Technical Document

Heart and Stroke Care in Utah Hospitals: Quality and Charges, 2006-2008

Office of Health Care Statistics
Health Data Committee
Utah Department of Health
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Table of Contents

Introduction

Mandates for Publishing Utah Health Care Consumer Reports:

Utah Senate Bill 132, titled "Health Care Consumer's Report" and passed by the 2005 Utah Legislature, requires the Health Data Committee (HDC) to report annually hospital performance for consumers. The public consumer reports shall use nationally recognized quality and patient safety standards and facility (hospital) charges for diseases or conditions. In December 2005, the HDC published the consumer maternity and newborn report, the first in a series of hospital comparison reports on hospital charges, quality and patient safety.

Purpose of the Technical Documentation:

This technical document is one of a series of publications that provide technical information and methodological explanations on the Utah health care consumer reports. Audiences for this publication include hospital personnel, health professionals, health data analysts and other interested professionals.

The Health Data Committee

Chapter 33a, Title 26, Utah Code Annotated established the 13-member Utah Health Data Committee. In accordance with the act, the committee's purpose is:

> *"to direct a statewide effort to collect, analyze, and distribute health care data to facilitate the promotion and accessibility of quality and cost-effective health care and also to facilitate interaction among those with concern for health care issues."*

The SB132 Health Care Consumer's Report Task Force

The Health Data Committee established the SB 132 Health Care Consumer's Report Task Force (SB 132 Task Force) in 2005. The SB132 Task Force is a technical advisory group that provides consultation to the Utah Health Data Committee and its staff members in the Office of Health Care Statistics on measures, methods and priorities for developing health care consumer's reports and the related Web reporting system.

Data Source

The Hospital Discharge Database

Data for the Utah health care consumer reports come from the statewide hospital discharge database. Administrative Rule R428-10, titled "Health Data Authority, Hospital Inpatient Reporting Rule," mandates that all Utah licensed hospitals, both general acute care and specialty, report information on inpatient discharges. Since 1992, all hospitals have reported "discharge data" for each inpatient served. "Discharge data" means the consolidation of complete billing, medical and demographic information describing a patient, the services received, and charges

billed for each inpatient hospital stay. Discharge data records are submitted to the office quarterly. The data elements are based on discharges occurring in each calendar quarter.

Measures Used

Please note that the number of patients for each Agency for Healthcare Research and Quality (AHRQ) Inpatient Quality Indicator (IQI) may not be the same as the number of patients for similar APR-DRGs. First, the APR-DRGs are hierarchical, mutually exclusive groups of conditions and procedures. A patient's APR-DRG reflects that patient's most resource-intensive condition and/or procedure. Second, the IQIs use different inclusion and exclusion criteria than some similarly named APR-DRGs. Third, some IQIs are based on three years of data, because the annual number of deaths per indicator is often small. For example, if a patient has heart bypass surgery without heart catheterization or other major procedures, that patient receives the APR-DRG 166 (Coronary Bypass Without Cardiac Catheterization or Percutaneous Cardiac Procedure). Other heart bypass surgery patients may receive the APR-DRG 161 (Cardiac Defibrillator and Heart Assist Implant) or other APR-DRG depending on the treatment they received in addition to heart bypass surgery.

Sources of Quality Indicators

In compliance with SB 132, the Senate Bill for the Health Care Consumer's Report, the Utah Health Data Committee adopts "nationally recognized standards" for its public reporting on quality and safety. The federal government's agency charged with overseeing health care quality, the Agency for Healthcare Research and Quality (AHRQ) has developed a set of Quality Indicators derived from hospital discharge data. Carolyn M. Clancy, M.D., Director of AHRQ, has saluted Utah's efforts. She said, "AHRQ views public reporting as one important strategy to advance the quality improvement agenda in health care." Dr. Clancy added, "Evidence shows that publicly reporting performance by specific hospitals is a key element that promotes enhanced patient care." A document titled "Guidance for Using the AHRQ Quality Indicators for Hospital-level Public Reporting or Payment" is available at: **http://www.qualityindicators.ahrq.gov/documentation.htm.**

Inpatient Quality Indicators (IQIs]

These indicators were developed by the Agency for Healthcare Research and Quality (AHRQ) based on inpatient hospital discharge data. Although hospital discharge data do have some limitations, research has shown that IQIs may serve as proxies for utilization, quality or patient outcomes. AHRQ IQI definitions and analytical methods were used to calculate the quality indicators in this report. For more detailed information, go to **www.qualityindicators.ahrq.gov/**

Starting with 2006-2008 data, patients with a palliative care code (ICD9 V66.7) are excluded from the IQIs.

This report includes four of the AHRQ IQIs for heart patients and one AHRQ IQI for stroke patients.

Definitions and Codes for Each Quality Indicator

The following pages for the quality indicators used in this report are from AHRQ Quality Indicators, Guide to Inpatient Quality Indicators: Quality of Care in Hospitals, Volume, Mortality, and Utilization. Rockville, MD: Agency for Healthcare Research and Quality, 2002, Version 3.1 (March 2007)
http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_v31.pdf

AHRQ Quality Indicators, Inpatient Quality Indicators Technical Specifications, 2002, Version 3.2a (March 2008)
http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_technical_specs_v32a.pdf

Coronary Artery Bypass Graft Mortality Rate (IQI 12)

Coronary artery bypass graft (CABG) is a relatively common procedure that requires proficiency with the use of complex equipment. Technical errors may lead to clinically significant complications such as myocardial infarction, stroke, and death.

Relationship to Quality	Better processes of care may reduce mortality for CABG, which represents better quality care.
Benchmark	State, regional, or peer group average.
Definition	Number of deaths per 100 discharges with procedure code of CABG.
Numerator	Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator.
Denominator	Discharges, age 40 years and older, with ICD-9-CM codes of 3610 through 3619 in any procedure field. Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates)
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Procedures

Coronary Artery Bypass Graft (CABG) Mortality Rate (IQI 12)
Numerator: Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator.
Denominator: Discharges, age 40 years and older, with ICD-9-CM codes of 3610 through 3619 in any procedure field. ICD-9-CM CABG procedure codes: 3610 AORTOCORONARY BYPASS NOS 3611 AORTOCOR BYPAS-1 COR ART 3612 AORTOCOR BYPAS-2 COR ART 3613 AORTOCOR BYPAS-3 COR ART 3614 AORTCOR BYPAS-4+ COR ART 3615 1 INT MAM-COR ART BYPASS 3616 2 INT MAM-COR ART BYPASS 3617 ABD-CORON ART BYPASS OCT96- 3619 HRT REVAS BYPS ANAS NEC Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates)

END IQI 12

Percutaneous Transluminal Coronary Angioplasty (IQI 30)

Percutaneous transluminal coronary angioplasty (PTCA), or balloon angioplasty, is a relatively common procedure that requires proficiency with the use of complex equipment, and technical errors may lead to clinically significant complications. The definition for PTCA mortality rate (IQI 30) is also noted below. The QI software calculates mortality for PTCA, so that the volumes for this procedure can be examined in conjunction with mortality. However, the mortality measure should not be examined independently, because it did not meet the literature review and empirical evaluation criteria to stand alone as its own measure.

Relationship to Quality	Better processes of care may reduce short-term mortality, which represents better quality care.
Definition	Number of deaths per 100 PTCAs.
Numerator	Number of deaths among cases meeting the inclusion and exclusion rules for the denominator.
Denominator	Discharges, age 40 years and older, with ICD-9-CM codes 0066, 3601, 3602, 3605 in any procedure field. Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates)
Type of Indicator	Provider Level, Mortality Indicator – Recommended for use only with the corresponding volume indicator above.

PTCA Mortality Rate (IQI 30)

Numerator:

Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator.

Denominator:

Discharges, age 40 years and older, with ICD-9-CM codes of 0066, 3601, 3602 or 3605 in any procedure field.

ICD-9-CM PTCA procedure codes:

0066	PERC TRANS CORO ANGIO OCT05-
3601	PTCA-1 VESSEL W/O AGENT
3602	PTCA-1 VESSEL WITH AGNT
3605	PTCA-MULTIPLE VESSEL

Exclude cases:

- missing discharge disposition (DISP=missing)
- transferring to another short-term hospital (DISP=2)
- MDC 14 (pregnancy, childbirth, and puerperium)
- MDC 15 (newborns and other neonates)

END IQI 30

Acute Myocardial Infarction Mortality Rate (IQI 32)

Timely and effective treatments for acute myocardial infarction (AMI), which are essential for patient survival, include appropriate use of thrombolytic therapy and revascularization.

Relationship to Quality	Better processes of care may reduce mortality for AMI, which represents better quality care.
Benchmark	State, regional, or peer group average.
Definition	Number of deaths per 100 discharges with a principal diagnosis code of AMI.
Numerator	Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator
Denominator	All discharges, age 18 years and older, with a principal diagnosis code of AMI. Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • missing admission source (SID ASOURCE=missing) • transferring from another short-term hospital (SID ASOURCE=2)
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Conditions

Acute Myocardial Infarction (AMI) Mortality Rate, Without Transfer Cases (IQI 32)

Numerator:

Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator.

Denominator:

All discharges, age 18 years and older, with a principal diagnosis code of AMI.

ICD-9-CM AMI diagnosis codes:

41001	AMI ANTEROLATERAL, INIT	41051	AMI LATERAL NEC, INITIAL
41011	AMI ANTERIOR WALL, INIT	41061	TRUE POST INFARCT, INIT
41021	AMI INFEROLATERAL, INIT	41071	SUBENDO INFARCT, INITIAL
41031	AMI INFEROPOST, INITIAL	41081	AMI NEC, INITIAL
41041	AMI INFERIOR WALL, INIT	41091	AMI NOS, INITIAL

Exclude cases:

- missing discharge disposition (DISP=missing)
- transferring to another short-term hospital (DISP=2)
- missing admission source (SID ASOURCE=missing)
- transferring from another short-term hospital (SID ASOURCE=2)

END IQI 32

Congestive Heart Failure Mortality Rate (IQI 16)

Congestive heart failure (CHF) is a progressive, chronic disease with substantial short-term mortality, which varies from provider to provider.

Relationship to Quality	Better processes of care may reduce short-term mortality, which represents better quality care.
Benchmark	State, regional, or peer group average.
Definition	Number of deaths per 100 discharges with principal diagnosis code of CHF.
Numerator	Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator
Denominator	All discharges, age 18 years and older, with a principal diagnosis code of CHF. Exclude cases • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates).
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Conditions

Congestive Heart Failure (CHF) Mortality Rate (IQI 16)

Numerator:

Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator.

Denominator:

All discharges, age 18 years and older, with principal diagnosis code of CHF.

ICD-9-CM CHF diagnosis codes:

39891	RHEUMATIC HEART FAILURE	42821	AC SYSTOLIC HRT FAILURE OCT02-
40201	MAL HYPERT HRT DIS W CHF	42822	CHR SYSTOLIC HRT FAILURE OCT02-
40211	BENIGN HYP HRT DIS W CHF	42823	AC ON CHR SYST HRT FAIL OCT02-
40291	HYPERTEN HEART DIS W CHF	4289	HEART FAILURE NOS
40401	MAL HYPER HRT/REN W CHF	42830	DIASTOLIC HRT FAILURE NOS OCT02-
40403	MAL HYP HRT/REN W CHF&RF	42831	AC DIASTOLIC HRT FAILURE OCT02-
40411	BEN HYPER HRT/REN W CHF	42832	CHR DIASTOLIC HRT FAIL OCT02-
40413	BEN HYP HRT/REN W CHF&RF	42833	AC ON CHR DIAST HRT FAIL OCT02-
40491	HYPER HRT/REN NOS W CHF	42840	SYST/DIAST HRT FAIL NOS OCT02-
40493	HYP HT/REN NOS W CHF&RF	42841	AC SYST/DIASTOL HRT FAIL OCT02-
4280	CONGESTIVE HEART FAILURE	42842	CHR SYST/DIASTL HRT FAIL OCT02-
4281	LEFT HEART FAILURE	42843	AC/CHR SYST/DIA HRT FAIL OCT02-
42820	SYSTOLIC HEART FAILURE NOS OCT02-		

Exclude cases:

- missing discharge disposition (DISP=missing)
- transferring to another short-term hospital (DISP=2)
- MDC 14 (pregnancy, childbirth, and puerperium)
- MDC 15 (newborns and other neonates)

END IQI 16

Acute Stroke Mortality Rate (IQI 17)

Quality treatment for acute stroke must be timely and efficient to prevent potentially fatal brain tissue death, and patients may not present until after the fragile window of time has passed.

Relationship to Quality	Better processes of care may reduce short-term mortality, which represents better quality care.
Benchmark	State, regional, or peer group average.
Definition	Number of deaths per 100 discharges with principal diagnosis code of stroke.
Numerator	Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator
Denominator	All discharges, age 18 years and older, with a principal diagnosis code of stroke. Exclude cases: • missing discharge disposition (DISP=missing) • transferring to another short-term hospital (DISP=2) • MDC 14 (pregnancy, childbirth, and puerperium) • MDC 15 (newborns and other neonates)
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Conditions

Stroke Mortality Rate (IQI 17)

Numerator:

Number of deaths (DISP=20) among cases meeting the inclusion and exclusion rules for the denominator.

Denominator:

All discharges, age 18 years and older, with a principal diagnosis code of stroke.

ICD-9-CM Stroke diagnosis codes:
430 SUBARACHNOID HEMORRHAGE
43331 MULT PRECER OCCL W/ INFRCT
431 INTRACEREBRAL HEMORRHAGE
43381 PRECER OCCL NEC W/ INFRCT
4320 NONTRAUM EXTRADURAL HEM
43391 PRECER OCCL NOS W/ INFRCT
4321 SUBDURAL HEMORRHAGE
43401 CERE THROMBOSIS W/ INFRCT
4329 INTRACRANIAL HEMORR NOS
43411 CERE EMBOLISM W/ INFRCT
43301 BASI ART OCCL W/ INFARCT
43491 CEREB OCCL NOS W/ INFRCT
43311 CAROTD OCCL W/ INFRCT
436 CVA*
43321 VERTB ART OCCL W/ INFRCT
*Only for discharges before September 30, 2004 (FY2004). Does not apply to discharges on or after October 1, 2004 (FY2005).

Exclude cases:

- missing discharge disposition (DISP=missing)
- transferring to another short-term hospital (DISP=2)
- MDC 14 (pregnancy, childbirth, and puerperium)
- MDC 15 (newborns and other neonates)

END IQI 17

AHRQ Rates for Quality Indicators

The Agency for Healthcare Research and Quality (AHRQ) Quality Indicators (QI) Software outputs several rates. The AHRQ Quality Indicators e-Newsletter, June 2005, provided guidance to users for appropriate rates to use for specific purposes.

QI Tips: Using Different Types of QI Rates

Which rate should you use: the observed (actual), expected, risk adjusted, and/or smoothed rates?

Here are some guidelines.

If the user's primary interest is to identify cases for the health care provider's internal follow-up and quality improvement, then the **observed rate** would help to identify them. *The observed rate is the raw rate generated by the QI software from the data the user provided.* Areas for improvement can be identified by the magnitude of the observed rate compared to available benchmarks and/or by the number of patients impacted.

Additional breakdowns by the default patient characteristics used in stratified rates (e.g., age, gender, or payer) can further identify the target population. Target populations can also be identified by user-defined patient characteristics supplemented to the case/discharge level flags. Trend data can be used to measure change in the rate over time.

Another approach to identifying areas of focus is to compare the observed and **expected rates**. *The expected rate is the rate the provider would have if it performed the same as the reference population given the provider's actual case mix (e.g., age, gender, APR-DRG and comorbidity categories*). This case mix is not the same as the Case Mix Index calculated and reported in the Office of Health Care Statistics Standard Reports. An example of how the expected rate is calculated appears later in this document.

If the observed death rate is higher than the expected rate (i.e., the ratio of observed/expected is greater than 1.0, or observed minus expected is positive), the implication is that the provider had more deaths than the reference population for that particular indicator. Users may want to focus on these indicators for quality improvement.

If the observed death rate is lower than the expected rate (i.e., the ratio of observed/expected is less than 1.0, or observed minus expected is negative), the implication is that the provider had fewer deaths than the reference population. Users may want to focus on these indicators for identifying best practices.

If the observed use rate is higher than the expected rate, the implication is that the provider had more patients with the specified procedure than the reference population for that particular indicator. If the observed use rate is lower than the expected rate, then the implication is that the provider had fewer patients with the specified procedure than the reference population for that particular indicator.

Users can also compare the expected rate to the **population rate** reported in the detailed evidence section of the IQI, PQI, or PSI Guide to determine how their case mix compares to the

reference population. If the population rate is higher than the expected rate, then the provider's case mix is less severe than the reference population. If the population rate is lower than the expected rate, then the provider's case mix is more severe than the reference population.

AHRQ uses this difference between the population rate and the expected rate to "adjust" the observed rate to account for the difference between the case mix of the reference population and the provider's case mix. This is the provider's **risk-adjusted rate**.

If the provider has a less severe case mix, then the adjustment is positive (population rate > expected rate) and the risk-adjusted rate is higher than the observed rate. If the provider has a more severe case mix, then the adjustment is negative (population rate < expected rate) and the risk-adjusted rate is lower than the observed rate. *The risk-adjusted rate is the rate the provider would have if it had the same case mix as the reference population given the provider's actual performance.*

Finally, users can compare the risk-adjusted rate to the **smoothed** or "reliability-adjusted" rate to determine whether the difference between the risk-adjusted rate and reference population rate is likely to remain in the next measurement period. *Smoothed rates are weighted averages of the population rate and the risk-adjusted rate, where the weight reflects the reliability of the provider's risk-adjusted rate.*

A ratio of (smoothed rate - population rate) / (risk-adjusted rate - population rate) greater than 0.80 suggests that the difference is likely to persist (whether the difference is positive or negative). A ratio of less than 0.80 suggests that the difference may be due in part to random differences in patient characteristics (patient characteristics that are not observed and controlled for in the risk-adjustment model). In general, users may want to focus on areas where the differences are more likely to persist.

From http://qualityindicators.ahrq.gov/newsletter/2005-June-AHRQ-QI-Newsletter.htm#Headline3 (Accessed on July 16, 2008).

Expected Death Percentage

Expected death percentage is the number of deaths expected per 100 patients with a certain heart condition or procedure if the hospital performed the same as other hospitals in the nation with similar patients. Expected death percentage adjusts for the hospital's case mix (patients' age, gender and how ill the patients are). For example, a hospital's heart attack expected death percentage is the number of expected patient deaths per 100 heart attack patients in that hospital if it performed similarly with patients similar to those in the Health Care Cost and Utilization Project (HCUP) State Inpatient Databases for 2006, which contain the most recent, available national data. For more information on the AHRQ Inpatient Quality Indicators, see: www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_v32.pdf.

Statistical Tests and Rating System for Quality Indicators

Star Rating

The star rating system in the report is based on a test of statistical significance. This test shows

whether the difference between a hospital's observed (actual) rate and the expected rate is real or just due to chance. For each indicator, the upper and lower 95% confidence intervals were calculated for each hospital's rate. The 95% confidence interval is the interval that one can be 95% certain contains the "true" hospital average. The 95% confidence interval for each hospital was then compared to the expected rate. When the lower limit of 95% confidence interval of a hospital rate is higher than the expected rate, the hospital rate is significantly higher than the expected rate. It is rated as one star, " * ". When the higher limit of 95% confidence interval of a hospital rate is lower than the expected rate, the hospital rate is significantly lower than the expected rate. It is rated as three stars, " *** ". When a hospital's 95% confidence interval overlaps with the expected rate, the hospital rate is not significantly different from the expected rate and is rated as two stars, " ** ". For selected death rate indicators, if a hospital had no deaths and had at least 30 discharges in the denominator for three years, the hospital received three stars.

Keep in mind that many factors affect a hospital's rates. For example, in this health care consumer report series a hospital that cares for a higher percentage of high-risk patients may have a higher rate of a quality indicator than a hospital that cares for a lower percentage of high-risk patients, which does not mean that the hospital delivers poor quality care.

95% Confidence Interval

Most methods for calculation of confidence intervals assume a normal distribution among the values for which the confidence intervals are calculated. However, these formulas do not work well on small numbers. The formula for exact confidence intervals does not assume a normal distribution. Instead, confidence intervals of the actual (observed) rate are calculated using the method of exact confidence intervals for the cumulative binomial distribution (Holubkov, 1998). This method is more appropriate for rates based on small numbers than other methods and is used in this report's rating system.

The statistical formulas to calculate standard errors and 95% confidence intervals are as follows:

[[Pi].sub.L]=x/(x+[n-x+1][F.sub..025,2n-2x+2,2x])
[[Pi].sub.U]=(x+1)/(x+1+[n-x][[[F.sub..025,2x+2,2n-2x]].sup.-1])

Formulas used in an Excel spread sheet to calculate the values for indicators based on number of patients per 100 are:

95% CI LowerLimit = (x/(x+(n-x+1)*finv(0.025, (2*(n-x)+2), 2*x))*100
95% CI UpperLimit = ((x+1)/(x+1+(n-x)/finv(0.025, 2*x+2, 2*(n-x))))*100

Where:
[Pi].sub.L = Value of 95% Confidence Interval Lower Limit
[Pi].sub.U = Value of 95% Confidence Interval Lower Limit
x = numerator/number of events
n = denominator/number of risk population
F = F distribution
F.sub..025 = Selected critical value for 95% Confidence Interval

For indicators based on number of patients per 1,000, the formulas are the same except that the last term is 1,000 instead of 100.

The health care consumer reports use the values that these formulas produce. An exception is cases in which the lower limit is a negative value. These negative values are converted to zero.

Reference: Holubkov, R. 1998 (August). "Analysis, assessment, and presentation of risk-adjusted statewide obstetrical care data: the StORQS II study in Washington State-Statewide Obstetrics Review and Quality System," published in Health Service Research.

Health care consumer reports may use some of the following additional methods:

I. AHRQ Method for Calculating Standard Errors for Actual [Observed) Rates

1) The root mean squared error (RMSE) for each QI for "Hospital J" is:

RMSE = sqrt(RATEij*(1-RATEij))

where RATEij is the observed rate for "QI #i" and "Hospital J"

2) The standard error on the observed rate for "Hospital J" is:

SE=RMSE/ SQRT (Nij)

where Nij is the denominator for "QI #i" and "Hospital J"

4) The 95% confidence interval on the observed rate for "Hospital J" for each QI is:

Lower confidence interval = "Hospital J" observed rate – (1.96 * SE)
Upper confidence interval = "Hospital J" observed rate + (1.96 * SE)

5) For example, if the rate for "Hospital J" for IQI #12 is Rate=0.10 and the denominator is N=20,000, then the lower bound 95% CI is:

0.10 - 1.96 * sqrt[(0.10 * (1-0.10)) / 20000] =
0.10 - 1.96 * 0.021213 =
0.10 - 0.041578

and the upper bound 95% CI is:

0.10 + 1.96 * sqrt[(0.10 * (1-0.10)) / 20000] =
0.10 + 1.96 * 0.021213 =
0.10 + 0. 041578

II. Calculating Standard Errors for the IQI Risk-adjusted Rates

Risk adjusted rates

1) Open the file IQI_V21_R4_RMSE.xls in the AHRQ Quality Indicator Software Package

2) The column labeled "RMSE" is the root mean squared error (RMSE) for each IQI based on the risk-adjustment model.

3) The standard error on the risk-adjusted rate for "Hospital J" is:

   SE=SQRT(MSE/Nij) = RMSE/ SQRT (Nij)

   where Nij is the denominator for "IQI #i" and "Hospital J"

4) The 95% confidence interval on the risk-adjusted rate for "Hospital J" for each IQI is:

   Lower confidence interval = "Hospital J" risk-adjusted rate – (1.96 * SE)
   Upper confidence interval = "Hospital J" risk-adjusted rate + (1.96 * SE)

5) For example, if the denominator for "Hospital J" for IQI #12 is N=20,000, then RMSE= 0.171757 and the lower bound 95% CI is:

   rate - 1.96 * (0. 171757 / sqrt(20000)) =
   rate - 1.96 * 0.012145 =
   rate - 0.023804

and the upper bound 95% CI is:

rate + 1.96 * (0. 171757 / sqrt(20000)) =
rate + 1.96 * 0.012145 =
rate + 0.023804

Example for Expected Rate Calculation for Quality Indicators

The expected rate comes from a logistic regression AHRQ analysts have run on all inpatients in the National Inpatient Database 2006. The logistic regression produces coefficients (or weights) for each variable for each AHRQ Inpatient Quality Indicator (IQI). The variables vary by Indicator. Each Indicator has selection criteria for which patients to include. The AHRQ software assigns coefficients for each included inpatient, depending on the inpatient's values for each of the indicator's variables. The sum of the inpatient's coefficients gives this inpatient's contribution to the expected rate for a particular indicator for the hospital at which this inpatient was treated. The sum of all the hospital's inpatients' contributions is the hospital's expected rate. In this way, the expected rate shows the expected rate for other similar inpatients nationwide, providing a national comparison for each Utah hospital and Utah overall.

For Congestive Heart Failure Death (IQI 16), the logistic regression equation is
M = I + C1 + C2 + C3 + C4
where

M = inpatient's contribution to the expected rate
I = intercept
C1 = age coefficient
C2 = sex coefficient
C3 = age sex interaction coefficient
C4 = APR-DRG risk of mortality interaction coefficient

For example, among all congestive heart failure patients IQI 16 includes in its denominator, a congestive heart failure female inpatient, age 57, with a minor level of risk of mortality contributes to her hospital's expected rate

-5.618 = -5.378 + (-0.072) + (-0.154) + (-0.014) + 0.000

and a congestive heart failure female inpatient, age 87, with an extreme level of risk of mortality contributes to her hospital's expected rate

-0.404 = -5.304 + 0.000 + 0.666 + 0.000 + 4.308

for all other congestive heart failure patients. The M values for all IQI 16 congestive heart failure inpatients are combined using the following formula to give the hospital's expected death rate for congestive heart failure. See
http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_covariates_v31.pdf

ER = sum(Exp(M) / (1.000 + Exp(M)) / P)
where

ER = expected death rate
Exp = exponent function, in this case, e raised to the power of M
M = inpatient's contribution to the expected rate
P = number of patients this indicator includes for this hospital

The expected death rate for Utah overall is the above formula for all Utah inpatients selected for this AHRQ congestive heart failure indicator.

Limitations of Quality Indicators

Many factors affect a hospital's performance on utilization measures. Such factors include the hospital's size, the number of heart and stroke patients treated, available specialists, teaching status and especially the medical history of the hospital's patients and how ill those patients are. Hospitals that treat high-risk (very ill) patients may have higher death rates than hospitals that transfer these patients. Hospitals that treat patients with do-not-resuscitate (DNR) orders may have higher percentages of deaths. Hospitals may report patient diagnosis codes differently, which could impact the comparison of utilization measurement among hospitals. Quality indicators adjust for how ill each hospital's patients are, but the adjustment may not capture the full complexity of the patient's condition. The Utah Hospital Discharge Database includes up to nine diagnoses and up to six procedures for each patient. Some patients have additional

diagnoses and procedures that are not included in this database. As a result, the measures of inpatient illness may not be complete.

Method of Reporting Charges

Use of All-patient Refined Diagnosis Related Group (APR-DRG)

The APR-DRG classification system is used in the Utah health care consumer reports to categorize discharge records into different disease/condition groups of patients.

- **Diagnosis Related Group (DRG)**

The DRG, developed for the federal Health Care Financing Administration, is a patient classification scheme that relates the type of patients a hospital treats (i.e., its case mix) to the costs incurred by the hospital. While all patients are unique, groups of patients have common demographic, diagnostic and therapeutic attributes that determine their resource needs. All patient classification schemes capitalize on these commonalities and utilize the same principle of grouping patients by common characteristics.

The use of DRGs as the basic unit of payment for Medicare patients represents a recognition of the fundamental role a hospital's "sicker" patients play in determining resource usage and costs, at least on average. "The DRGs, as they are now defined, form a manageable, clinically coherent set of patient classes that relate a hospital's case mix to the resource demands and associated costs experienced by the hospital." (*Diagnosis Related Groups, Seventh Rev., Definitions Manual*, page 15.)

Each discharge in the Utah Health Discharge Database was assigned a DRG based on the principal diagnosis, secondary diagnoses, surgical procedures, age, sex and discharge status of the patient.

- **APR-DRG and Patient Severity Level**

APR-DRG software is widely used in health services research. The APR-DRG software organizes about 20,000 clinical diagnoses and procedures into about 300 hierarchical, mutually exclusive groups. As stated previously, each inpatient is assigned a single APR-DRG that reflects the most complex care that the inpatient received and the most hospital resources used to care for the inpatient. An inpatient may not belong to more than one APR-DRG. For example, if a heart inpatient had heart bypass surgery and also had a heart attack during that hospital stay, that inpatient would be assigned APR-DRG 190 (Acute Myocardial Infarction), not APR-DRG 166 (Coronary Artery Bypass Surgery Without Cardiac Catheterization or Percutaneous Cardiac Procedure).

Each APR-DRG has four levels for severity of illness. The severity of illness and risk of mortality subclasses have levels of 1 to 4, indicating minor, moderate, major and extreme, respectively. In the consumer reports, patients are assigned to one of two groups. Patients with a minor or moderate level of severity of illness are in the Minor/Moderate group and patients who are assigned a major or extreme level of severity of illness are in the Major/Extreme group.

Patients whose care is classified in the Major/Extreme group are those who have multiple conditions, diseases, illnesses or are much sicker than patients who are classified in the Minor/Moderate group. This report uses APR-DRG version 20.0 for expected deaths, because AHRQ uses this version for risk adjustment in the Inpatient Quality Indicators. This report also uses APR-DRG version 20.0 for average charges. Read more about APR-DRGs at http://solutions.3m.com/wps/portal/3M/en_US/3M_Health_Information_Systems/HIS/Products/APRDRG_Software/.

Note that other Health Data Committee reports, such as the Utah Inpatient Hospital Utilization and Charges Profile, Hospital Detail report for 2004 and previous years, use APR-DRG Version 15.0.

Excluding Outlier Cases from Calculating Hospital Average Charges

Some patients have exceptionally low or high lengths of stay or total facility (hospital) charges. A hospital's charges can be affected by just a few unusually long (or short) or expensive (or inexpensive) cases. These high or low values could be a result of coding or data submittal errors, particularly in length of stay, total charges, or data elements that affect APR-DRG assignments. Other reasons for exceptionally low charges could be due to death or transfer to another hospital. Exceptionally high charges could be due to a catastrophic condition. Whatever the reason, these values, referred to as "outliers," distort the averages and were excluded from calculations. Following the "industry standards" and research conventions in statistics, high charge outliers are defined in this report, as well as those preceding and succeeding it, as values above 2.5 standard deviations from the state mean for each of the four levels of severity of illness for each APR-DRG. Means and standard deviations are APR-DRG-specific and calculated on a statewide basis for a specific calendar year. For this report, the high outlier cases for both charge and length of stay are excluded from calculation of hospital average charges.

Facility Charge is Used for the Consumer Reports

The Utah Hospital Discharge Database contains two types of charge summary information:

(1) Total Charge: Sum of all charges included in the billing form, including both facility charges and professional fees and patient convenience items. This is different from *cost* of treatment or *payment* received by the hospital.
(2) Facility Charge: Sum of all charges related to using a hospital. Facility charge is calculated by subtracting professional fees and patient convenience item charges from total charge.

The facility charge is used for public reporting on hospital charges.

Payment received by the hospital may be less than the total charges billed for the patient's hospital stay due to contractual agreements with the insurance plans and/or charity/hardship programs available.

Average Charge:

Average charge is the calculated average for all services for which patients in a particular

severity of illness group (one of two groups in this report, minor/moderate or major/extreme) were billed as the facility charges at a particular hospital for a given condition or procedure. The average was calculated by adding the facility charges for all services billed at that hospital for a given condition or procedure and then dividing by the total number of patients in this severity of illness group for that condition or procedure. For example, the average facility charge for stroke patients with a moderate level of severity of illness at Hospital A would be the sum of the facility charges for this hospital's stroke patients with a moderate level of severity of illness divided by the sum of Hospital A's stroke patients with a moderate level of severity of illness.

The method of calculating the average facility charge is identical to the method used in the HDC standard report: Utah Hospital Utilization and Charge Profile, Hospital Details, Table ST 1-3. In other words, both publications report average facility charges at APR-DRG and patient level for severity of illness (one of four levels for each APR-DRG) without high outliers.

Average Length of Stay:

The average length of stay was the sum of days all patients stayed in the hospital for a certain condition or procedure divided by the total number of patients who were treated for that condition or procedure. For example, the average length of stay for stroke patients with a moderate level of severity of illness at Hospital A would be the sum of the days of stay for this hospital's stroke patients with a moderate level of severity of illness divided by the sum of Hospital A's stroke patients with a moderate level of severity of illness.

The method of calculating the average length of stay is the identical method used in the Health Data Committee's standard report: Utah Hospital Utilization and Charge Profile, Hospital Details (ST-1) Table ST 1-3. The average hospital length of stay excludes high outliers by APR-DRG and patient severity level.

Limitations of Charge Indicators

The average charge shown in this report differs from "costs," "reimbursement," "price" and "payment." Many factors will affect the cost of your hospital stay, including whether you have health insurance, the type of insurance and the billing procedures at the hospital. This report excludes outlier (unusually high) charge cases and length of stay cases from the calculation of average charge (see Glossary).

This report shows total billed facility charges. Billed charges are to be used as only one indicator of hospital performance. All patients, or insurance plans, do not pay the same amount for similar treatments, supplies, services and procedures, even though they may be billed the same amount. Different payers have varied arrangements with each hospital for payment. Hospitals offer a variety of contracts, many with discount arrangements based on volume. Because of this, the data reflect pre-contractual prices for hospitalization and not the actual payment between providers and payers. Each patient may have additional charges from physicians, such as the surgeon and the anesthesiologist.

This report can be used to compare broad measures of utilization for all hospitals, but more detailed data are needed to look at specific performance comparisons between hospitals. This information serves as an important first step toward consumers' taking a more active role in health care decision-making.

The price of hospital services, while important, is not the only consideration in making inpatient hospital decisions. Other factors can influence hospital services, including: the type of condition treated, the physicians who practice at the hospital, and the insurance company's managed care policies. The health plan subscriber should be familiar with his or her health plan long before hospital care is needed. For additional information on managed care performance, please contact the Office of Health Care Statistics at 801-538-7048.

Types of Stroke

This report includes some but not all types of stroke among adult hospital inpatients (age 18 years and older). Though stroke can be a serious illness for children, the causes, course of disease, and outcomes are different for adults.

In-hospital Deaths Among Stroke Patients

The indicator for in-hospital deaths among adult stroke patients (AHRQ IQI 17) differs from the indicator for average hospital charges. Whereas the charge indicator includes all ICD-9-CM codes for APR-DRG 045, the stroke deaths indicator includes some but not all types of stroke from:

APR-DRG 044 Intracranial Hemorrhage
APR-DRG 045 Cerebral Vascular Accident (CVA) and Precerebral Occlusion With Infarction
APR-DRG 046 Nonspecific CVA and Precerebral Occlusion Without Infarction

A complete list of types of stroke included in this indicator is on page 9 of this document. A list that shows the ICD-9-CM codes for these types of stroke by APR-DRG follows later in this document.

Average Hospital Charge

The average hospital charge in this report is for patients in the All Patient Refined Diagnosis Related Group 045 (APR-DRG 045) Cerebral Vascular Accident and Precerebral Occlusion With Infarction. This includes some of the more common types of stroke. It does not include APR-DRG 044 (Intracranial Hemorrhage) or APR-DRG 046 (Nonspecific Cerebral Vascular Accident and Precerebral Occlusion Without Infarction). This report includes a hospital level table for APR-DRG 045. It also includes Utah overall information for APR-DRGs 044 and 046 in the Key Findings. A complete list of types of stroke included in APR-DRG 045 follows later in this document.

AHRQ In-hospital Stroke Deaths (IQI 17) ICD-9-CM Diagnosis Codes by APR-DRG (v. 20.0) and DRG (2006)

Code	Description	IQI 17	APR-DRG 044	APR-DRG 045	APR-DRG 046
094.87	Syphilitic ruptured cerebral aneurysm		**X**		
430	Subarachnoid hemorrhage	X	X		
431	Intracerebral hemorrhage	X	X		
432.0	Nontraumatic extradural hemorrhage	X	X		
432.1	Subdural hemorrhage	X	X		
432.9	Intracranial hemorrhage not otherwise specified	X	X		
433.00	Occlusion and stenosis of basilar artery without mention of cerebral infarction				X
433.01	Occlusion and stenosis of basilar artery with cerebral infarction	X		X	
433.10	Occlusion and stenosis of carotid artery without mention of cerebral infarction				X
433.11	Occlusion and stenosis of carotid artery with cerebral infarction	X		X	
433.20	Occlusion and stenosis of vertebral artery without mention of cerebral infarction				X
433.21	Occlusion and stenosis of vertebral artery with cerebral infarction	X		X	
433.30	Occlusion and stenosis of multiple and bilateral precerebral arteries without mention of cerebral infarction				X
433.31	Occlusion and stenosis of multiple and bilateral precerebral arteries with cerebral infarction	X		X	
433.80	Occlusion and stenosis of other specified precerebral artery without mention of cerebral infarction				X
433.81	Occlusion and stenosis of other specified precerebral artery with cerebral infarction	X		X	
433.90	Occlusion and stenosis of unspecified precerebral artery without mention of cerebral infarction				X

AHRQ In-hospital Stroke Deaths (IQI 17) ICD-9-CM Diagnosis Codes by APR-DRG (v. 20.0) and DRG (2006) (continued)

Code	Description	IQI 17	APR-DRG 044	APR-DRG 045	APR-DRG 046
433.91	Occlusion and stenosis of unspecified precerebral artery with cerebral infarction	X		X	
434.00	Cerebral thrombosis without mention of cerebral infarction				X
434	Cerebral thrombosis with cerebral infarction	X		X	
434.10	Cerebral embolism without mention of cerebral infarction				X
434.11	Cerebral embolism with cerebral infarction	X		X	
434.90	Cerebral artery occlusion not otherwise specified without infarction				X
434.91	Unspecified cerebral artery occlusion with cerebral infarction	X		X	
436	Cerebral vascular accident	X			X
443.21	Dissect carotid artery				X
443.24	Dissect vertebral artery				X
767.0	Cerebral hemorrhage at birth		X		
772.10	Intraventricular hemorrhage, unspecified grade		X		
772.11	Intraventricular hemorrhage, Grade I		X		
772.12	Intraventricular hemorrhage, Grade II		X		
772.13	Intraventricular hemorrhage, Grade III		X		
772.14	Intraventricular hemorrhage, Grade IV		X		
772.2	Fetal and neonatal subarachnoid hemorrhage of newborn		X		