
OREGON HOSPITAL QUALITY INDICATOR PROJECT, 2004

TECHNICAL GUIDE

This document outlines key technical issues, addresses questions and concerns raised throughout the development of this report, and describes rationale for technical decisions and future development steps as appropriate. It is intended for individuals with some degree of statistical expertise.

Please refer to [The User Guide](#) for a more general discussion of how to use and interpret the data contained in the Oregon's Inpatient Hospital Quality Indicators, or [Technical Data Methods](#) for details about the data source, data preparation, and implementation of the quality indicator software.

See the [Detailed Data Tables](#) for display of Oregon's 2004 numerator and denominator values, various types of rates, and 95% and 99% confidence intervals discussed below.

Technical Decision-Making – A Team Effort

Through technical workgroups, staff at OHPR worked closely with statistical and communications experts who volunteered their time and expertise to contribute to the methods used in this report. Experts represented Oregon Health and Science University, Providence Health Systems, Oregon Healthcare Quality Corporation, as well as members of the Health Policy Commission's Quality and Transparency Workgroup. We are grateful for their contributions and look forward to ongoing collaboration with them.

AHRQ Inpatient Quality Indicator Code and Documentation

Information about steps taken by OHPR to prepare and implement the Agency for Healthcare Research and Quality's (AHRQ) Inpatient Quality Indicator software can be found in the [Technical Data Methods](#).

The most complete and up-to-date information about the Agency for Healthcare Research and Quality (AHRQ) IQI's can be found at http://www.qualityindicators.ahrq.gov/iqi_download.htm. This website provides a user guide, technical manual, and code that generates the calculations. This report used Version 2.1, revision 4a of the IQI Software for SPSS, released May 19, 2005.

Indicator Definitions

AHRQ's Inpatient Quality Indicators pertain to selected **medical conditions** and **surgical procedures**. Inclusion and exclusion criteria are defined by AHRQ for each indicator, for the most part based on **ICD-9-CM diagnosis and procedure** codes. Specific codes and definitions are provided in Appendix A of AHRQ's Guide to Inpatient Quality Indicators¹.

These definitions are integrated into the AHRQ Inpatient Quality Indicator software, which is then applied to inpatient discharge data by **calendar year**.

Inpatient Quality Indicators include **volume** and **death rates** (mortality).

Volume indicators represent the number of discharges that meet the inclusion and exclusion criteria for the given procedure.

- Procedures for which volume is reported have been demonstrated to show a **positive relationship between volume and patient outcomes** in large,

¹ http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_rev4.pdf <accessed 07.14.2005>

representative samples. In general, these procedures are very **specialized** and require a certain degree of experience both by the surgeons and other members of the medical team. Volumes are not reported for conditions.

- The same research literature provides possible **threshold volumes**, which are the volumes at which improved patient outcomes have been observed. These threshold volumes are specific to each procedure and range from as few as 7 and as many as 200 discharges. To assess each hospital's volume indicators, they should be **compared to the corresponding threshold volume**.
- Hospital volumes should be **assessed in conjunction with the corresponding death rates** to obtain a more complete picture of each hospital's performance.
- For **Oregon's** report, **volumes were excluded if all cases were transferred to another hospital** (always fewer than 10 cases).

Death Rates (mortality) represent the percent of discharges with the specified condition or procedure who died in the hospital. Deaths after discharge from the hospital are not captured in these measures. Death rates are risk-adjusted for graphical display (see below), and rates based on less than 30 cases are not included in data displays.

- **Denominator** populations include discharges with the specified conditions or procedures, defined in most cases by ICD-9-CM diagnosis and/or procedure code(s). For some indicators, only certain age groups were included. Discharges that were transferred to another short-term hospital were excluded. In general, maternal and neonate discharge records (MDC 14 and 15) were excluded.
- **Numerator** values are the number of in-hospital deaths that occurred in the denominator population.

Inclusion and exclusion criteria for corresponding **volume** indicators are the same as the denominator, except that transfers to other short-term hospitals are included in volume calculations. Volumes less than five were excluded from data displays.

Risk Adjustment & All of Those Rates

The AHRQ software produces several rates, some of which are associated with the risk adjustment methods, while others are not. While AHRQ's documentation should be considered the authority on these rates (see AHRQ's IQI Software Documentation²), an overview is provided here as well as special considerations for Oregon's Inpatient Quality Indicator report.

Why Risk Adjust? Some patient characteristics such as age, gender, and comorbidities impact the likelihood of dying in the hospital, and some hospitals treat more high-risk patients than others. Risk adjustment "levels the playing field" among hospitals by adjusting for differences in patients treated at each hospital. These risk adjusted values are needed for making hospital-to-hospital comparisons. There are a variety of off the shelf packages as well as regression modeling techniques that can be used for risk adjustment; the AHRQ software integrates the risk adjustment procedure discussed below.

² http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_spss_documentation_rev4.pdf <accessed 07.14.2005>

All-Patient Refined Diagnosis-Related Groups (APR-DRG) is 3M product designed to classify administrative discharge records into clinically-cohesive groups. The base APR-DRG code is similar to the Diagnosis Related Group (DRG) used by the Centers of Medicare and Medicaid Services (CMS) in that it acts as an overall summary code for the nature of the inpatient stay. However, APR-DRGs are **more expansive**, particularly for pediatric populations, and **restructured**. Further, the APR-DRG package classifies the discharge record into two “severity” scores (ranging from 1 to 4) based on comorbidities and other factors: **Risk of Mortality** and **Severity of Illness**. Risk of Mortality was used in the risk adjustment by the AHRQ Inpatient Quality Indicator Software.

It is important to note that there are many software packages and methodologies that assign risk of mortality and/or severity of illness using medical data. APR-DRG was used for this project because it was integrated into AHRQ’s Inpatient Quality Indicator software, and because it is applicable to inpatient discharge record data, fully transparent, and shows statistical performance that is comparable or better than alternative packages. Refer to the [Risk Adjustment Brief](#) for more information about other risk adjustment packages considered.

Risk Adjustment Process. The two key components of risk adjustment are the observed rate and the expected rate. The risk adjusted rate is then obtained using the calculated observed and expected rates.

Observed Death Rate. The observed death rates, or raw rates, are simply the number of events (deaths) divided by the number of discharges for a given condition or procedure. See Appendix A in AHRQ’s Guide to Inpatient Quality Indicators for details about inclusion and exclusion criteria for each condition and procedure.

Expected Death Rate. The expected rate is the death rate that one would expect if the hospital’s performance was the same as the national average, given the hospital’s case mix for a specified indicator. It is the most appropriate rate upon which to compare the *observed rate*.

- AHRQ provides national statistics obtained using a nationally representative sample of inpatient hospital discharge records. AHRQ used multivariate **regression modeling** to predict death rates for various patient characteristics. Age group, gender, APR-DRG (base code), and the APR-DRG Risk of Mortality score were included in the regression model as independent variables, and risk of death was the dependant variable. Risk of death was treated as a **linear** variable, resulting in some complications discussed below.
- The regression **coefficients** from these regression models are applied by the AHRQ Inpatient Quality Indicator software to the discharge records being analyzed. **Expected death rates** are calculated based on the regression coefficients and the patient characteristics at each hospital.
- In sum, the expected rate is based on 1) average death rates for certain patient characteristics (age, gender, APR-DRG, and risk of mortality) in a national sample and 2) the same set of patient characteristics at any given hospital. It is **calculated without regard to the observed rate**.

Risk-Adjusted Death Rate. Risk-adjusted rates are the estimated performance if the hospital had an “average” patient mix, given the actual performance. It is the most appropriate rate upon which to compare *across hospitals*.

- The risk adjusted rate is calculated by adding the difference between the observed and expected rate to the U.S. population rate:

$$\text{risk-adjusted rate} = (\text{observed rate} - \text{expected rate}) + \text{population rate}$$

- In theory, comparing the difference between (or the ratio of) the observed and expected rates is sufficient for assessing higher or lower quality among hospitals. However, adding the population rate translates the difference into a more generally intuitive figure that can be compared across hospitals.
- Because these rates are treated as linear variables, calculated risk-adjusted rates may be less than 0% or more than 100%. The AHRQ software **truncates** these rates at 0% and 100%.
- Risk-adjusted rates generated by the AHRQ software **may be greater than 0% even if observed rate is 0%** if the hospital's patient mix has a relatively expected death rate.
- **Oregon's** Inpatient Quality Report presents these **risk-adjusted rates**. Additionally, the risk-adjusted rate is **reported as 0% if the raw rate is 0%**, even if the risk-adjusted rate calculated by the AHRQ software is greater than 0%. Rationale for this decision is that there is nothing upon which to base the adjustment because there were no observed deaths.

Smoothing. Reporting on infrequent procedures or for small hospitals relies on relatively small numbers of cases, so death rates can be **unstable from year to year**. To address this issue, the AHRQ Inpatient Quality Indicator software calculates smoothed rates.

- Smoothed rates **reduce random variation** in the measures across providers by **adjusting the risk-adjusted rate toward the overall mean according to the degree of reliability of the specific value**.
- In other words, if a hospital with only a **few cases** has a **very high** mortality rate, the smoothed rate will **migrate substantially toward the state average** because 1) due to the small number of cases, the reliability is low, and 2) the distance from the mean is large. On the other hand, smoothed rates will be similar to risk-adjusted rates for hospitals with a large number of cases or for smaller hospitals with rates closer to the statewide average.
- **Oregon's** Inpatient Quality Report **does not present smoothed rates** because 1) it adds complexity to the process that may be unwarranted and 2) the confidence intervals address the unequal variability/uncertainty that the smoothed rates adjust for.

Calculation of Confidence Intervals

Confidence intervals were chosen as the basis of statistical comparison because they allowed comparison **with an intuitively appealing reference (the state average)** and they provide information about both the risk-adjusted death rate **estimate and the reliability of the estimate**. While a number of calculation methods were considered, AHRQ's recommended calculation was selected because 1) it is the current standard and 2) it accounts for the variance associated with the risk adjustment.

AHRQ's recommended method assumes normality of the rates, resulting in symmetric confidence intervals. The standard error is calculated from the root mean square error (RMSE) from AHRQ's risk-adjustment models and the square root of the number of cases. This value represents the uncertainty of the risk adjustment, scaled by the number of cases included in the rate. Confidence intervals were calculated as follows:

$$\text{risk-adjusted rate} \pm z_{(\alpha/2)} * (\text{RMSE} / \sqrt{(n)})$$

Lower bounds were truncated at 0% (no upper bounds exceeded 100%).

AHRQ plans to refine this method in the future by using bootstrap methods for variance estimation; OHPR will update their methods accordingly.

Geographic Regions

Data are presented by geographic regions to facilitate comparisons among hospitals in the same area and that might have similar characteristics. Note that the state average is used as the reference rate used for statistical comparison as well as graphic display for each geographic region.

Geographic regions were defined at the county level and are based on the regions used for the Oregon Population Survey. Due to small numbers of hospital in the eastern portion of the state, four of these regions were combined into two. See [User Guide](#) for a complete list of counties and hospitals contained in each region.