysm repair,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, excluding obstetric admissions and transfers to another hospital.
IQI 12	Deaths per 1,000 hospital admissions with coronary artery bypass graft,[a] age 40 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions and transfers to another hospital.
IQI 13	Deaths per 1,000 hospital admissions with craniotomy,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include admissions with a principal diagnosis of head trauma and transfers to another hospital.
IQI 14	Deaths per 1,000 hospital admissions with a hip replacement procedure,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include hip fractures, obstetric admissions, and transfers to another hospital.
IQI 15	Deaths per 1,000 hospital admissions with acute myocardial infarction (AMI),[a] age 18 and over	[a] Consistent with the AHRQ IQI software, AMI must be the principal diagnosis and the following cases are excluded: obstetric admissions and transfers to another hospital.
IQI 16	Deaths per 1,000 hospital admissions with congestive heart failure (CHF),[a] age 18 and over	[a] Consistent with the AHRQ IQI software, CHF must be the principal diagnosis and the following cases are excluded: obstetric admissions and transfers to another hospital.

[11] Indicator IQI 10 is not assigned by the IQI software, version 4. Volume measures IQI 1 to 7 are not calculated.

QI No.	Description	Footnote
IQI 17	Deaths per 1,000 hospital admissions with acute stroke,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, stroke must be the principal diagnosis and the following cases are excluded: obstetric admissions and transfers to another hospital.
IQI 18	Deaths per 1,000 hospital admissions with gastrointestinal hemorrhage,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, gastrointestinal hemorrhage must be the principal diagnosis and the following cases are excluded: obstetric admissions and transfers to another hospital.
IQI 19	Deaths per 1,000 hospital admissions with hip fracture,[a] age 65 and over	[a] Consistent with the AHRQ IQI software, hip fracture must be the principal diagnosis and the following cases are excluded: periprosthetic fractures, obstetric admissions, and transfers to another hospital.
IQI 20	Deaths per 1,000 hospital admissions with pneumonia,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, pneumonia must be the principal diagnosis and the following cases are excluded: obstetric admissions and transfers to another hospital.
IQI 21	Cesarean deliveries per 1,000 deliveries[a]	[a] Consistent with the AHRQ IQI software, exclusions include deliveries for preterm or multiple infants, deliveries with abnormal presentations or breech procedures, and deliveries resulting in fetal death.
IQI 22	Uncomplicated vaginal birth after cesarean (VBAC) per 1,000 women with previous cesarean deliveries[a]	[a] Consistent with the AHRQ IQI software, exclusions include deliveries for preterm or multiple infants, deliveries with abnormal presentations or breech procedures, and deliveries resulting in fetal death.
IQI 23	Laparoscopic cholecystectomies per 1,000 cholecystectomy procedures,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions.
IQI 24	Incidental appendectomies per 1,000 hospital admissions with abdominal or pelvic surgery,[a] age 65 and over	[a] Consistent with the AHRQ IQI software, exclusions include admissions for cancer involving or adjacent to the appendix, admissions with a colectomy or pelvic evisceration, and obstetric admissions.
IQI 25	Bilateral cardiac catheterizations per 1,000 heart catheterizations for coronary artery disease,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include valid indications for right-side catheterization and obstetric admissions.
IQI 26	Coronary artery bypass grafts (CABG)[a] per 100,000 population, age 40 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions.
IQI 27	Percutaneous coronary intervention[a] per 100,000 population, age 40 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions.
IQI 28	Hysterectomies[a] per 100,000 female population, age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include admissions with genital cancer, pelvic or lower-abdominal trauma, and obstetric admissions.
IQI 29	Laminectomies or spinal fusions[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions.
IQI 30	Deaths per 1,000 hospital admissions with percutaneous coronary intervention,[a] age 40 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions and transfers to another hospital.
IQI 31	Deaths per 1,000 hospital admissions with carotid endarterectomy,[a] age 18 and over	[a] Consistent with the AHRQ IQI software, exclusions include obstetric admissions and transfers to another hospital.
IQI 32	Deaths per 1,000 hospital admissions with acute myocardial infarction (AMI),[a] age 18 and over	[a] Consistent with the AHRQ IQI software, AMI must be the principal diagnosis and the following cases are excluded: obstetric admissions and transfers to and from another hospital.

QI No.	Description	Footnote
IQI 33	First-time cesarean deliveries (identified by no previous cesarean delivery diagnosis on the record) per 1,000 deliveries[a]	[a] Consistent with the AHRQ IQI software, exclusions include previous cesarean delivery, deliveries for preterm or multiple infants, deliveries with abnormal presentations or breech procedures, and deliveries resulting in fetal death.
IQI 34	All vaginal births after cesarean per 1,000 women with previous cesarean deliveries[a]	[a] Consistent with the AHRQ IQI software, there are no exclusions.
IQI 90	AHRQ Inpatient Quality Indicator (IQI) mortality composite for selected procedures,[a] age 18 and over	[a] Based on seven mortality AHRQ IQIs for esophageal resection for cancer, pancreatic resection for cancer, abdominal aortic aneurysm repair, coronary artery bypass graft (age 40 and over), craniotomy, percutaneous coronary intervention (age 40 and over), and carotid endarterectomy.
IQI 91	AHRQ Inpatient Quality Indicator (IQI) mortality composite for selected conditions,[a] age 18 and over	[a] Based on the six mortality AHRQ IQIs for acute myocardial infarction, congestive heart failure, acute stroke, gastrointestinal hemorrhage, hip fracture (age 65 and over), and pneumonia.
Patient Safety Indicators[12]		
PSI 2	Deaths per 1,000 hospital admissions with expected low-mortality,[a] age 18 and over or obstetric admissions	[a] Consistent with the AHRQ PSI software, admissions with expected low-mortality are identified by Medicare Severity Diagnosis Related Group (MS-DRG) or Diagnosis Related Group (DRG), depending on the date of discharge. Exclusions include admissions with cancer, admissions in an immunocompromised state, admissions involving a traumatic injury, and transfers to an acute care facility.
PSI 4	Deaths per 1,000 elective-surgery admissions having developed specified complications of care during hospitalization,[a] ages 18-89 or obstetric admissions	[a] Consistent with the AHRQ PSI software, complications of care include acute renal failure, pneumonia, pulmonary embolism, deep vein thrombosis, sepsis, shock, cardiac arrest, gastroentestinal hemorrhage, and acute ulcer with transfers to another hospital excluded. The AHRQ PSI software requires that the complication be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. In addition, the surgery is not verifiable as occurring in the first two days of the inpatient stay.
PSI 6	Admissions with iatrogenic pneumothorax per 1,000 medical and surgical admissions,[a] age 18 and over	[a] The AHRQ PSI software requires that the iatrogenic pneumothorax be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric admissions and admissions with chest trauma, pleural effusion, thoracic surgery, lung/pleural biopsy, diaphragmatic surgery repair, and cardiac surgery.
PSI 7	Admissions with central venous catheter-related bloodstream infection per 1,000 medical and surgical discharges of length 2 or more days,[a] age 18 and over or obstetric admissions	[a] The AHRQ PSI software requires that the central venous catheter-related bloodstream infection be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PSI software, the following cases are excluded: admissions with a diagnosis of cancer or in an immunocompromised state.

[12] Indicators PSI 1 and 20 are not assigned by the PSI software, version 4. Incidence measures PSI 3 (pressure ulcer), PSI 5 (foreign body), and PSI 16 (transfusion reaction) are not calculated.

QI No.	Description	Footnote
PSI 8	Postoperative hip fracture per 1,000 surgical admissions who were not susceptible to falling,[a] age 18 and over	[a] The AHRQ PSI software requires that the hip fracture be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. In addition, the hip fracture repair is not verifiable as following surgery. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric cases; admissions for seizure, syncope, stroke, coma, cardiac arrest, poisoning, trauma, delirium and other psychoses, anoxic brain injury, metastatic cancer, lymphoid/bone malignancy malignancy, or self-inflicted injury; admissions for diseases and disorders of the musculoskeletal system and connective tissue; and admissions in which hip fracture repair is the only operating room procedure.
PSI 9	Postoperative hemorrhage or hematoma with surgical drainage or evacuation per 1,000 surgical admissions,[a] age 18 and over	[a] The AHRQ PSI software requires that the hemorrhage or hematoma complicating procedure be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. In addition, the control of the hemorrhage or hematoma is not verifiable as following surgery. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric conditions and admissions in which the control of the hemorrhage or hematoma is the only operating room procedure.
PSI 10	Postoperative physiologic and metabolic derangements per 1,000 elective-surgery admissions,[a] age 18 and over	[a] The AHRQ PSI software requires that the physiologic and metabolic derangements be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. In addition, the derangement is not verifiable as following surgery. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric admissions and admissions for ketoacidosis, hyperosmolarity, and diabetic coma; admissions with acute renal failure, acute myocardial infarction, cardiac arrhythmia, cardiac arrest, shock, hemorrhage, gastrointestinal hemorrhage, or chronic renal failure.
PSI 11	Postoperative respiratory failure per 1,000 elective-surgery admissions,[a] age 18 and over	[a] The AHRQ PSI software requires that the respiratory failure be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. In addition, the tracheostomy is not verifiable as following surgery. Consistent with the AHRQ PSI software, the following cases are excluded: admissions with respiratory disease, circulatory disease, craniofacial anomalies, neuromuscular disorders, or degenerative neurological disorder; obstetric admissions; admissions in which the tracheostomy is the only operating room procedure; and admissions with a procedure for esophageal resection, lung cancer, or the nose, mouth, and pharynx.
PSI 12	Postoperative pulmonary embolism (PE) or deep vein thrombosis (DVT) per 1,000 surgical admissions,[a] age 18 and over	[a] The AHRQ PSI software requires that the PE or DVT be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. The detection of the PE or DVT did not count procedures to unspecified sites. In addition, the interruption of vena cava is not verifiable as following surgery. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric conditions and admissions in which the interruption of vena cava is the only operating room procedure.

QI No.	Description	Footnote
PSI 13	Postoperative sepsis per 1,000 elective-surgery admissions of length 4 or more days,[a] age 18 and over	[a] The AHRQ PSI software requires that the sepsis be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. In addition, the sepsis is not verifiable as following surgery. Consistent with the AHRQ PSI software, the following cases are excluded: admissions with a principal diagnosis of sepsis or infection, admissions with cancer or in an immunocompromised state; and obstetric admissions.
PSI 14	Reclosure of postoperative abdominal wound dehiscence per 1,000 abdominopelvic-surgery admissions of length 2 or more days,[a] age 18 and over	[a] Reclosure of abdominal wound dehiscence is not verifiable as following surgery and may have occurred on or before the abdominopelvic procedure. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric admissions and admissions in an immunocompromised state.
PSI 15	Accidental puncture or laceration during procedure per 1,000 medical and surgical admissions,[a] age 18 and over	[a] The AHRQ PSI software requires that the accidental puncture or laceration be reported as a secondary diagnosis (rather than the principal diagnosis), but unlike the AHRQ PSI software, the secondary diagnosis could be present on admission. Consistent with the AHRQ PSI software, the following cases are excluded: obstetric admissions and admissions involving spinal surgery.
PSI 17	Birth trauma - injury to neonate per 1,000 live births[a]	[a] Consistent with the AHRQ PSI software, exclusions include newborns weighing less than 2000 grams and newborns with injury to brachial plexus or with osteogenesis imperfecta.
PSI 18	Obstetric trauma[a] per 1,000 instrument-assisted vaginal deliveries	[a] Consistent with the AHRQ PSI software, obstetric trauma must involve 3rd or 4th degree lacerations.
PSI 19	Obstetric trauma[a] per 1,000 vaginal deliveries without instrument assistance	[a] Consistent with the AHRQ PSI software, obstetric trauma must involve 3rd or 4th degree lacerations.
PSI 21	Admissions for foreign body accidentally left in during procedure[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all diagnosis, including those present on admission.
PSI 22	Admissions for iatrogenic pneumothorax[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all diagnosis, including those present on admission. Exclusions include obstetric admissions and admissions with chest trauma, pleural effusion, thoracic surgery, lung/pleural biopsy, diaphragmatic surgery repair, or cardiac surgery.
PSI 23	Admissions for central venous catheter-related bloodstream infections[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all diagnosis, including those present on admission. Exclusions include admissions with a diagnosis of cancer or in an immunocompromised state.
PSI 24	Admissions for reclosure of abdominal wound dehiscence[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all procedures. Exclusions include obstetric admissions and admissions in an immunocompromised state.
PSI 25	Admissions for accidental puncture or laceration during procedure[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all diagnosis, including those present on admission. Exclusions include obstetric admissions and admissions involving spinal surgery.
PSI 26	Admissions for transfusion reactions[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all procedures.
PSI 27	Admissions for postoperative hemorrhage or hematoma[a] per 100,000 population, age 18 and over	[a] Consistent with the AHRQ PSI software, admissions are identified using all procedures. Exclusions include obstetric admissions.

QI No.	Description	Footnote
PSI 90	AHRQ Patient Safety Indicator (PSI) composite,[a] age 18 and over	[a] The AHRQ PSI composite has been modified to include the seven PSIs for iatrogenic pneumothorax, central venous catheter-related bloodstream infection, postoperative hip fracture, postoperative pulmonary embolism/deep vein thrombosis, postoperative sepsis, reclosure of postoperative abdominal wound dehiscence, and accidental puncture or laceration. The AHRQ PSI for pressure ulcers is excluded.

Table 2. Sources of 2015 HCUP Inpatient Data for the QDR

Sponsored by the Agency for Healthcare Research and Quality (AHRQ), HCUP is a family of databases, software tools, and products developed through the collaboration of State data organizations, hospital associations, private data organizations, and the Federal government.

HCUP would not be possible without the contributions of the following data collection Partners from across the United States. Use of the HCUP data for the National Healthcare Quality and Disparities Report (QDR) is dependent on when the HCUP Partner joined the project, the availability of the State Inpatient Databases (SID), and the permission from the HCUP Partner to release State-level information in the QDR.

HCUP Partner Organizations
Alaska Department of Health and Social Services and State Hospital and Nursing Home Association
Arizona Department of Health Services
Arkansas Department of Health
California Office of Statewide Health Planning and Development
Colorado Hospital Association
Connecticut Hospital Association
District of Columbia Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Health Information Corporation
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Center for Health Information and Analysis
Michigan Health & Hospital Association
Minnesota Hospital Association
Mississippi State Department of Health
Missouri Hospital Industry Data Institute
Montana Hospital Association
Nebraska Hospital Association
Nevada Department of Health and Human Services

HCUP Partner Organizations
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services
North Dakota (data provided by the Minnesota Hospital Association)
Ohio Hospital Association
Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems and Office of Health Analytics
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina Revenue and Fiscal Affairs Office
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Department of Health and Human Resources, West Virginia Health Care Authority
Wisconsin Department of Health Services
Wyoming Hospital Association

Table 3. HCUP National and State Inpatient Databases Used for QI Estimates

Use of the HCUP inpatient databases for reporting the AHRQ Quality Indicators (QIs) in the National Healthcare Quality and Disparities Report (QDR) varied by data year and type of reporting.

- **For national QI estimates for data years 2000–2011**, the HCUP Nationwide Inpatient Sample (NIS) was used to calculate national QI estimates for all level of reporting *except by race/ethnicity*. The NIS was not used for reporting QI estimates by race/ethnicity because the availability of race/ethnicity information varied across States and hospitals within States. In addition, the 20 percent sample of the hospitals in the NIS did not provide enough statistical power to detect differences in QI estimates between whites and the other specific racial groups. To facilitate analyses by race/ethnicity, a separate nationally weighted analysis file was constructed from the State Inpatient Databases (SID) and hospitals with good reporting of race/ethnicity using a sampling and weighting strategy similar to the NIS. Appendix A to this report provides detail on the creation of the analysis files for national estimates.

- **For national QI estimates for data years 2012–2015**, the HCUP National Inpatient Sample (NIS) was not used because the database had been redesigned into a sample of discharges (instead of hospitals) with a revised definition for the target universe that excluded acute long-term care facilities.[13] For consistent estimates before and after data year 2012, nationally weighted analysis files were constructed from the SID using a sampling and weighting strategy similar to the 2000–2011 NIS. In 2012, two analysis file were constructed, one for national estimates not reported by race/ethnicity and a second for reporting by race/ethnicity. In 2013–2015, only one nationally weighted analysis file was created.

The table below lists the HCUP databases used for national QI estimates from 2000–2015, the included SID, and the number of hospitals and unweighted discharges. Use of the SID in the nationally weighted analysis files depended on the availability of the SID when the work began. Appendix A to this report provides detail on the creation of the analysis files for national estimates.

It should be noted that over time the States include in the NIS and nationally weighted analysis files change as additional statewide data organizations participate in HCUP. Because each file 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.

[13] More information on the redesign of the NIS is available on the HCUP user support Web site at https://www.hcup-us.ahrq.gov/db/nation/nis/reports/NIS_2012_Redesign_report.jsp

Year	National inpatient QI estimates, not reported by race/ethnicity	National inpatient QI estimates, reported by race/ethnicity
2000	Nationwide Inpatient Sample (NIS) States (28): AZ, CA, CO, CT, FL, GA, HI, IA, IL, KS, KY, MA, MD, ME, MO, NC, NJ, NY, OR, PA, SC, TN, TX, UT, VA, WA, WI, WV Hospitals: 994 Sample size: 7.5 million records	No analysis file created for this data year
2001	Nationwide Inpatient Sample (NIS) States (33): AZ, CA, CO, CT, FL, GA, HI, IA, IL, KS, KY, MA, MD, ME, MI, MN, MO, NC, NE, NJ, NY, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV Hospitals: 986 Sample size: 7.5 million records	Nationally weighted analysis file with a 20 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (22): AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NJ, NY, PA, RI, SC, TN, TX, VA, VT, and WI Hospitals: 976 Sample size: 7.7 million discharges
2002	Nationwide Inpatient Sample (NIS) States (35): CA, CO, CT, FL, GA, HI, IA, IL, KS, KY, MA, MD, ME, MI, MN, MO, NC, NE, NJ, NV, NY, OH, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV Hospitals: 995 Sample size: 7.9 million records	Nationally weighted analysis file with a 20 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (22): AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NJ, NY, PA, RI, SC, TN, TX, VA, VT, and WI Hospitals: 985 Sample size: 7.7 million discharges
2003	Nationwide Inpatient Sample (NIS) States (37): AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MN, MO, NC, NE, NH, NJ, NV, NY, OH, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV Hospitals: 994 Sample size: 8.0 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (23): AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NH, NJ, NY, PA, RI, SC, TN, TX, VA, VT, and WI Hospitals: 1,711 Sample size: 14.6 million discharges
2004	Nationwide Inpatient Sample (NIS) States (37): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MN, MO, NC, NE, NH, NJ, NV, NY, OH, OR, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV Hospitals: 1,004 Sample size: 8.0 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (23): AR, AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NH, NJ, NY, RI, SC, TN, TX, VA, VT, and WI Hospitals: 1,770 Sample size: 14.7 million discharges

Year	National inpatient QI estimates, not reported by race/ethnicity	National inpatient QI estimates, reported by race/ethnicity
2005	Nationwide Inpatient Sample (NIS) States (37): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MN, MO, NC, NE, NH, NJ, NV, NY, OH, OK, OR, RI, SC, SD, TN, TX, UT, VT, WA, WI, WV Hospitals: 1,054 Sample size: 8.0 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (23): AR, AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NH, NJ, NY, OK, RI, SC, TN, TX, VT, and WI Hospitals: 1,883 Sample size: 15.0 million discharges
2006	Nationwide Inpatient Sample (NIS) States (38): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MN, MO, NC, NE, NH, NJ, NV, NY, OH, OK, OR, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV Hospitals: 1,045 Sample size: 8.1 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (25): AR, AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NH, NJ, NY, OK, RI, SC, TN, TX, UT, VA, VT, and WI Hospitals: 1,908 Sample size: 15.0 million discharges
2007	Nationwide Inpatient Sample (NIS) States (40): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, NC, NE, NH, NJ, NV, NY, OH, OK, OR, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY Hospitals: 1,044 Sample size: 8.0 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (26): AR, AZ, CA, CO, CT, FL, GA, HI, KS, MA, MD, MI, MO, NH, NJ, NY, OK, RI, SC, TN, TX, UT, VA, VT, WI, and WY Hospitals: 1,904 Sample size: 15.0 million discharges
2008	Nationwide Inpatient Sample (NIS) States (42): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, NC, NE, NH, NJ, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY Hospitals: 1,056 Sample size: 8.2 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (31): AR, AZ, CA, CO, CT, FL, GA, HI, KS, KY, MA, MD, ME, MI, MO, NH, NJ, NV, NY, OK, OR, PA, RI, SC, TN, TX, UT, VA, VT, WI, and WY Hospitals: 1,904 Sample size: 15.0 million discharges

Year	National inpatient QI estimates, not reported by race/ethnicity	National inpatient QI estimates, reported by race/ethnicity
2009	Nationwide Inpatient Sample (NIS) States (44): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MT, NC, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY Hospitals: 1,050 Sample size: 7.8 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (36): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, KS, KY, MA, MD, ME, MI, MO, NH, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, and WY Hospitals: 1,967 Sample size: 15.7 million discharges
2010	Nationwide Inpatient Sample (NIS) States (45): AK, AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, NE, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY Hospitals: 1,051 Sample size: 7.8 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (37): AK, AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MO, MS, NC, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WI, and WY Hospitals: 2,077 Sample size: 15.2 million discharges
2011	Nationwide Inpatient Sample (NIS) States (46): AK, AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY Hospitals: 1,049 Sample size: 8.0 million records	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (39): AK, AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MI, MO, MS, NC, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, and WY Hospitals: 2,076 Sample size: 15.4 million discharges
2012	Nationally weighted analysis file with a 20 percent sample of hospitals in the SID States (44): AK, AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, MT, NC, ND, NE, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, and WY Hospitals: 1,048 Sample size: 7.6 million discharges	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (40): AK, AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MO, NC, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, and WY Hospitals: 1,988 Sample size: 15.4 million discharges

Year	National inpatient QI estimates, not reported by race/ethnicity	National inpatient QI estimates, reported by race/ethnicity
2013	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (34): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MD, MI, MO, NC, NJ, NM, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, VA, VT, WA, WI, and WY Hospitals: 2,063 Sample size: 14.9 million discharges	
2014	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (36): AR, AZ, CA, CO, CT, DC, FL, GA, HI, IA, IL, IN, KS, KY, MD, MI, MO, NC, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, VA, VT, WA, WI, WV, and WY Hospitals: 2,048 Sample size: 14.8 million discharges	
2015	Nationally weighted analysis file with a 40 percent sample of hospitals in the SID with good reporting of race/ethnicity data States (36): AR, AZ, CA, CO, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MI, MO, MS, NC, NJ, NM, NV, NY, OH, OK, OR, PA, SD, TN, TX, VA, VT, WA, WI, WV and WY Hospitals: 2,034 Sample size: 14.6 million discharges	

Table 4. 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-sex categories for risk adjustment are constructed from the 18 age categories split into male and female.

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

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APPENDICES

APPENDIX A: DEVELOPMENT OF NATIONALLY WEIGHTED ANALYSIS FILES FOR THE NATIONAL HEALTHCARE QUALITY AND DISPARITIES REPORT

Nationally weighted analysis files were developed for reporting the AHRQ Quality Indicators (QIs) in the National Healthcare Quality and Disparities Report (QDR) for two reasons:

- The availability of information on patient race/ethnicity varied across States and hospitals within States. In addition, the 20 percent sample of the hospitals in the HCUP Nationwide Inpatient Sample (NIS) did not provide enough statistical power to detect differences in QI estimates between Whites and the other specific racial groups.
- The NIS changed its sampling and weighting strategy in 2012. For consistent national estimates from 2000–2015, weighted analysis files were created for 2012–2015 using the same sampling and weighting strategy employed for the 2000–2011 NIS.

The nationally weighted analysis files were developed using the HCUP State Inpatient Databases (SID). Use of the SID varies by data year and is detailed in Table 3. The nationally weighted analysis files use the same sampling strategy as the 2000–2011 NIS. Hospitals are sampled within five hospital characteristics: geographic region, hospital control (i.e., public, private not-for-profit, and proprietary), urbanized location, teaching status, and size of the hospital based on the number of acute care beds. The 2003–2015 analysis files used for reporting by race/ethnicity used a 40 percent sample of hospitals, instead of a 20 percent sample used in the NIS. The target universe for the nationally weighted analysis files was community hospitals in the United States excluding rehabilitation hospitals. Discharge counts and hospital characteristics for the target universe were obtained from the American Hospital Association Annual Survey Database™. Table 3 lists the number of States, hospitals, and unweighted discharges in all of the nationally weighted analysis files used for the QDR.

For data years 2013–2015, there was only one QDR nationally weighted analysis file developed from the SID used for reporting national QI estimates overall and by subpopulations including community income, expected primary payer, and race/ethnicity. In prior years, a separate weighted analysis file was developed for reporting national QI estimates by race/ethnicity.

2015 Nationally Weighted Analysis File for the QDR

Of the 40 SID that were available when the work on the 2017 QDR began, three States did not provide information on patient race to HCUP and one State reported race and ethnicity, but was missing information on more than half the discharges. The remaining 36 States were used for the creation of the 2015 nationally weighted analysis file. Table A-1 demonstrates the representation by U.S. Census region of these 36 States.

Table A-1. Geographic Representation of the QDR Analysis File, 2015

Census Region	Number of States used for the Nationally Weighted Analysis File	Number of States in the region	Percent of States in the region included in the Analysis File
Northeast	6	9	67%
Midwest	9	12	75%
South	12	16+ District of Columbia	71%
West	9	13	69%
Total	36	50 + District of Columbia	71%

Table A-2 compares aggregated totals of various measures for the 36 States as a percent of the national measure. In 2015, the 36 States accounted for 85 percent of U.S. discharges from community, nonrehabilitation hospitals (based on the AHA's Annual Survey). They accounted for over 80 percent of Whites, African Americans, Asian/Pacific Islanders, and Hispanics in the nation (based on 2015 Claritas data).

Table A-2. Population Representation of the QDR Analysis File, 2015

Measure	Total for 36 HCUP States with race/ethnicity as a percent of national total
Hospital discharges	85%
Total resident population	89%
Population by race/ethnicity:	
White	88%*
African American	87%*
Asian/Pacific Islander	95%*
Hispanic	96%*
Population by age:	
Population under age 18	89%*
Population age 18-64	89%*
Population over age 64	89%*
Population by income:	
Population with income under the Federal poverty level	89%**

**Calculated using 2015 Claritas Demographic Update data and 1977 OMB Directive 15 race definitions (e.g. no option for selecting "two or more races").*

***Calculated using Kaiser Family Foundation, statehealthfacts.org. Data Source: Urban Institute and Kaiser Commission on Medicaid and the Uninsured estimates based on the Census Bureau's March 2017 Current Population Survey (CPS: Annual Social and Economic Supplements), accessed November 12, 2017.*

Preparing the 2015 Nationally Weighted QDR Analysis File

The creation of the 2015 nationally weighted analysis file from the SID included the following steps.

1. The sampling frame was defined as community hospitals excluding those that are also rehabilitation hospitals.
2. Hospitals were excluded from the sampling frame if the coding of patient race was suspect (i.e., more than 30 percent of the discharges in the hospital had the race

reported as “other”; more than 50 percent of the discharges had no information on the race of the patient; all of the discharges in the hospital had race coded as white, other, or missing; or 100 percent of the discharges had race coded as white and the hospital had more than 50 beds). This caused 4.5 percent of the hospitals and 2.5 percent of the discharges in 2015 to be excluded. Hospitals were most often excluded because substantial shares of discharges were coded as “other” or “missing” race.

3. A 40-percent stratified sample of hospitals was randomly selected using the strata consistent with the 2000–2011 NIS.
4. For discharges missing race, a “hot deck” imputation method (which draws donors from strata of similar patients within the same hospital) is used to assign values while preserving the variance within the data. Race was missing on 1.9 percent of discharges in the 2015 nationally weighted analysis file.
5. Discharge-level weights were developed using the target universe to produce national-level estimates when applied to the analysis file.

The final nationally weighted analysis file in 2015 included about 14.6 million hospital discharges from over 2,000 hospitals.

Evaluating the 2015 Nationally Weighted QDR Analysis File

After creating the 2015 nationally weighted analysis file using the above steps, we evaluated the reliability of national estimates produced with these data by comparing its composition to the 2015 National Inpatient Sample (which was redesigned with a new sample strategy that selects a sample of discharge records from all hospitals participating in HCUP and excludes acute long-term care hospitals). Tables A.3–A.10 contain the distribution of discharges in both files by key demographic and clinical data elements. Based on these analyses, the 2015 nationally weighted analysis file appears to provide reliable national estimates when compared with the 2015 NIS.

Table A-3. Comparison of Census Region, QDR Analysis File and HCUP National Inpatient Sample, 2015

Census Region				
	2015 QDR Analysis File		2015 NIS	
REGION	Frequency	Percent	Frequency	Percent
1: Northeast	6,858,036	18.5	6,603,860	18.5
2: Midwest	8,319,330	22.4	7,989,872	22.3
3: South	14,638,309	39.4	14,097,218	39.4
4: West	7,311,590	19.7	7,078,992	19.8

Table A-4. Comparison of Patient Age, QDR Analysis File and HCUP National Inpatient Sample, 2015

Patient Age in Years at Admission				
	2015 QDR Analysis File		2015 NIS	
AGE	Frequency	Percent	Frequency	Percent
.: Missing	23,306	0.1	10,185	0.0
.A: Invalid	14	0.0	50	0.0
.C: Inconsistent	3,700	0.0	3,760	0.0
0-17	5,670,396	15.3	5,587,800	15.6
18-44	9,038,272	24.3	8,738,185	24.4
45-64	9,082,158	24.5	8,782,484	24.6
65+	13,309,419	35.8	12,647,479	35.4

Table A-5. Comparison of Patient Sex, QDR Analysis File and HCUP National Inpatient Sample, 2015

Patient Sex				
	2015 QDR Analysis File		2015 NIS	
FEMALE	Frequency	Percent	Frequency	Percent
.: Missing	1,904	0.0	2,230	0.0
.A: Invalid	108	0.0	60	0.0
.C: Inconsistent	7,655	0.0	8,650	0.0
0: Male	15,925,755	42.9	15,359,479	42.9
1: Female	21,191,842	57.1	20,399,523	57.0

Table A-6. Comparison of Expected Primary Payer, QDR Analysis File and HCUP National Inpatient Sample, 2015

Expected Primary Payer				
	2015 QDR Analysis File		2015 NIS	
PAY1	Frequency	Percent	Frequency	Percent
.: Missing	33,738	0.1	42,995	0.1
.A: Invalid	6,160	0.0	6,405	0.0
1: Medicare	14,841,941	40.0	14,082,773	39.4
2: Medicaid	8,372,944	22.6	8,200,095	22.9
3: Private Insurance	11,262,192	30.3	10,900,309	30.5
4: Self-pay	1,457,113	3.9	1,376,139	3.8
5: No Charge	128,633	0.3	118,810	0.3
6: Other	1,024,544	2.8	1,042,416	2.9

Table A-7. Comparison of Community Income Quartile, QDR Analysis File and HCUP National Inpatient Sample, 2015

Community Income Quartile Based on the Patient's ZIP Code				
	2015 QDR Analysis File		2015 NIS	
ZIPINC_QRTL	Frequency	Percent	Frequency	Percent
.: Missing	677,545	1.8	674,325	1.9
.A: Invalid	5,947	0.0	5,190	0.0
1:First Quartile (lowest income)	11,456,775	30.9	10,903,584	30.5
2:Second Quartile	8,825,983	23.8	8,620,204	24.1
3:Third Quartile	8,749,077	23.6	8,433,424	23.6
4:Fourth Quartile (highest income)	7,411,938	20.0	7,133,215	19.9

Table A-8. Comparison of Patient Race, QDR Analysis File and HCUP National Inpatient Sample, 2015

Patient Race/Ethnicity				
	2015 QDR Analysis File		2015 NIS	
RACE	Frequency	Percent	Frequency	Percent
.: Missing	720,719	1.9	2,151,572	6.0
.A: Invalid	340	0.0	835	0.0
1: White	23,975,096	64.6	21,972,682	61.4
2: Black	5,414,718	14.6	5,194,536	14.5
3: Hispanic	4,545,435	12.2	4,113,316	11.5
4: Asian/Pacific Islander	1,201,716	3.2	1,015,845	2.8
5: Native American	217,044	0.6	214,266	0.6
6: Other	1,052,197	2.8	1,106,890	3.1

Table A-9. Comparison of Patient Location, QDR Analysis File and HCUP National Inpatient Sample, 2015

Location of Patient Residence				
	2015 QDR Analysis File		2015 NIS	
PL_NCHS	Frequency	Percent	Frequency	Percent
.: Missing	157,726	0.4	160,790	0.4
1: Large central metropolitan	11,321,425	30.5	10,718,267	30.0
2: Large fringe metropolitan	9,304,376	25.1	8,477,560	23.7
3: Medium metropolitan	7,030,646	18.9	7,391,151	20.7
4: Small metropolitan	3,430,120	9.2	3,280,308	9.2
5: Micropolitan (nonmetropolitan)	3,390,324	9.1	3,273,475	9.2
6: Noncore (nonmetropolitan)	2,492,648	6.7	2,468,391	6.9

Table A-10. Comparison of Means, QDR Analysis File and HCUP National Inpatient Sample, 2015

	2015 QDR Analysis File			2015 NIS		
Variable / Label	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
LOS: Length of stay (cleaned)	0	365	4.7	0	365	4.6
NDX: Number of diagnoses on this record	0	71	10.3	0	90	10.2
NPR: Number of procedures on this record	0	66	1.6	0	66	1.6
TOTCHG: Total charges (cleaned)	$100	$4,994,156	$45,043	$100	$4,991,579	$44,071

APPENDIX B: MODIFICATION TO THE STATE INPATIENT DATABASES FOR STATE-LEVEL REPORTING BY RACE/ETHNICITY

Data from the each year's State Inpatient Databases (SID) were used to create individual State analysis files that were designed to be used for reporting the State-level Quality Indicators (QIs) in the National Healthcare Quality and Disparities Report (QDR). In SID that include the race/ethnicity of the patient additional data preparation was needed for reporting QI estimates by race/ethnicity. These additional changes to the SID were performed after the modifications described in the HCUP Databases section of this report (e.g., limit the SID to community, nonrehabilitation hospitals, impute missing patient characteristics such as age and sex).

For data year 2015, 36 SID with race/ethnicity were available at the time the work began on the HCUP estimates for the 2017 QDR. Not all of these States participate in reporting State-level QI estimates by race/ethnicity in the QDR. The following steps were taken to further prepare the State-level analysis files for reporting by race/ethnicity:

1. *Exclusion of Hospitals.* We first identified hospitals whose original coding of patient race-ethnicity was "suspect" (i.e., more than 30 percent of the discharges in the hospital had the race reported as "other"; more than 50 percent of the discharges had no information on the race of the patient; all of the discharges in the hospital had race coded as white, other, or missing; or 100 percent of the discharges had race coded as white and the hospital had more than 50 beds).

   Table B-1 indicates for data year 2015 the number of excluded hospitals from the race/ethnicity analyses and their associated discharge counts. Twenty-five of the 36 SID had at least one hospital excluded due to suspect race coding. Eleven States had no hospitals with suspect race coding. Overall, 3.6 percent of hospitals and 2.6 percent of discharges were excluded. Except in a few cases, hospitals were most often excluded because substantial shares of discharges were coded as "other" or "missing" race.

Table B-1. Exclusions from State-level Analysis Files for Race/Ethnicity, 2015

Measure	Excluded for any reason	Percent of Total	>30% discharges are "other" race	>50% discharges are "missing" race	All discharges are white, other or missing	All discharges are white and hospital has >50 beds
Total number of hospitals excluded	147	3.6%	45	64	35	3
Total number of discharges excluded	827,210	2.6%	446,210	368,091	12,438	471

2. *Impute for Missing Race/Ethnicity.* Because the area-level QI measures use total State population in the denominator, minimizing the loss of discharges from the numerator for the QI calculation is critical to producing unbiased QI rates. For missing race, we used a "hot deck" imputation method (which draws donors from strata of similar patients within the same hospital) to assign values while preserving the variance within the data. Typically, most hospitals with good reporting of race/ethnicity have no more than five percent of discharges with missing race values before imputation.

3. *Weighting of Selected Hospitals.* We calculated discharge-level weights to account for hospitals excluded because of suspect race coding, community hospitals not reported in the SID, and missing quarters of data. We weighted to the State's universe of hospitals in the American Hospital Association (AHA) Annual Survey Database based on hospital characteristics (teaching status, ownership, urban-rural location, and size of the hospital based on the number of acute care beds).

Some caution should be used in interpreting State comparisons. There may be differences in race and ethnicity coding among States that affect the estimates. For example, some States include Hispanic ethnicity as one of the racial categories, and others record Hispanic ethnicity separately from race. At the hospital-level, policies vary on methods for collecting such data. Some hospitals ask the patient to identify their race and ethnicity, and others determine it from observation. The effect of these and other unmeasured differences in coding of race and ethnicity across the States and hospitals cannot be assessed.

APPENDIX C: EMERGENCY DEPARTMENT RATES FOR SELECTED AHRQ QUALITY INDICATORS

The HCUP Nationwide Emergency Department Samples (NEDS) were used to examine national and regional differences in emergency department (ED) rates for selected AHRQ Prevention Quality Indicators (PQIs) and related Pediatric Quality Indicators (PDIs). The PQIs are measures of quality associated with processes and outcomes of care that occurred in an outpatient or an inpatient setting. The PQIs rely solely on hospital administrative data and, for this reason, are screens for examining quality that may indicate the need for more in-depth studies. Experts have suggested that using both inpatient and emergency room data may give a more accurate picture of avoidable visits/admissions for some ambulatory care sensitive conditions which can be identified by certain PQIs and PDIs. Table C-1 lists the PQIs and PDIs examined.

Table C-1. PQIs and PDIs Used to Examine QI Rates in Inpatient and ED Settings

PQI or PDI	Description
PQI 1	Diabetes with short-term complications
PQI 3	Diabetes with long-term complications
PQI 5	Chronic obstructive pulmonary disease or asthma
PQI 7	Hypertension
PQI 8	Heart failure
PQI 10	Dehydration
PQI 11	Bacterial pneumonia
PQI 12	Urinary tract infections
PQI 13	Angina without cardiac procedure
PQI 14	Uncontrolled diabetes without complications
PQI 15	Adult asthma admissions
PQI 16	Lower extremity amputations among patients with diabetes
PQI 18*	Immunization-preventable influenza
PQI 90	Overall Prevention Quality Indicator (PQI) composite
PQI 91	Acute Prevention Quality Indicator (PQI) composite
PQI 92	Chronic Prevention Quality Indicator (PQI) composite
PDI 14	Pediatric asthma admissions
PDI 15	Pediatric diabetes with short-term complications

* Modified or added version of PQI.

The NEDS contains approximately 30 million ED events from about 950 hospital-based EDs. The NEDS includes information on ED visits that do not result in an admission (i.e., treat-and-release visits and transfers to another hospital) as well as discharge information on patients initially seen in the ED and then admitted to the same hospital. The NEDS was drawn for the State Inpatient Database (SID) and the State Emergency Department Databases (SEDD). Discharge-level weights included with the NEDS are used to produce national estimates.

Table C-2 lists the number of States, EDs, and unweighted ED visits in the NEDS starting in 2008.

Table C-2. States, EDs, and unweighted ED visits in the NEDS

Year	Nationwide Emergency Department Sample (NEDS)
2008	States (28): AZ, CA, CT, FL, GA, HI, IA, IN, KS, KY, MA, MD, ME, MN, MO, NC, NE, NH, NJ, NY, OH, RI, SC, SD, TN, UT, VT, and WI Hospital-based EDs: 980 Sample size: 28.4 million ED visits
2009	States (29): AZ, CA, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MN, MO, NC, NE, NH, NJ, NY, OH, RI, SC, SD, TN, UT, VT, and WI Hospital-based EDs: 964 Sample size: 28.9 million ED visits
2010	States (28): AZ, CA, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MN, MO, NC, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, and WI Hospital-based EDs: 961 Sample size: 28.6 million ED visits
2011	States (30): AZ, CA, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MN, MO, NC, ND, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, and WI Hospital-based EDs: 951 Sample size: 28.8 million ED visits
2012	States (30): AZ, CA, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MN, MO, NC, ND, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, and WI Hospital-based EDs: 950 Sample size: 31.1 million ED visits
2013	States (30): AR, AZ, CA, CT, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, MN, MO, NC, ND, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, and WI Hospital-based EDs: 947 Sample size: 29.6 million ED visits

Year	Nationwide Emergency Department Sample (NEDS)
2014	States (34): AR, AZ, CA, CT, DC, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MN, MO, MT, NC, ND, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, WI, and WY Hospital-based EDs: 945 Sample size: 31.0 million ED visits
2015	States (34): AR, AZ, CA, CT, DC, FL, GA, HI, IA, IL, IN, KS, KY, MA, MD, ME, MN, MO, MT, NC, ND, NE, NJ, NV, NY, OH, RI, SC, SD, TN, UT, VT, WI, and WY Hospital-based EDs: To be determined (TBD) Sample size: TBD million ED visits

Several steps were taken to prepare the NEDS: (1) QI software review and modification, (2) acquisition of population-based data, (3) handling of missing data, and (4) identification of statistical methods.

1. **QI Software Review and Modification.** A modification of PQI Version 4.4 was used. The PQIs were developed for use with hospital inpatient discharge data. No guidelines for applying the AHRQ QIs to emergency department data were available when this analysis began. Some of the events in the NEDS are visits for patients initially seen in the emergency room and then admitted to the same hospital (an “ED admission”), and some NEDS events are ED visits that do not result in an inpatient admission (e.g., treat-and-release visits and transfers to another hospital). About 15 percent of records in the NEDS represent an ED admission. The PQIs rely on the first-listed diagnosis code (DX1) to identify cases with the outcome of interest. For ED admissions, DX1 is the principal diagnosis code and reflects the condition established to be chiefly responsible for a patients’ admission to the hospital. Unfortunately, principal diagnosis is not clearly discernible for ED visits that do not result in admission. Coding instructions for outpatient data specify that the first-listed diagnosis is supposed to be the "reason for visit," which is different than the principal diagnosis. Even though DX1 in ED data is not necessarily the principal diagnosis, using DX1 preserves the concept from the PQI algorithm that the first code has higher priority than others. Therefore, this analysis used the first-listed diagnosis in the NEDS.

2. **Acquisition of Population-Based Data.** The next step was to acquire data for the numerator and denominator populations for the PQIs and PDIs in this analysis. These QIs are measures of events that occurs in a hospital, requiring a numerator count of the event of interest and a denominator count of the population (within the geographic area) to which the event relates.

   For the numerator counts of the PQI or PDI, we used the HCUP NEDS to create national estimates of all ED visits, ED visits resulting in admission to the same hospital, and all other types of ED visits. For the denominator counts, population ZIP-Code-level counts from demographic update data provided by Claritas (a vendor that compiles and adds value to the U.S. Bureau of Census data) were used for all reporting categories. Claritas uses intra-census methods to estimate household and demographic statistics for geographic areas (Claritasy). We also used the Claritas population data for risk adjustment by age and sex.

Because the Version 4.4 PQIs and PDIs use ICD-9-CM codes, only data from January–September 2015 of the NEDS were used to calculate the numerators of the population-based rates. In addition, the population denominators were multiplied by 0.75 to adjust for the nine-month numerator counts.

3. **Preparation of HCUP Data.** Next, "hot deck" imputation method (which draws donors from strata of similar hospitals and patients) was used to assign missing values of patient age and sex. Patient age and sex are missing on less than one percent of the records in the NEDS.

4. **Statistical Methods.** Age-sex adjustments were made for age and sex differences across population subgroups and were based on methods of direct standardization (Fleiss, 1973). Age was categorized into 18 five-year increments. Statistical methods are explained in more detail in Appendix D to this report.

5. **Masking Rates for Statistical Reliability, Data Quality, and Confidentiality.** PQI and PDI estimates were included in this analysis if they reached a threshold defined by a relative standard error less than 30 percent and at least 11 unweighted cases in the denominator. Estimates that did not meet this threshold were suppressed and the corresponding table cell was marked with an asterisk.

APPENDIX D: 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 NEDS, the nationally weighted analysis files, the SID, and demographic population data provided by Claritas (a vendor that compiles and adds value to Bureau of Census data). For NIS, NEDS, and nationally weighted analysis files, 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 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 SID databases contain nearly all discharges from nearly all hospitals in the State, we treat the files 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 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-Based QIs using Weighted Discharge Data in the Numerator and Claritas Population Data in the Denominator

a. Standard error estimates for discharge rates per 100,000 population using the 2015 Claritas population data.

The observed rate was calculated as follows:

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

w_i and $x_{i,}$ respectively, are the weight and variable of interest for patient i in the quality analysis file 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:

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

b. Standard error estimates for age/sex adjusted inpatient rates per 100,000 population using the 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 Table 4 in this methods report, 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 2010. 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):

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

g = index for the 36 age/sex cells.
$N_{g,std}$ = Standard population for cell g (year 2010 total US population in cell g).
$N_{g,obs}$ = Observed population for cell g (year 2015 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).
$w_{g,i}$ = Quality analysis file 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:

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

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

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

2. Provider-based QIs using Weighted Discharge Data in the Numerator and Denominator

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:

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

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 2010 NIS national 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:

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

g = index for the 36 age/sex cells.
$\hat{N}_{g,std}$ = Standard inpatient population for cell g (Estimate of year 2010 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.
$w_{g,i}$ = Quality analysis file 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:

$$t = \frac{R_1 - R_2}{\sqrt{SE_1^2 + SE_2^2}} \quad \text{(A.10)}$$

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

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 E: CAVEATS TO THE INTREPRETAION OF HCUP-BASED QI ESTIMATES REPORTED IN THE NATIONAL HEALTHCARE QUALITY AND DISPARITIES REPORT

Some caution should be used in interpreting the AHRQ Quality Indicators (QI) statistics presented in the National Healthcare Quality and Disparities Report (QDR). These caveats relate to the how the AHRQ QIs were applied to the HCUP data, ICD-9-CM coding changes, inter-State differences in data collection, and other more general issues.

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. If coding changes cause earlier estimates to be non-comparable to the later estimates, then the earlier estimates are not reported. For this reason, the following QIs are not reported for certain years:

- *Not reported prior to 2004*: birth trauma (PSI 17)
- *Not reported prior to 2005*: the PQI for chronic obstructive pulmonary disease (PQI 5), the overall PQI composite (PQI 90), and chronic PQI composite (PQI 92), the PSI for deaths per elective-surgery admissions having developed specified complications of care during hospitalization (PSI 4), and the PSI for post-operative pulmonary embolism or deep vein thrombosis (PSI 12).
- *Not reported prior to 2008*: QIs for sepsis (PDI 10 and PSI 13) and blood stream infections (NQI 3, PDI 12, PSI 7, and PSI 23).
- *Not reported for any year:* QIs for pressure ulcer (PDI 2 and PSI 3) because numerous coding changes between 2000 and 2012 make longitudinal analysis inadvisable.

Data Collection Differences Among States: Organizations providing statewide data generally collect the data using the Uniform Billing format (UB-04) and, for earlier years, the UB-92 or 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 QDR, uneven availability of a few data elements underlie some estimates, as noted next.

Data Elements Used for QI 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:

- Some of the PSIs and PDIs use procedure days to determine the timing of a patient safety event. In States without procedure days, the patient safety event cannot be verified as following surgery.[14] Seven PSIs and three PDIs use procedure day to qualify safety events as post-operative, excluding patients for which the event is not pre-operative:
    - PSI 8 – Post-operative hip fractures
    - PSI 9 – Post-operative hemorrhage or hematoma
    - PSI 10 – Post-operative physiologic/metabolic derangements
    - PSI 11 – Post-operative respiratory failure

[14] Several States are missing data on day of procedure. The states without procedure days in the 2004-2015 SID include: Oklahoma and West Virginia. For 2004-2013, Utah did not have procedure days. For 2004-2011, Ohio did not have procedure days. For 2004, Illinois, Kansas, and Washington did not have procedure days.

- PSI 12 – Post-operative pulmonary embolism or deep vein thrombosis
- PSI 14 – Post-operative abdominal wound dehiscence
- PSI 27 – Post-operative hemorrhage or hematoma (area based)
- PDI 8 – Pediatric: Post-operative hemorrhage or hematoma
- PDI 9 – Pediatric: Post-operative respiratory failure
- PDI 11 – Pediatric: Post-operative wound dehiscence.

- PSI 4 "Deaths per 1,000 elective-surgery admissions having developed specified complications of care during hospitalization" uses the day of the principal procedure or type of admission to identify an elective admission. All of the States that do not report day of principal procedure do report type of admission, so one of the other can be used.
- 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. Ten PSIs and nine PDIs used information on whether a condition was present on admission (POA) to exclude patients:
    - PSI 6 Iatrogenic Pneumothorax
    - PSI 7 Central Venous Catheter-Related Bloodstream Infection
    - PSI 8 Postoperative Hip Fracture
    - PSI 9 Postoperative Hemorrhage or Hematoma
    - PSI 10 Postoperative Physiologic and Metabolic Derangements
    - PSI 11 Postoperative Respiratory Failure
    - PSI 12 Postoperative Pulmonary Embolism or Deep Vein Thrombosis
    - PSI 13 Postoperative Sepsis
    - PSI 14 Postoperative Abdominal Wound Dehiscence (Provider-based)
    - PSI 15 Accidental Puncture or Laceration (Provider-based)
    - PDI 1 Pediatric: Accidental Puncture or Laceration
    - PDI 5 Pediatric: Iatrogenic Pneumothorax
    - PDI 8 Pediatric: Postoperative Hemorrhage or Hematoma
    - PDI 9 Pediatric: Postoperative Respiratory Failure
    - PDI 10 Pediatric: Postoperative Sepsis
    - PDI 11 Pediatric: Postoperative Abdominal Wound Dehiscence
    - PDI 12 Pediatric: Central Venous Catheter-Related Bloodstream Infection
    - NQI 01 Neonatal Iatrogenic Pneumothorax
    - NQI 03 Neonatal Central Venous Catheter-Related Bloodstream Infection

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. The SID for different States can contain as few as 6 or as many as 50 or more fields for reporting diagnoses and procedures, as shown in Table E-1. The more fields used, the more quality-related events that can be captured. However, in an analysis of year 2000 data, 95 percent of discharge records captured all of patients' diagnoses in 10 to 13 data

elements in States with 30 diagnosis fields available. For States with 30 procedure fields available, 95 percent of records captured all of patients' procedures in five 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 nine diagnoses and six procedures. All available diagnosis and procedure fields in the SID were used for the QDR analyses, so that the full richness of the databases would be included.

Table E-1. Number of Diagnosis and Procedure Fields by State, 2015

State	Number of Diagnoses	Number of Procedures
Arkansas	18	8
Arizona	25	12
California	25	21
Colorado	30	30
Connecticut	30	30
Florida	31	31
Georgia	50	50
Hawaii	25	25
Illinois	25	25
Indiana	60	50
Iowa	50	50
Kansas	30	25
Kentucky	25	25
Maryland	30	30
Massachusetts	71	66
Michigan	30	30
Minnesota	50	50
Mississippi	48	30
Missouri	30	25
Montana	25	25
Nebraska	9	6
Nevada	33	25
New Jersey	25	25
New Mexico	18	6
New York	25	14
North Carolina	25	20
North Dakota	52	25
Ohio	92	110
Oklahoma	16	16
Oregon	25	25
Pennsylvania	18	6
South Dakota	25	25
Tennessee	18	6
Texas	25	15
Vermont	20	20
Virginia	18	6
Washington	25	25
West Virginia	18	6
Wisconsin	66	50
Wyoming	30	25

Use of External Cause-of-Injury Codes*:* Another issue relates to the reporting of external cause-of-injury codes (E Codes). Five of the 25 PSIs and one of the PDIs use E codes to help identify complications of care or to exclude cases (e.g., poisonings, self-inflicted injury, and trauma) from numerators and denominators, as shown in Table E-2.

Table E-2. Use of E codes in the AHRQ Quality Indicators, Version 4.4

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 21	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	E870n	9982	None	None
PSI 26	E8760	9996-9997	None	None

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

The E codes in the AHRQ PSI and PDI software have been augmented wherever possible with similar ICD-9-CM codes. Uneven capture of these data has the potential of affecting rates and should be kept in mind when judging the level of these events.

While all HCUP States report E Codes, the policies on reporting medical misadventures and adverse effects can vary:

- California (through data year 2009) and Washington do not require hospitals to report E codes in the range E870-E879 (medical misadventures and abnormal reactions).
- Georgia does not report E codes in the range E870-E879 (medical misadventures and abnormal reactions) and E930-E949 (adverse effects).
- South Carolina (through data year 2007) did not report E codes in the range E870-E876 (medical misadventures).

Non-Resident Discharges in State-Level Estimates*:* HCUP databases include discharges from all hospitals in a State, and may include non-residents, including foreign patients, which can bias the results for QIs using area-based denominators (State populations). We had no way to adjust the HCUP data to consistently exclude the non-resident discharges and include discharges for residents hospitalized in other States. Therefore, non-resident discharges were retained in the SID databases for the QDR analyses. Based on an analysis performed with the 2013 SID, the overall percentage of non-resident discharges within a State is 4 percent with a range from 1 percent to 45 percent. Most States were below 10 percent, but five States (ND,

SD, TN, VT, WV) and the District of Columbia had more than 10 percent of discharges in the SID that were for non-residents.

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-level QI rates in relation to these types of factors. For more information on this study, refer to the *Methods Applying AHRQ Quality Indicators to the Healthcare Cost and Utilization Project (HCUP) Data for the Ninth (2011) NHQR and NHDR* (Coffey et al., 2011). The report includes an appendix that describes analyses performed for each Prevention Quality Indicator (PQI), 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. 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. For more information on this study, refer to the Methods Applying AHRQ Quality Indicators to the Healthcare Cost and Utilization Project (HCUP) Data for the Ninth (2011) NHQR and NHDR (Coffey et al., 2011). The report includes the executive summary from the report, Patient Safety in Hospitals in 2004: Toward Understanding Variation Across States.

APPENDIX F: QDR SUMMARY MEASURES FOR PATIENT SAFETY AND MORTALITY FOR SELECTED PROCEDURES AND CONDITIONS

To examine national and State-level trends in inpatient mortality and patient safety events, risk-adjusted rates for select AHRQ Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs) were summarized. The three QDR summary measures include the following:

1. Mortality for selected conditions based on select IQIs
2. Mortality for selected procedures based on select IQIs
3. Patient safety based on select PSIs

These summary measures were calculated as a weighted sum of risk-adjusted rates for individual IQIs and PSIs. The weights used to calculate the QDR summary measures were relatively consistent with AHRQ IQI and PSI Composites; however, the methodology employed to perform the calculations differed. The IQI and PSI composites were designed for use with hospital-level rates, while the QDR report only national and State-level statistics.

IQIs and PSIs Used for the QDR Summary Measures

The QDR summary measure for mortality for selected conditions was based on six IQIs also included in the similar IQI Composite (Table F-1). The IQI composite weights were extracted from the SAS software, version 4.4. They are based on pooled SID denominators (i.e., the relative frequency of the denominators of the component indicators). This approach is known as "opportunity weighting," because it gives equal weight to each opportunity that the health care system has to do "the right thing," which in this case is to discharge the patient alive from the hospital. The QDR summary measure weights were the same as the weights in the similar IQI Composite.

Table F-1. IQIs Included in the QDR Summary Measure for Mortality for Selected Conditions

IQI	Description	IQI Composite Weight	QDR Summary Measure Weight
IQI 15	Acute Myocardial Infarction	0.1433	0.1433
IQI 16	Congestive Heart Failure	0.2739	0.2739
IQI 17	Acute Stroke Adult Mortality Rate	0.1329	0.1329
IQI 18	Gastrointestinal Hemorrhage	0.1302	0.1302
IQI 19	Hip Fracture	0.0678	0.0678
IQI 20	Pneumonia	0.2519	0.2519

The QDR summary measure for mortality for selected procedures was based on four IQIs instead of the eight IQIs included in the similar IQI Composite (Table F-2). Three IQIs were excluded because the procedures were not high-volume at the State level and, therefore, State-level risk-adjusted rates were often unavailable. The IQI for Hip Replacement has a zero-weight in the IQI Composite because it was not endorsed by the National Quality Forum (NQF) (for version 4.4 IQIs). The IQI composite weights were extracted from the SAS software, version 4.4, and were also based on pooled SID denominators. The IQI Composite weights were proportionally reallocated into the QDR summary measure weights to account for the excluded IQIs.

Table F-2. IQIs Included in the QDR Summary Measure for Mortality for Selected Procedures

IQI	Description	IQI Composite Weight	QDR Summary Measure Weight
IQIs Included in the QDR Summary			
IQI30	Percutaneous coronary intervention	0.5659	0.6275
IQI12	CABG	0.2001	0.2219
IQI13	Craniotomy	0.1031	0.1143
IQI11	Abdominal Aortic Aneurysm Repair	0.0328	0.0364
IQIs Excluded in the QDR Summary, but in the IQI Composite			
IQI08	Esophageal Resection	0.0043	0.0000
IQI09	Pancreatic Resection	0.0048	0.0000
IQI14	Hip Replacement	0.0000	0.0000
IQI31	Carotid Endarterectomy	0.0890	0.0000

The QDR summary measure for patient safety was based on seven PSIs instead of the eleven PSIs included in the similar PSI Composite (Table F-3). One PSI Pressure Ulcer was excluded due to its dependence upon reporting whether the diagnosis is present on admission (POA) to the hospital. (This information is not uniformly available across HCUP States). Three PSIs have zero weights in the PSI Composite because they were not endorsed by the NQF (for version 4.4 PSIs). The PSI composite weights were extracted from the SAS software, version 4.4, and are based on pooled SID numerators (i.e., the relative frequency of the numerators of the component indicators). This approach is known as "event weighting," because it gives equal weight to each event, regardless of how many patients were evaluated for the occurrence of that event. The PSI Composite weights were proportionally reallocated into the QDR summary measure weights to account for the excluded PSIs.

Table F-3. PSIs Included in the QDR Summary Measure for Patient Safety

PSI	Description	PSI Composite Weight	QDR Summary Measure Weight
PSIs Included in the QDR Summary			
PSI15	Accidental Puncture or Laceration	0.2982	0.3925
PSI12	Postoperative Pulmonary Embolism or Deep Vein Thrombosis	0.2360	0.3106
PSI07	Central Venous Catheter-Related Bloodstream Infections (2008 only)	0.1280	0.1685
PSI06	Iatrogenic Pneumothorax	0.0457	0.0602
PSI13	Postoperative Sepsis (2008 only)	0.0383	0.0504
PSI14	Postoperative Wound Dehiscence	0.0124	0.0163
PSI08	Postoperative Hip Fracture	0.0011	0.0014

PSI	Description	PSI Composite Weight	QDR Summary Measure Weight
PSIs Excluded in the QDR Summary, but in the PSI Composite			
PSI03	Pressure Ulcer	0.2403	0.0000
PSI09	Postoperative Hemorrhage or Hematoma	0.0000	0.0000
PSI10	Postoperative Physiologic and Metabolic Derangement	0.0000	0.0000
PSI11	Postoperative Respiratory Failure	0.0000	0.0000

Calculation of the IQI and PSI Summary Measures

Each summary measure was calculated as follows:

$$S = \sum_i ai \; X_i$$

Where a_i corresponds to the weight to the i^{th} QI and X_i corresponds to the risk-adjusted rate for the i^{th} QI.

The standard error (SE) of the summary measure is the square-root of the variance:

$$\mathrm{Var}\left(\sum_i a_i X_i\right) = \sum_i a_i^2 \mathrm{Var}(X_i) + \sum_i \sum_{j \neq i} a_i a_j \mathrm{Cov}(X_i, X_j)$$

Where a_i corresponds to the weight to the i^{th} QI and X_i corresponds to the risk-adjusted rate for the i^{th} QI. The correlations actually had very little effect on the estimated SE for the summary measures. For example, in examining mortality for select conditions, the SE was 0.293 if we assume the correlations are zero (i.e., the individual measures are uncorrelated) and the SE was 0.303 if we assume the correlations are those estimated by the covariance matrix of the State-level rates, which were in the range of 70 to 85 percent. Therefore, the SEs were calculated on the assumption that the individual measures were independent of one another, which eliminates the second term on the right-hand side of the formula above.