



# AHRQ Quality Indicators Mapping Tool Documentation and User Guide

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## Introduction: What Is the Quality Indicators (QI) Mapping Tool?

The QI Mapping Tool is a software program that:

- Maps selected AHRQ Quality Indicators (QIs) for a State, by county.
- Estimates the cost savings associated with reducing the level of potentially avoidable hospitalizations.

This tool assists health care decisionmakers in identifying communities for future interventions—such as programs to improve preventive services, primary care, or patient safety—and in tracking the impact of such interventions over time. By overlaying residence data, the program shows where interventions can have the biggest impact for certain health plan enrollees or other target populations.

The QI Mapping Tool uses a set of programs written in the SAS<sup>®</sup> programming language that read in user-supplied SAS<sup>®</sup> datasets of hospital discharge records. The program calculates the county-level rates for each of the area-level indicators in AHRQ's four QI modules:

- Prevention Quality Indicators (PQIs).
- Inpatient Quality Indicators (IQIs).
- Patient Safety Indicators (PSIs).
- Pediatric Quality Indicators (PDIs).

The QI Mapping Tool will:

- Produce maps displaying the county-level QI rates.
- Overlay user-defined population data, assuming the user can supply these additional datasets. This tool can calculate the expected cost savings for a 10- to 50-percent reduction in cases for each county. With this function, the user supplies the supplementary charge information for inputted discharge records.
- Display county-level rates and cost-reduction data in SAS<sup>®</sup> as well as in Microsoft Excel<sup>®</sup> format.

## Who Can Benefit From Using This Tool?

The QI Mapping Tool was designed to help health care policymakers and administrators analyze their own hospital inpatient discharge data in order to assess the magnitude of problems they face and identify interventions to reduce potentially preventable hospitalizations and medical errors. Therefore, the tool would be useful for employers, employer coalitions, Medicaid programs, health departments, hospitals, health systems, health plans, and researchers interested in population-based quality measures.

Examples of how certain groups of users might apply the QI Mapping Tool to address pressing policy questions include the following:

- **Hospitals and hospital systems** could use the tool to assess how hospital cesarean section rates compare across the State or identify which hospitals have similar mortality rates following hip replacement.
- **State data organizations and community health partnerships** could use the tool to provide initial feedback about clinical areas appropriate for further, more in-depth analysis, such as creating a comparison of hysterectomy rates across the State.
- **Managed care organizations, business-health coalitions, and State data organizations** could use the analysis to design community interventions that reduce hospital admission rates in areas with high rates of diabetes complications.
- **State policymakers** could use the tool to track health care quality in the State over time. For example, to assess whether health care quality is improving they can look at how the rate of coronary artery bypass graft procedures varies over time and across the State.

If you have a working understanding of the SAS<sup>®</sup> program software and past experience with Microsoft Excel<sup>®</sup>, you can use the QI Mapping Tool. However, you must also input hospital administrative data to SAS<sup>®</sup> in a prespecified way using the step-by-step guidance provided in this guide.

Although you do not need expertise in data manipulation to use the QI Mapping Tool, a localized understanding of the hospitals and the surrounding communities in your area will serve to heighten the presentation and application of the findings.

## What Kinds of Questions Does This Tool Address?

The AHRQ QIs can be used to address a variety of issues. Building upon the intrinsic value of these measures, the QI Mapping Tool helps aggregate and display this information in new ways to address the following kinds of questions:

- Which counties have the highest rates of admissions for short-term complications for diabetes that could potentially have been avoided through improved outpatient services?
- Which counties have the highest rates of infections due to medical care in their hospitals?
- Which counties consistently have poorer indicators or consistently better indicators?
- In which counties would there be the largest potential payoff for reducing admissions by 10 percent, 20 percent, 30 percent, 40 percent, or even 50 percent?
- Which counties have the highest density of my target population?

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## Which Quality Indicator Sets Does the Tool Use?

As noted above, the AHRQ QIs are organized into four "modules," each of which measures the quality associated with processes of care that occurred in an outpatient or an inpatient setting. These modules, discussed below, rely solely on hospital inpatient administrative data. The QI Mapping Tool uses only population-based QI measures, so the rates are not applicable to individual hospitals.

More information on each module and documentation for all QI modules can be downloaded from the AHRQ Quality Indicators Web site at <http://www.qualityindicators.ahrq.gov/downloads.htm>. Detailed technical reports are based on projects conducted for AHRQ by the University of California at San Francisco (UCSF)-Stanford Evidence-based Practice Center.

**Prevention Quality Indicators (PQIs).**<sup>1</sup> This set of measures can be used with hospital inpatient discharge data to identify "ambulatory care sensitive conditions"—those conditions for which good outpatient care can potentially prevent the need for hospitalization, or for which early intervention can prevent complications or more severe disease.

Even though these indicators are based on hospital inpatient data, they provide insight into the quality of the health care system *outside* the hospital setting. For example:

- Patients with diabetes may be hospitalized for diabetic complications if their conditions are not adequately monitored or if they do not receive the patient education needed for appropriate self-management.
- Patients may be hospitalized for asthma if primary care providers fail to adhere to practice guidelines or to prescribe appropriate treatments.
- Patients with appendicitis who do not have ready access to surgical evaluation may experience delays in receiving needed care, which can result in a life-threatening condition—perforated appendix.

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<sup>1</sup> PQI rates can be calculated using the modified Federal Information Processing Standards (FIPS) State/county code. A list of codes is available at: <http://www.census.gov/popest/geographic/codes02.pdf>.

The PQIs consist of the following 14 ambulatory care sensitive conditions, which are measured as rates of admission to the hospital:

- Diabetes, short-term complication admission rate (PQI 1)
- Perforated appendicitis admission rate (PQI 2)
- Diabetes, long-term complication admission rate (PQI 3)
- Chronic obstructive pulmonary disease admission rate (PQI 5)
- Hypertension admission rate (PQI 7)
- Congestive heart failure admission rate (PQI 8)
- Low birth weight (PQI 9)
- Dehydration admission rate (PQI 10)
- Bacterial pneumonia admission rate (PQI 11)
- Urinary infection admission rate (PQI 12)
- Angina admission without procedure (PQI 13)
- Uncontrolled diabetes admission rate (PQI 14)
- Adult asthma admission rate (PQI 15)
- Rate of lower extremity amputations among patients with diabetes (PQI 16)

(PQI 4 and PQI 6 relate to children and have been moved to the Pediatric Quality Indicators module. All PQIs now apply only to adult populations.)

Although other factors outside the direct control of the health care system, such as poor environmental conditions or lack of patient adherence to treatment recommendations, can result in hospitalization, the PQIs provide a good starting point for assessing quality of health services in the community. Because the PQIs are calculated using readily available hospital administrative data, they are an easy-to-use and inexpensive screening tool. They can be used to provide a window into the community—to identify unmet community health care needs, to monitor how well complications from a number of common conditions are being avoided in the outpatient setting, and to compare performance of local health care systems across communities.

**Inpatient Quality Indicators (IQIs).** These measures reflect the quality of care inside hospitals, focusing on the utilization of procedures for which there are questions of overuse, underuse, or misuse and on the volume of procedures for which there is evidence that a higher volume of procedures may be associated with lower mortality. The IQIs are:

- Coronary artery bypass graft (IQI 26)
- Percutaneous transluminal coronary angioplasty (IQI 27)
- Hysterectomy (IQI 28)
- Laminectomy or spinal fusion (IQI 29)

**Patient Safety Indicators (PSIs).** This set of measures can be used with hospital inpatient discharge data to provide a perspective on patient safety. Specifically, PSIs screen for problems that patients experience as a result of exposure to the health care system and that are likely amenable to prevention by changes at the system or provider level. These are referred to as complications or adverse events.

Area-level PSIs capture all cases of the potentially preventable complications that occur in a given area (e.g., metropolitan service area or county) either during hospitalization or resulting in subsequent hospitalization. Area-level indicators are specified to include principal diagnosis, as well as secondary diagnoses, for the complications of care. This specification adds cases where a patient's risk of the complication occurred in a separate hospitalization. The PSIs are:

- Foreign body left during procedure (PSI 21)
- Iatrogenic pneumothorax (PSI 22)

- Selected infections due to medical care (PSI 23)
- Postoperative wound dehiscence (PSI 24)
- Accidental puncture and laceration (PSI 25)
- Transfusion reaction (PSI 26)
- Postoperative hemorrhage or hematoma (PSI 27)

**Pediatric Quality Indicators (PDIs).** This set of measures can be used with hospital inpatient discharge data to provide a perspective on the quality of pediatric health care. Specifically, PDIs screen for problems that pediatric patients experience as a result of exposure to the health care system and that may be amenable to prevention by changes at the system or provider level.

Development of quality indicators for the pediatric population involves many of the same challenges associated with the development of quality indicators for the adult population. These challenges include the need to carefully define indicators using administrative data, establish validity and reliability, detect bias and design appropriate risk adjustment, and overcome challenges of implementation and use.

However, the special population of children invokes additional, special challenges. Four factors—differential epidemiology of child health care relative to adult health care, dependency, demographics, and development—can pervade all aspects of children’s health care; simply applying adult indicators to younger age ranges is insufficient.

These PDIs focus on potentially preventable complications and iatrogenic events for pediatric patients treated in hospitals, and on preventable hospitalizations among pediatric patients. The five area-level indicators are:

- Asthma admission rate (PDI 14)
- Diabetes short-term complications admission rate (PDI 15)
- Gastroenteritis admission rate (PDI 16)
- Perforated appendix admission rate (PDI 17)
- Urinary tract infection admission rate (PDI 18)

### What Are the Primary Outputs/Reports?

SAS® allows to you customize data inputs in multiple ways. The QI Mapping Tool can produce area-level maps and Microsoft Excel® data tables. A walk-through of all these resources is provided. They are:

- **Maps.** Maps of the State present each indicator’s rate (e.g., PQI 1, PQI 2) within quintiles for each year. Maps can also show the location of the presenting hospital(s), as well as a symbol indicating the number of patients within each county.
- **Indicator rates.** Microsoft Excel® spreadsheets contain the rates of each PQI and area-level IQIs, PSIs, and PDIs organized by individual indicators.
- **Indicator costs.** Microsoft Excel® spreadsheets detail the average (mean) cost per discharge for each indicator by county. These also display the number of discharges per year, total costs, and the potential cost savings if the number of discharges is reduced by a set percentage. The represented costs are hospital facility costs that do not include the costs for physicians who bill separately. The costs also do not represent the health plans’ reimbursements.

### Where Do I Get the Necessary Data To Run the Tool?

You may acquire the relevant hospital discharge data from individual hospitals, State associations or data organizations, or State agencies that make discharge data available. As of June 2006, 38 States are part of the Healthcare Cost and Utilization Project (HCUP), an ongoing Federal-State-private sector collaboration to build uniform databases from administrative hospital-based data (<http://www.hcup->

[us.ahrq.gov/home.jsp](http://us.ahrq.gov/home.jsp)). The National Association of Health Data Organizations (NAHDO) also provides information on how to access State datasets (<http://www.nahdo.org>).

## What Are the Technical Requirements?

In order to use this module, you must have version 9 or greater of SAS® (<http://www.SAS.com>) and an input SAS® dataset containing the hospital discharge records to be processed. The Base SAS® is required to produce all the rates and to export all the data to Microsoft Excel®; SAS/Graph® is required to generate the maps of the rates. You must also have a copy of Microsoft Excel® on the computer where SAS® is installed, and Microsoft Excel® must be turned off before running the SAS® programs<sup>2</sup>. An additional user-supplied SAS® dataset of population values is required only if you wish to overlay your data on to the maps showing the county-level rates.

Table 1 describes the required and optional fields on the user's input dataset of hospital discharges. The order in which the variables appear in the input dataset is irrelevant. Note however, that if any of the required fields are absent, the module will not run at all; and if any of the optional fields are absent, the cost-savings portion of the module will be skipped.

<b>Table 1. Structure of user-supplied SAS® dataset of hospital discharge records</b>	
<b>Variable name</b>	<b>Description</b>
HOSPSTCO	This field is required. It should contain a numeric FIPS county code ([ss][ccc], where [ss] corresponds to a 1-digit or 2-digit State FIPS code followed by a 3-digit county FIPS code) corresponding to the area on which all rates and optional cost savings will be calculated. For example,  01001 or 1001=Autauga, Alabama 16001 = Ada, Idaho  This field may correspond to the county where the hospital is located or to the county where the patient resides. In either case, the field must be called HOSPSTCO.
HOSPID	This field is optional. If available, it should contain the numeric SID hospital identifier. Like TOTCHG, it is used to calculate the cost-savings which is estimated to be achieved from a 10-50% reduction in the cases in an area. If users are not interested in the cost-savings component of these programs or otherwise do not have access to the hospital's SID identifier, this field should be left off the input dataset.
TOTCHG	This field is optional. Like HOSPID, it is used to calculate cost savings for a 10-50% reduction of cases. If users are not interested in the cost savings component of these programs, this field should be left off the input dataset.
SEX	This field is required. It should contain a numeric value denoting the patient's sex coded:  1 = male 2 = female  Any discharge record with an unspecified sex of patient (any code other than 1 or 2) will not be utilized in any analysis.
AGE	This field is required. It should contain a numeric value denoting the age of the patient in whole years. Discharges where the age of the patient is unknown or otherwise unspecified (any code less than 0) will not be utilized in any analysis. Any value greater than 0 is taken to be the patient's age.

<sup>2</sup> Microsoft Excel® should be on the same computer because SAS® will use DDE to turn Microsoft Excel® on and to create Microsoft Excel® workbooks and transfer the data to them. Unexpected results will occur if Microsoft Excel® is open when the application starts.

<b>Table 1. Structure of user-supplied SAS<sup>®</sup> dataset of hospital discharge records</b>	
<b>Variable name</b>	<b>Description</b>
DX1-DX[n]	DX1, the field containing the 1 <sup>st</sup> listed or principal diagnosis is required. Users may have as many [n] secondary diagnoses fields as they wish. All of them will be utilized. If they exist, the secondary diagnosis fields must be called DX2-DX[n].
PR1-PR[n]	PR1, the field containing the 1 <sup>st</sup> listed or principal procedure is required. Users may have as many [n] secondary procedure fields as they wish. All of them will be utilized. If they exist, the secondary procedure fields must be called PR2-PR[n].
MDC	This field is required. It should be a numeric code denoting the major diagnostic category in effect on the date of the discharge.
ATYPE	This field is required. It should contain a numeric value for the admission type. ATYPE = 4 should denote a newborn.
ASOURCE	This is a required field that contains a numeric value for the uniform admission source. ASOURCE = 2 or ASOURCE = 3 should denote a transfer from another institution.

Users may have additional variables on their input dataset of hospital discharge records. All of those variables will not be utilized by any of the programs.

Table 2 describes the required fields on the optional secondary dataset of population values that you may wish to overlay onto the maps showing the rates for each area-level quality indicator. This dataset need not be provided for the programs to work. If you wish to overlay your data, the dataset with the population values must have the following required variables:

<b>Table 2. Structure of user-supplied dataset of population values to be overlaid on maps</b>	
<b>Variable name</b>	<b>Description</b>
COUNTY	This field should contain a numeric FIPS county code ([ss][ccc], where [ss] corresponds to a 1-digit or 2-digit State FIPS code followed by a 3-digit county FIPS code). For example, 01001 or 1001=Autauga, Alabama 16001 = Ada, Idaho
SEX	Sex 1 = male 2 = female
AGE	Age group 1 = age 0-17 2 = age 18-39 3 = age 40 and greater
POP	Population (that is, population of interest) in the county by sex and by age cell.

The program will select the population closest to the at-risk population for each indicator and overlay that on the maps. For instance, on the map displaying pediatric asthma admission rates (PDI 14), the user population age 0-17 will be displayed; for low birth weight (PQI 9), the population of women age 18 to 39 will be displayed. For other indicators, the total population or other population subgroups will be displayed.

## What Steps Are Required To Use This Tool?

1. You should already have Base SAS<sup>®</sup> and SAS<sup>®</sup>/Graph installed and configured. (Refer to the SAS<sup>®</sup> documentation for help on this).
2. If you have not already done so, create a directory (e.g., c:\myUserData), and store your SAS<sup>®</sup> dataset of hospital discharge records and your optional dataset of population values to this directory.
3. Also create a directory (e.g., c:\myPrograms) for the program files and auxiliary files needed by these programs. Extract the contents of the downloaded archive into this directory.
4. You should now have a directory with your hospital discharge dataset; for example,
  - c:\myUserData\myHospitalDischarges.sas7bdat
  - (optional) c:\myUserData\myPopulation.sas7bdat
 and an additional directory with all programs and auxiliary information from the downloaded archive, for example,
  - c:\myPrograms\control.sas
  - c:\myPrograms\includes\macros\\*.sas [these are the supplied SAS<sup>®</sup> programs]
  - c:\myPrograms\includes\txfiles\\*.txt [these are the supplied auxiliary text files]
5. After configuring your directories, launch SAS<sup>®</sup> and open the control.sas program in the SAS<sup>®</sup> program editor. (You can select the control.sas file from Windows Explorer to do this).
6. You will need to modify the parameters shown in Table 3 in control.sas (each line must end with a semicolon):

Table 3. Parameters in the CONTROL.SAS program that users should modify	
Parameter	Description and example
includes	This specifies the location of the includes directory, i.e., the directory where all the supplied SAS <sup>®</sup> programs needed to process the discharge records, calculate all rates and optional cost savings and draw the maps are located. Specify the fully qualified path, without quotes, for example,  %let includes = c:\myPrograms\includes;
user_dir	This specifies the <i>directory</i> location where the user's input dataset of discharge records is stored, for example,  %let user_dir = c:\myUserData;  (Note: this is also the directory where SAS <sup>®</sup> will write its final dataset and all Excel <sup>®</sup> workbooks).
data_in	This specifies the <i>filename</i> of the user's input dataset (without the file extension). For example, to specify the file myHospitalDischarges.sas7bdat, use:  %let data_in = myHospitalDischarges;  Do not use %let data_in = myHospitalDischarges.sas7bdat;
data_yr	This specifies the 4-digit year of the discharge data. If the discharges are from 2002, then use:  %let data_yr = 2002;  (Note: you may chose any year from 1995 to 2006.)



**Table 3. Parameters in the CONTROL.SAS program that users should modify**


Parameter	Description and example
mapsize	<p>This specifies the dimensions, in inches, of the graphic image of the maps that you want SAS<sup>®</sup> to produce. For example, to instruct SAS<sup>®</sup> to produce maps 4 inches wide by 7 inches tall, specify:</p> <pre>%let mapsize=4x7;</pre>
gdevice	<p>This instructs SAS<sup>®</sup> to produce maps in either PDF or EMF format.</p> <p>PDF is Adobe<sup>®</sup> Portable Document Format. It should be used to produce hard copy pictures; that is, images that can be sent directly to a printer.</p> <p>EMF is Microsoft<sup>®</sup> Enhanced Meta File format. It should be used to produce pictures that can be inserted into Microsoft applications<sup>3</sup>, e.g. Microsoft Word<sup>®</sup> documents, Microsoft Excel<sup>®</sup> or Power Point files.</p> <p>To produce PDF images, specify %let gdevice = PDF; To produce EMF images, specify %let gdevice = EMF;</p>
palette	<p>This specifies the palette<sup>4</sup> (color scheme) to be used in the maps. Four palettes are supplied – “gyr,” “red,” “blu,” and “gry.”</p> <p>“gyr” (green-yellow-red) is the only diverging color scheme that is supplied. It shades counties with average rates in yellow, those with lower rates in green and those with higher rates in red.</p> <p>“red,” “blu,” and “gry” are the sequential color schemes that are supplied. They display counties with average rates in a medium shade, those with lower rates in a lighter shade, and those with higher rates in a darker shade [of red, blue or gray, respectively].</p> <p>To specify the gyr palette, specify:</p> <pre>%let palette = gyr;</pre>
userPopData	<p>This tells SAS<sup>®</sup> the name (without the file extension) of the optional SAS<sup>®</sup> dataset with the user’s population data. If you do not have this dataset or otherwise do not want it displayed, specify:</p> <pre>%let userPopData = None;</pre> <p>To use the optional population dataset, called myPopulation.sas7bdat, specify:</p> <pre>%let userPopData = myPopulation;</pre>
userPopLabel	<p>This tells SAS<sup>®</sup> the label that you want written in the legend of the user-supplied values. If the user population contains the number of Medicare beneficiaries, then the label can be specified with</p> <pre>%let userPopLabel = Medicare beneficiaries;</pre>
map_Hospital_Locations	<p>This tells SAS<sup>®</sup> to display the SID hospitals on each map (shown as blue dots). To specify that hospitals should be displayed, use:</p> <pre>%let map_Hospital_Locations = Yes; (use = No to suppress them)</pre>

<sup>3</sup> To insert an EMF picture into a Microsoft Word<sup>®</sup> document, please see your Microsoft Word software instructions.

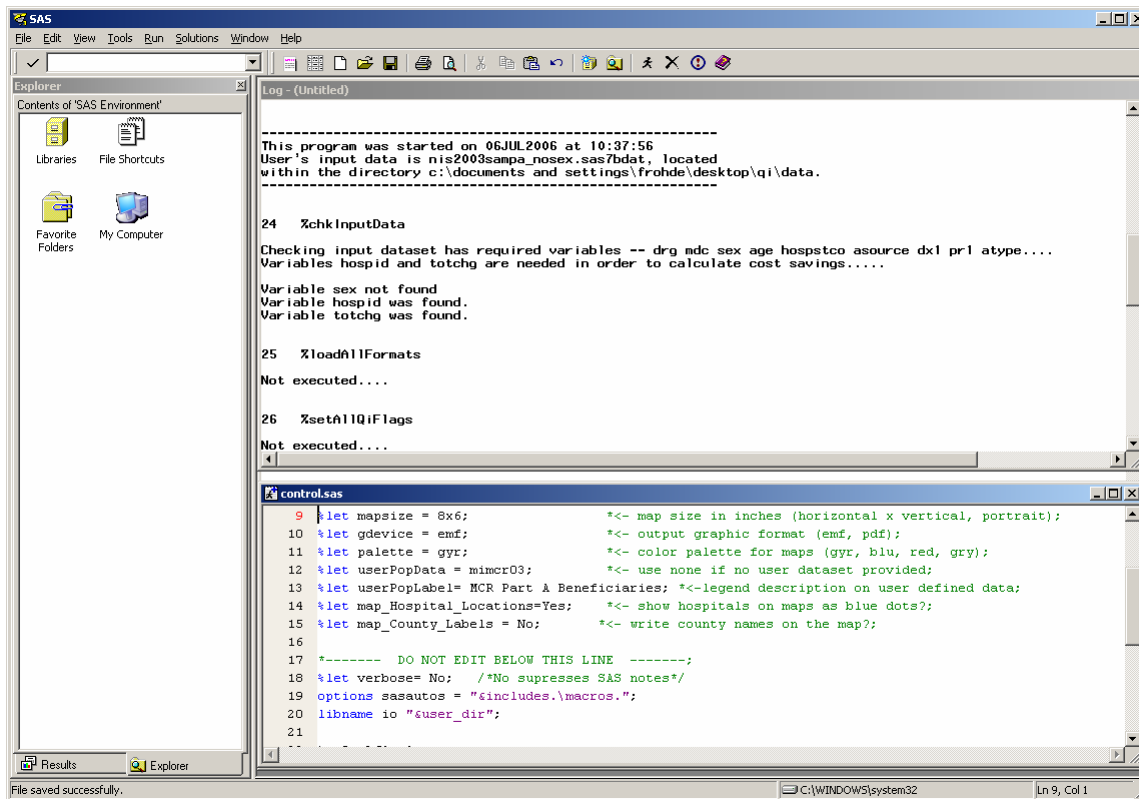
<sup>4</sup> See ColorBrewer ([http://www.personal.psu.edu/faculty/c/a/cab38/ColorBrewer/ColorBrewer\\_intro.html](http://www.personal.psu.edu/faculty/c/a/cab38/ColorBrewer/ColorBrewer_intro.html)) for more information on these or other color schemes.

**Table 3. Parameters in the CONTROL.SAS program that users should modify**

Parameter	Description and example
map_County_Labels	This tells SAS® to display the names of the counties on the map. To specify that county names should be written on the map, use  %let map_County_Labels= Yes; (use = No; to suppress the labels)

7. Before running the control.sas program, make sure Microsoft Excel® is not open.
8. Once all the parameters have been correctly set, should submit this program by using the run program button  on the SAS® application toolbar. The program will examine your input dataset to make sure it has all the required and optional variables. If any of the required variables are missing, SAS® will skip all the processing of the records. The example in Figure 1 shows the log when it reads a dataset that does not have the required variable, sex.

**Figure 1. A screen shot of a SAS® software log that indicates that the inputted dataset does not have the required variable, “sex”**



If all the required variables are present, SAS® will process all the records, calculate all the rates, draw the maps and export the final dataset to Excel® workbooks. If the optional variables are present, SAS® will additionally calculate the cost savings from 10-50% reduction of cases and add that to the final dataset and to the Excel® workbooks. If the optional variables are not present, SAS® will skip just the cost-savings portion of the program.

(Note: depending on the age of your computer, the amount of available memory, and the number of hospital discharge records, this program should complete in 3 to 4 minutes per million discharge records. So, for instance, if the input dataset has 1 million discharge records, the program should complete in 3 to 4 minutes, and if it has 10 million discharge records, it should complete in about 30 to 40 minutes).

9. When the program completes, you will have the following additional files in the dataset specified by the user\_dir parameter:

- A SAS® dataset called rates.sas7bdat which will contain the one record per indicator per county (plus one more for all counties combined). Figure 2 gives an example of the SAS® dataset run with fabricated discharges.

Figure 2. A screen shot of a SAS® dataset run with fabricated discharges

Log - (Untitled)

NOTE: Copyright (c) 2002-2003 by SAS Institute Inc., Cary, NC, USA.  
 NOTE: SAS (r) 9.1 (TS1M3)  
 Licensed to AGENCY FOR HEALTHCARE RESEARCH & QUALITY, Site 0040776001.  
 NOTE: This session is executing on the XP\_PRO platform.

VIEWTABLE: TMP1.rates

QI modul	QI numb	FIPS County of	countynm	Flagged Discharges	Population at risk for	Observed Rate	Risk adjusted rate	SE of risk adjusted rate	flag	meancost	save10	save20	save30	save40	save50
1	IQ	26	Overall	7420	4499687	0.0016490036	0.001659109	0.000023625	hi	113.3	84068.6	168137	252205.8	336274.4	420343
2	IQ	26	Alcona	92	7281	0.012635627	0.0093207155	0.0005026896	hi	120.75	1110.9	2221.8	3332.7	4443.6	5554.5
3	IQ	26	Alger	90	5203	0.0172977129	0.0153661955	0.0006527269	hi	101.45	913.05	1826.1	2739.15	3652.2	4565.26
4	IQ	26	Allegan	102	48327	0.0021106214	0.0021881757	0.0002314138	hi	112.82	1150.76	2301.53	3452.29	4603.06	5753.82
5	IQ	26	Alpena	83	16243	0.0051098935	0.0046431488	0.0003736326	hi	121.12	1005.3	2010.59	3015.89	4021.18	5026.46
6	IQ	26	Antrim	99	12536	0.0078972559	0.0066273895	0.0004086833	hi	133.37	1320.36	2640.73	3961.09	5281.45	6601.82
7	IQ	26	Arenac	92	8964	0.0102632753	0.0088173984	0.0004890071	hi	115.03	1058.28	2116.55	3174.83	4233.1	5291.36
8	IQ	26	Baraga	79	4343	0.0181901911	0.016495513	0.0007219152	hi	109.87	867.97	1735.95	2603.92	3471.89	4339.87
9	IQ	26	Benzie	85	27403	0.0031018502	0.003077229	0.0003006081	hi	113.29	962.97	1925.93	2889.9	3851.86	4814.83
10	IQ	26	Benzie	92	54013	0.0017032937	0.001649307	0.0002115386	hi	122.87	1130.4	2260.81	3391.21	4521.62	5652.02
11	IQ	26	Benzie	98	8797	0.0111401614	0.0094693285	0.0004909866	hi	116.21	1138.86	2277.72	3416.57	4555.43	5694.25
12	IQ	26	Berrien	73	77833	0.0009379055	0.0008952771	0.0001749566	lo	112.27	819.57	1639.14	2458.71	3278.28	4097.86
13	IQ	26	Branch	87	21389	0.0040675113	0.0038970562	0.000334357	hi	104.43	908.54	1817.08	2725.62	3634.16	4542.71
14	IQ	26	Calhoun	97	63707	0.0015225956	0.0014712471	0.0001945707	hi	104.26	1011.32	2022.64	3033.97	4045.29	5056.61
15	IQ	26	Cass	93	25536	0.0036419173	0.0034276835	0.0003032876	hi	117.42	1092.01	2184.01	3276.02	4368.02	5460.03
16	IQ	26	Charlevoix	91	13415	0.0067834514	0.0062082479	0.0004126082	hi	111.68	1016.29	2032.58	3048.86	4065.15	5081.44
17	IQ	26	Chippewyan	84	14271	0.0058860626	0.0049517199	0.0003834987	hi	117.26	984.98	1969.97	2954.95	3939.94	4924.92
18	IQ	26	Chippewa	105	17518	0.0059383939	0.0057314317	0.0003690999	hi	114.03	1197.32	2394.63	3591.95	4789.26	5996.56
19	IQ	26	Clare	80	16292	0.0049103855	0.0040709729	0.0003563111	hi	112.38	893.04	1798.08	2697.12	3596.16	4495.2
20	IQ	26	Clinton	82	31144	0.0026329309	0.0027160814	0.0002875475	hi	112.94	926.11	1852.22	2778.32	3704.43	4630.54
21	IQ	26	Crawford	67	7620	0.0087926509	0.0076035399	0.0005321156	hi	120.04	804.27	1608.54	2412.8	3217.07	4021.34
22	IQ	26	Delta	80	20143	0.003971603	0.0036022437	0.0003362078	hi	119.28	954.24	1908.48	2862.72	3816.96	4771.2
23	IQ	26	Dickinson	87	14252	0.0061044064	0.005739375	0.0004057661	hi	115.4	1003.98	2007.96	3011.94	4015.92	5019.9
24	IQ	26	Eaton	93	49326	0.0018854154	0.0019280663	0.0002274963	hi	114.39	1063.83	2127.65	3191.48	4255.31	5319.14

- Four Microsoft Excel® workbooks, one for each QI module, named PQI.XLS, IQI.XLS, PSI.XLS, and PDI.XLS. Each workbook will contain one sheet for each indicator – 14 indicators for the PQIs, 4 for the IQIs, 7 for the PSIs, and 5 for the PDIs. Each sheet will contain the same information as the rates.sas7bdat dataset. Instead of the flag indicating whether the county level rate is higher or lower than the overall rate, the cell with the rate will be shaded green (low) or red (high). Below is an example of an Excel® workbook output from running the discharges on the fabricated dataset.



**Figure 3. A screen shot of an Excel® workbook spreadsheet that the user receives after running discharge data**

Urinary Tract Infection Admission Rate (PDI 18)										
County FIPS	County Name	Number Cases	Population	Rate		Cost Savings Given Reduction of Cases Equal to				
				Observed	Risk Adjusted	10%	20%	30%	40%	50%
Overall		571	2,510,931	0.00022741	0.00024969	7,787.87	15,575.74	23,363.61	31,151.48	38,939.35
26139	Ottawa	10	67,011	0.00014923	0.00018324	123.56	247.12	370.68	494.24	617.80
26141	Presque Isle	7	2,716	0.00257694	0.00302715	90.31	180.63	270.94	361.26	451.57
26143	Roscommon	8	4,913	0.00162845	0.00169409	112.43	224.86	337.30	449.73	562.16
26145	Saginaw	10	53,075	0.00018841	0.00017953	152.56	305.12	457.68	610.24	762.80
26147	St Clair	8	42,326	0.00018901	0.00024670	148.88	297.76	446.64	595.52	744.40
26149	St Joseph	5	16,443	0.00030408	0.00034077	34.92	69.83	104.75	139.66	174.58
26151	Sanilac	10	11,120	0.00089929	0.00104054	184.13	368.26	552.39	736.52	920.65
26153	Schoolcraft	6	1,836	0.00326886	0.00396767	54.86	109.73	164.59	219.46	274.32
26155	Shiawassee	7	18,212	0.00038437	0.00050302	89.12	178.23	267.35	356.47	445.59
26157	Tuscola	6	14,334	0.00041860	0.00046266	103.64	207.28	310.91	414.55	518.19
26159	Van Buren	5	20,817	0.00024251	0.00027725	49.13	98.25	147.38	196.50	245.63
26161	Washtenaw	7	72,152	0.00009702	0.00011848	126.02	252.04	378.06	504.08	630.11
26163	Wayne	5	555,102	0.0000901	0.00008615	37.54	75.08	112.62	150.16	187.70
26165	Wexford	6	7,703	0.00077889	0.00091047	69.80	139.61	209.41	279.22	349.02
County rate is statistically lower than overall rate.										
County rate is statistically higher than overall rate.										

**Note:** The Excel spreadsheet will display county rates statistically lower than the overall rate in green and rates statistically higher than the overall rate in red.

- Thirty maps in either PDF or EMF format (depending on how the gdevice parameter was set) showing the risk-adjusted rate (observed rate for the PSI indicators) optionally overlaid with the user-defined population.
  - The 14 PQI maps in EMF format will be named PQI1.EMF—PQI16.EMF (there is no longer an indicator 4 and 6)
  - The 4 IQI maps will be named IQI26—IQI.EMF
  - The 7 PSI maps will be named PSI21—PSI27.EMF
  - The 5 PDI maps will be named PDI14—PDI17.EMF

### How Do I Change the Map Size?

- You may have to experiment a little with the map dimensions before you are satisfied. The entire program need not be rerun to do this. Provided the rates have all been calculated, you may change the map dimensions or turn on or off the county names and rerun just the mapping portion.
  1. In the control.sas program, change the parameters as required.  
For example, to change the dimensions from 8x6 to 6x7, change the line  
%let mapsize = 8x6; to %let mapsize = 6x7;
  2. Highlight this single line with the cursor and submit it using .
  3. Then highlight the command to draw all maps, %drawAllMaps and submit it using .

The two screen shots in Figures 4 and 5 show the steps.

Figure 4. A screen shot highlighting the steps that users must take to change the SAS® output map dimensions

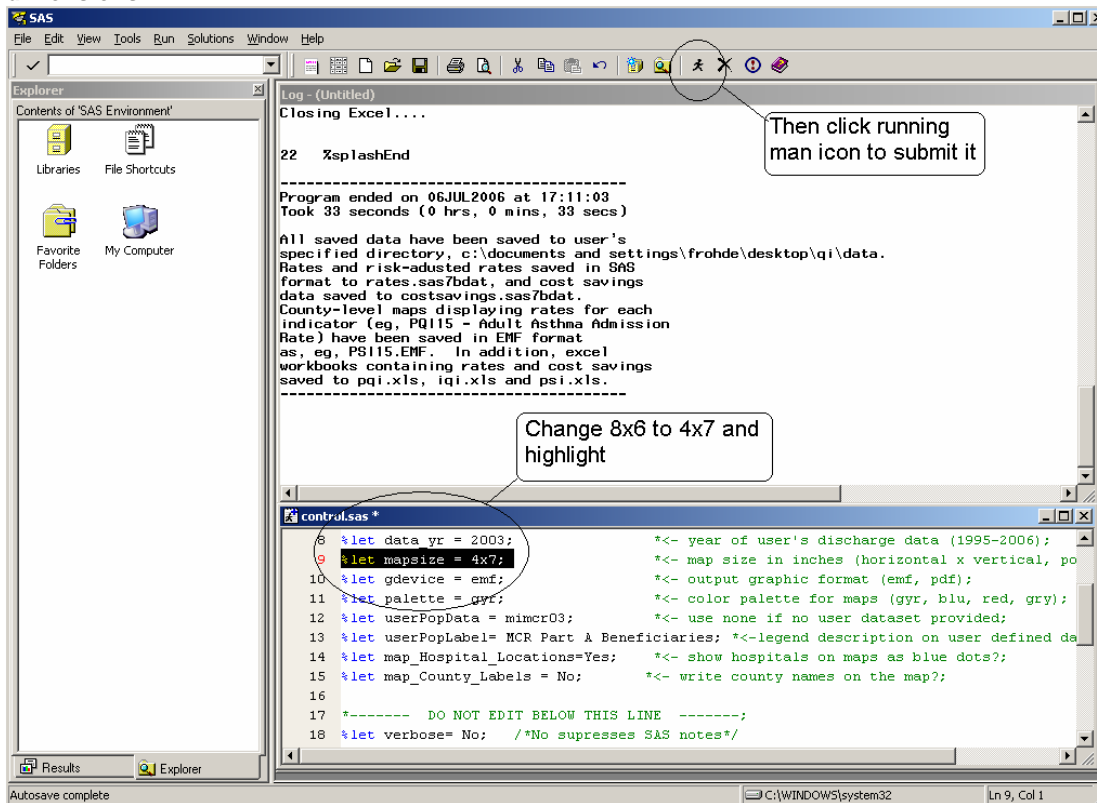
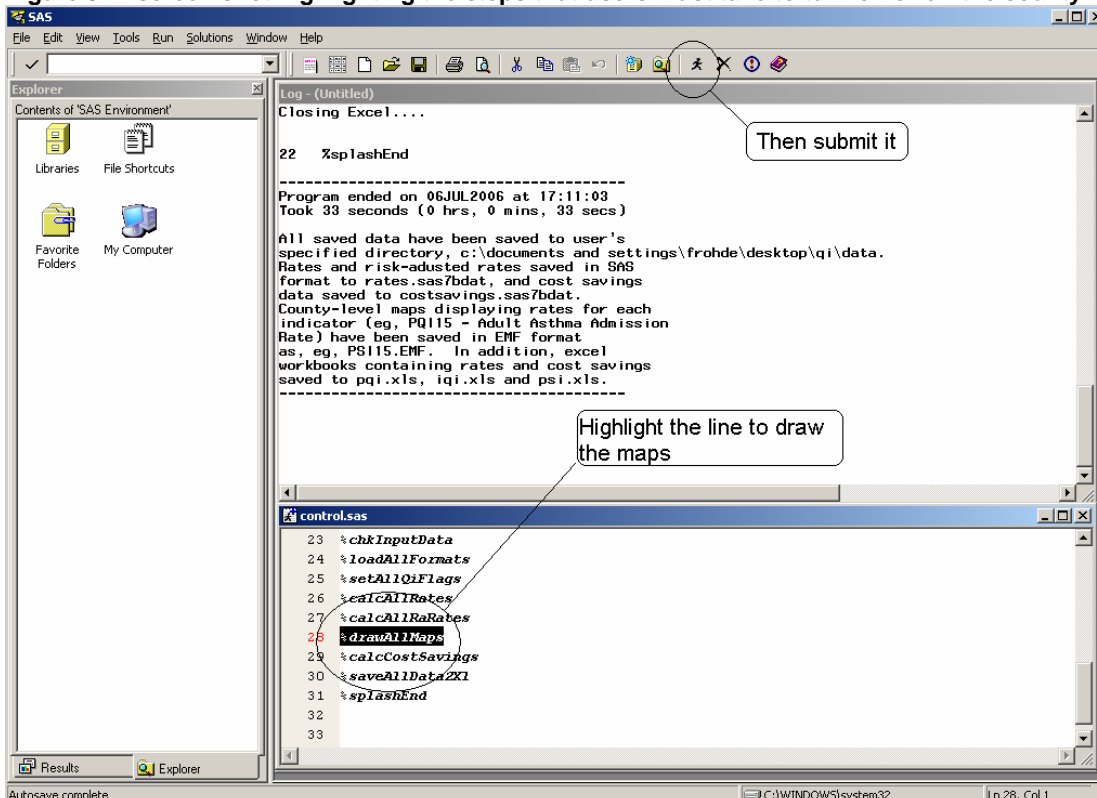


Figure 5. A screen shot highlighting the steps that users must take to turn on or off the county names



- The maps with the new dimensions will overwrite the maps with the old dimensions and should take only a minute or two to complete. If you wish to save maps with both the new and the old dimensions, rename or save to a different location the old maps before running the program with the new dimensions.

### **Is There Any Known Problem Area?**

There is a known bug in the Microsoft® DDE protocol which may affect users of this module. The first time you run this program on your computer, SAS® may report a DDE error to the effect that the Microsoft Excel® files (the Excel® files to which SAS® is attempting to write) do not exist. Should you experience this error, the solution is to highlight and resubmit the line in the control.sas program instructing SAS® to save data to Excel®, specifically,

```
%saveAllData2XI
```

The error will not appear again and SAS® will write the dataset correctly.

---

### **Example: Sample Analysis of Hypothetical State Population Data**

*Note: The following hypothetical situation was created to provide an example of how to use the QI Mapping Tool.*

You are a public health analyst working for the Holmes State Department of Health and Human Services. Your boss has asked you to identify areas where the State (represented in Figure 6) could achieve substantial health care cost savings over the next few years. Your aim is to identify possible areas for improving health care quality while reducing potentially avoidable hospital admissions and procedures.

**Figure 6. A map of the fabricated State of Holmes by county**

**State of Holmes**

Washington	Union	Marion	Monroe	Grant	
Clay	Wayne	Greene	Carroll	Shelby	
Madison	Warren	Douglas	Lake	Lee	
Clark	Marshall	Hancock	Johnson	Henry	
Adams	Crawford	Scott	Jefferson	Hamilton	Brown
Morgan	Lawrence	Calhoun	Lincoln	Cass	Clinton
Logan	Putnum	Benton	Fayette	Knox	Jackson
Perry	Polk	Pike	Boone	Montgomery	Franklin

As a State employee, you obtain access to the 2003 Holmes SID (State Inpatient Data), which contains administrative data on all discharges in the state in 2003. After processing these data using the QI Mapping Tool with SAS<sup>®</sup>, you receive the following outputs:

1. One SAS<sup>®</sup> dataset, called rates.sas7bdat file, with county-level summaries of the number of discharges flagged for each quality indicator, the corresponding at-risk population and observed rate, the risk-adjusted rate (this is the rate assuming a standard casemix of discharges), and estimates of the cost-savings that may be achieved if the number of flagged cases was reduced by 10% to 50%. (Go to Figure 7 for a display of the contents of the the first 18 records in the rates.sas7bdat file.)
2. Four Microsoft Excel<sup>®</sup> workbooks, called PQI.XLS, IQI.XLS, PSI.XLS and PDI.XLS, each containing the same information as the SAS dataset but organized into separate worksheets for each indicator. (Go to Figure 8 for a display of the contents in the SAS<sup>®</sup> produced output file labeled "IQI.XLS.")
3. Fourteen maps in EMF or PDF format (depending on how the gdevice parameter was set in control.sas), named PQI1.EMF – PQI16.EMF or PQI1.PDF – PQI16.PDF. (Note: there is no PQI4 and PQI6).
4. Four maps in EMF or PDF format corresponding to the area-level IQI indicators, named IQI26.EMF—IQI29.EMF or IQI26.PDF—IQI29.PDF.
5. Six maps in EMF or PDF format corresponding to the area-level PSI indicators, named PSI21.EMF—PSI26.EMF or PSI21.PDF—PSI26.PDF.
6. Four maps in EMF or PDF format corresponding to the area-level PDI indicators, named PDI14.EMF—PDI17.EMF or PDI14.PDF—PDI17.PDF.

Figure 7. A screen shot of the contents in the SAS® produced output file labeled “rates.sas7bdat” (first 18 records only)

	qimod	n	hospstco	countynm	numer	denom	rate	rarate	serarate	flag	meancost	save10	save20	save30	save40	save50
1	IQ	26	.	Overall	273	328,311	0.00083153	0.00079443	0.00008522		94.8	2,587.2	5,174.4	7,761.7	10,348.9	12,936.1
2	IQ	26	11	Washington	3	1,119	0.00268097	0.00232127	0.00138952		110.3	33.1	66.2	99.3	132.4	165.5
3	IQ	26	17	Jefferson	7	2,876	0.00243394	0.00213530	0.00087244		65.7	46.0	92.0	137.9	183.9	229.9
4	IQ	26	45	Franklin	8	868	0.00921659	0.00739609	0.00151875	hi	112.5	90.0	180.0	270.0	359.9	449.9
5	IQ	26	65	Jackson	9	3,221	0.00279416	0.00256575	0.00084345	hi	83.9	75.5	151.0	226.5	302.0	377.5
6	IQ	26	69	Lincoln	3	3,359	0.00089312	0.00081110	0.00082141		54.0	16.2	32.4	48.6	64.8	81.0
7	IQ	26	75	Madison	4	3,235	0.00123648	0.00108160	0.00082138		83.3	33.3	66.6	100.0	133.3	166.6
8	IQ	26	79	Clay	6	1,550	0.00387097	0.00346008	0.00113956	hi	90.0	54.0	108.0	162.1	216.1	270.1
9	IQ	26	87	Montgomery	6	1,606	0.00373599	0.00311332	0.00113784	hi	100.0	60.0	119.9	179.9	239.9	299.9
10	IQ	26	101	Union	2	1,018	0.00196464	0.00163109	0.00142650		86.8	17.4	34.7	52.1	69.4	86.8
11	IQ	26	107	Marion	2	3,067	0.00065210	0.00056433	0.00083911		70.7	14.1	28.3	42.4	56.5	70.7
12	IQ	26	111	Monroe	1	2,400	0.00041667	0.00041088	0.00101271		35.5	3.6	7.1	10.7	14.2	17.8
13	IQ	26	117	Wayne	6	7,118	0.00084293	0.00077932	0.00056934		89.2	53.5	107.1	160.6	214.2	267.7
14	IQ	26	125	Grant	5	1,270	0.00393701	0.00340090	0.00130274	hi	136.3	68.1	136.3	204.4	272.5	340.7
15	IQ	26	129	Greene	4	2,051	0.00195027	0.00156630	0.00098840		106.5	42.6	85.2	127.8	170.4	213.0
16	IQ	26	153	Warren	7	3,336	0.00209832	0.00182296	0.00080610		95.5	66.8	133.7	200.5	267.3	334.2
17	IQ	26	169	Carroll	7	2,093	0.00334448	0.00313168	0.00105668	hi	96.4	67.5	134.9	202.3	269.8	337.2
18	IQ	26	179	Adams	10	10,702	0.00093440	0.00082136	0.00045272		110.3	110.3	220.6	330.8	441.1	551.4

### Understanding the Excel® Table Displayed in Figure 7:

- **qimod**: the “Quality Indicator Module.” IQ is “Inpatient Quality Indicator.” Other values are PQ “Prevention Quality Indicator”, PS “Patient Safety Indicator” and PD “Pediatric Quality Indicator”
- **n**: the indicator number within the module. Indicator 26 within the IQI module is “Coronary Artery Bypass Graft Area Rate”.
- **hospstco**: the FIPS county code upon which the rate is based. The first record with no code is the overall rate, the rate based on all the discharges in all the counties.
- **countynm**: the name of the county, or Overall.
- **numer**: the “Numerator” number of flagged discharges in the county. This number is summarized from the user’s input dataset of hospital discharge records.
- **denom**: the “Denominator” number of at-risk persons. Depending on the indicator, the at-risk population might be persons age 0-17, persons age 18 and older, persons age 40 and older, number of live births, or something else. This number is summarized from the discharge records or comes from the population files supplied with the programs.
- **rate**: the observed rate, calculated as numer over denom. The rate is per discharge or per person in the population. Users can convert the rate to per 100 discharges or per 1,000 population, eg, by multiplying the rate by 100 or 1,000, respectively.
- **rarate**: the “Risk-adjusted Rate” is the rate assuming a standard case-mix of patients. Please refer to the User Guide to each QI module ([www.qualityindicators.com](http://www.qualityindicators.com)) for more information about how this rate is calculated.
- **serarate**: the “standard error” of the risk adjusted rate. Please refer to the User Guide to each QI module ([www.qualityindicators.com](http://www.qualityindicators.com)) for more information about how this is calculated.
- **flag**: a flag indicating whether the county’s rate is “hi” or “lo” relative to the Overall rate. This is calculated using a z-test. Counties not flagged with either “hi” nor “lo” are statistically similar to the overall rate.
- **meancost**: the mean cost per flagged discharge in the county. This is calculated if the user’s dataset has the proper variables (HOSPID, the hospital ID that links back to the SID, and TOTCHG, the total charge on the discharge record).
- **save10 to save50**: the savings estimated by reducing the number of cases 10 to 50 percent. This is calculated if the user’s dataset has the proper variables (HOSPID, the hospital ID that links back to the SID, and TOTCHG, the total charge on the discharge record).



Figure 8. A screen shot of the contents in the SAS® produced output file labeled “IQI.XLS”

Coronary Artery Bypass Graft Area Rate (IQI 26)										
County FIPS	County Name	Number Cases	Population	Rate		Cost Savings Given Reduction of Cases Equal to				
				Observed	Risk Adjusted	10%	20%	30%	40%	50%
Overall		273	328,311	0.00083153	0.00079443	2,587.20	5,174.40	7,761.70	10,348.90	12,936.10
11	Washington	3	1,119	0.00268097	0.00232127	33.10	66.20	99.30	132.40	165.50
17	Jefferson	7	2,876	0.00243394	0.00213530	46.00	92.00	137.90	183.90	229.90
45	Franklin	8	868	0.00921659	0.00738609	90.00	180.00	270.00	359.90	449.90
65	Jackson	9	3,221	0.00279416	0.00258675	75.50	151.00	226.50	302.00	377.50
69	Lincoln	3	3,359	0.00089312	0.00081110	16.20	32.40	48.60	64.80	81.00
75	Madison	4	3,235	0.00123648	0.00108160	33.30	66.60	100.00	133.30	166.60
79	Clay	6	1,550	0.00387097	0.00348008	54.00	108.00	162.10	216.10	270.10
87	Montgomery	6	1,606	0.00373599	0.00311332	60.00	119.90	179.90	239.90	299.90
101	Union	2	1,018	0.00196464	0.00163109	17.40	34.70	52.10	69.40	86.80
107	Marion	2	3,067	0.00065210	0.00056433	14.10	28.30	42.40	56.50	70.70
111	Monroe	1	2,400	0.00041667	0.00041088	3.60	7.10	10.70	14.20	17.80
117	Wayne	6	7,118	0.00084293	0.00077932	53.50	107.10	160.60	214.20	267.70
125	Grant	5	1,270	0.00393701	0.00340090	68.10	136.30	204.40	272.50	340.70
129	Greene	4	2,051	0.00195027	0.00156630	42.60	85.20	127.80	170.40	213.00
153	Warren	7	3,336	0.00209832	0.00182296	66.80	133.70	200.50	267.30	334.20
169	Carroll	7	2,093	0.00334448	0.00313168	67.50	134.90	202.30	269.80	337.20
179	Adams	10	10,702	0.00093440	0.00082136	110.30	220.60	330.80	441.10	551.40
189	Clark	8	14,126	0.00056633	0.00052206	90.70	181.40	272.20	362.90	453.60

**Note:** The table displayed in Figure 8 contains the same information from the SAS® database of IQI rates (IQI.XLS). There are no qimod and n variables. Instead, all the records from rates.sas7bdat with qimod equal to “IQ” have been sent to this workbook and placed into the worksheet IQI26 if n was equal to 26, in IQI27 if n was equal to 27, etc. Each worksheet has a title, and the flag variable was replaced with shading on the cell containing the risk-adjusted rates (red for high and green for low).

### Analysis Tips:

- After generating the data, you may have questions such as these:
  - (1) What is a reasonable risk-adjusted rate for this indicator?
  - (2) Is a higher or lower rate a sign of better quality?
  - (3) What rates are either too high or too low to signal a significant quality concern?

Although the QI Mapping Tool does not automatically benchmark the county rates against the State or national standard, you can easily access this information from one of AHRQ’s many online quality tools.

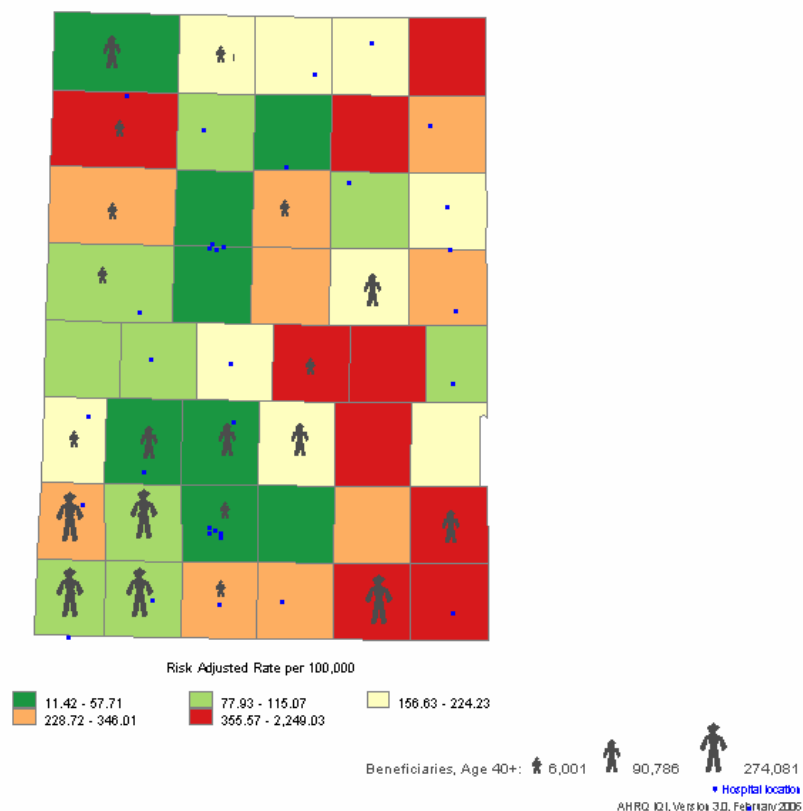
- HCUPnet, a free online query system based on HCUP data, presents the PQIs at the national level. The HCUPnet Web site provides national trend statistics as well as other breakouts. Also reported are the IQIs and PSIs that provide national trend information. Go to <http://hcupnet.ahrq.gov>.
  - The National Healthcare Quality Report (NHQR) and National Healthcare Disparities Report (NHDR) also include similar national level statistics for selected PQIs and the PSIs. Go to <http://www.ahrq.gov/qual/measurix.htm>.
  - You can also access the User Guides for each indicator set (PQI, IQI, PSI, and PedQIs) that contain information on national rates for the current definitions of each indicator at <http://www.qualityindicators.ahrq.gov/downloads.htm>.
  - State benchmarks can also be found in the State Snapshots derived from the NHQR. Go to <http://statesnapshots.ahrq.gov/2005>.
- The calculated risk rates can also be used to track hospital outcomes and primary care access over time, or across counties.

- The denominators for these indicators are mostly population based, and therefore, the rates do not directly apply to individual hospitals.
- The cost savings categories represent hospital facility costs only, and do not include the costs for physicians who bill separately. They also do not represent the health plans' reimbursements.
- To achieve the greatest cost savings look for counties where the ten percent reduction of cases will produce the largest decrease in spending. Be sure to assess both cost savings and risk-adjusted rates benchmarked to the State rates in tandem. While you may be able to achieve potentially high cost savings through reduced admissions for a particular condition in one county, if that same county already has rates significantly below the State average it may be hard to justify an increased intervention. Ideally, if you can identify counties with both high rates of avoidable hospitalizations and high procedural average costs they will signify areas ripe for intervention.
- Be sure to also look for counties where the admissions rates are substantially below State or national benchmarks as well. A possible action step might be to create a collaborative charged with identifying the county's best practices and opportunities, in an effort to capture and expand these effective practices to a broader population across the State.

Figure 9 displays in EMF format the risk-adjusted area-level rate for coronary artery bypass graft (CABG) with overlaid SID hospitals and an overlaid special population of interest (age 40 and over)

**Figure 9. A SAS® produced map of the State of Holmes highlighting the variations in coronary artery bypass graft rate by county**

### Coronary Artery Bypass Graft Area Rate (IQI 26)



#### Understanding the Map Displayed in Figure 9:

- The county-level risk-adjusted rates (multiplied by 100,000 for the map displayed in Figure 9) have been ranked into five categories with roughly an equal number of counties in each group. The counties with the lowest risk adjusted rate for CABG are displayed in dark green, those with

the highest rate are displayed in dark red, and those with an average rate are displayed in cream (average), light green (slightly lower than average), or orange (slightly higher).

- Overlaid onto the maps are two symbols: (1) SID hospitals and (2) a special population of interest. The blue dots represent SID hospitals in the area. You may suppress this symbol if you wish. The person-symbols represent the number of persons of the population of interest in the same age category as the at-risk population as this indicator (age 40 and older for this indicator). You can display these symbols only if you have such a dataset of population values formatted in the correct manner and you request they be displayed on the maps.

#### Analysis Tips:

- The overlaid population can be used to identify areas of particular interest to users. For instance, in the map displayed above, the population of interest is primarily clustered in the bottom left corner whereas the areas with the highest rates are in the bottom right corner. Only one of these counties has a large population of interest (Montgomery), and one has an average number (Jackson). Users may conclude that these two counties are in need of greater inspection.

---

### How Do I Interpret and Present Findings?

The previous example analysis presented a sample of the SAS<sup>®</sup> program and Microsoft Excel<sup>®</sup> outputs that the QI Mapping Tool produces and also suggested some tips for further analysis. After running the data, the user is likely to ask: how do I present this data in a meaningful way? Stakeholders have divergent needs and so may want to consider presenting data in variety of ways. Therefore, consider reconstructing some of the data tables to eliminate information not needed for your purposes. It may also be useful to create an accompanying narrative summary of the data to share with interested parties.

**Displaying major findings/opportunities.** As generated, the SAS<sup>®</sup> and Microsoft Excel<sup>®</sup> tables do not produce dynamic data displays. To make the data more visually appealing and to highlight the most significant findings, you can cull the most valuable data from across the numerous data outputs. You may also choose to display only the most pertinent data illustrating the greatest potential for improvements.

Figure 10 provides an example of an alternative presentation of data from the Rates.SAS7bdat file for CABG rates (IQI 26). A new category for the “Total Potential Savings from a 10% Reduction” in CABG for the first 10 counties was created (although the SAS<sup>®</sup> and Microsoft Excel<sup>®</sup> tables do not have a column for total savings, you can create your own by adding up all the individual county savings rates). Also, a new level of analysis was added to the county risk-adjusted rates column by benchmarking these rates to the Holmes State average. The Holmes State risk-adjusted average for CABG is 0.000217673.<sup>5</sup> Figure 10 displays an Excel<sup>®</sup> spreadsheet highlighting which counties are statistically above, below, or equal to that rate, so which counties have the greatest quality issues can be easily identified.

The example spreadsheet presents:

- Number of discharges per year.
- Average cost of each discharge.
- County risk-adjusted rate (with a color-coding system based on whether the county rate was above, below, or near similar to the State average).<sup>6</sup>

---

<sup>5</sup> This rate is different from the statistical significance rates produced in the SAS<sup>®</sup> and Excel<sup>®</sup> data tables. The Holmes State average is a more robust than the number produced by the QIMT software because it is an average across the entire State, not just the counties for which the user may have available data. Users should feel free to utilize the overall average for the calculated counties or another quality benchmark for comparison as well.

<sup>6</sup> The State risk-adjusted significance rates are not calculated by the QIMT. These numbers were derived from the AHRQ National Healthcare Quality Report State Snapshots. The Holmes State risk-adjusted average for CABG is 0.000217673. The color-coding is based upon retrieving the State average rate for CABG and comparing it to the individual county rates. Where the county rate is higher than that of the State, the number is highlighted in red. Where the county rate is below the State rate, the number is highlighted in green. If there is little variation between the county and State rates the cell is left white. These numbers can be obtained at <http://statesnapshots.ahrq.gov/2005>.

- Potential savings from a 10% reduction in admissions per county.
- Total savings with a 10% reduction in cases across 10 counties.

This example more clearly illustrates how CABG is affecting these 10 counties in Holmes. Eliminating information such as the FIPS codes, adding in a color-coded comparison of the county rates to the State rate, and creating a new total savings column helps to synthesize the bottom line and make the data more user friendly.

**Figure 10. Excel® spreadsheet highlighting the potential savings by county for reductions in coronary artery bypass graft rates by 10 percent**

IQI Number	Inpatient Quality Indicators	County Name	Number of Discharges 2003	County Risk-adjusted rate*	Average Cost Per Discharge	Potential Savings with 10% Reduction in Admissions Per Year	Total Potential Savings with 10% Reduction
26	Coronary Artery Bypass Graft (CABG) area rate	Washington	2	0.000215629	\$114,307	\$22,860	<b>\$329,400.00</b>
		Jefferson	1	0	\$54,680	\$5,470	
		Franklin	4	0.000273631	\$75,798	\$30,320	
		Jackson	4	0.000375303	\$123,649	\$49,460	
		Lincoln	2	0.000462683	\$53,003	\$10,600	
		Madison	2	0.00045455	\$71,414	\$42,850	
		Clay	4	0	\$98,508	\$39,400	
		Montgomery	2	0.000008139	\$68,957	\$20,690	
		Union	7	0.000218253	\$77,089	\$53,960	
		Marion	5	0.000172798	\$107,575	\$53,790	

**\*Key to County Risk-Adjusted Rates:**

- County rate is lower than Holmes State average
- No statistical difference between county and State
- County rate is higher than State average

**Note:** Figure 10 shows that county risk-adjusted rates are lower than Holmes State average in Jefferson, Clay, and Montgomery counties and higher than Holmes State average in Jackson, Lincoln and Madison counties.

**Preparing a narrative summary.** You may also consider creating summaries for each QI that concisely explain the data findings, while also suggesting opportunities for intervention. The following sample narrative is presented as an example of how data from the map illustrated in Figure 10 might be summarized for presentation to policymakers and other health care leaders considering implementing community collaboratives or other efforts to reduce potentially preventable CABG hospitalizations. The summary:

- Highlights which counties have CABG rates that are statistically higher than the State average.
- Presents the degree of variation in costs associated with the procedure.
- Offers a clinical observation that CABG procedures are often overused.
- Presents the total cost savings associated with a 10% reduction in cases for the region.
- Suggests which counties might be the most beneficial for intervention.

#### **Sample Narrative Summary of Coronary Artery Bypass Graft Admission Rates in 10 Counties**

Considerable variance exists in the number of admissions for CABG, as well as the average cost per case in the Dillweed region. Madison, Lincoln, and Jackson counties each had rates significantly higher than the State average. Jefferson, Clay, and Montgomery counties had rates lower than the State average, while the rates in Washington, Franklin, Union and Marion counties were not significantly different. The average cost per case varied from \$54,680 (Jefferson) to \$123,649 (Jackson) per case. CABG is a procedure that may be overused. Reducing the rate of CABG admissions by just 10 percent offers a potential cost savings of nearly \$330,000 across the 10 counties. Jackson County presents the greatest opportunity for realized cost savings because it has a CABG rate that is statistically higher than the Holmes State average, and it has one of the highest cost-per-discharge rates in the region.

#### **Limitations of the QI Data Sets**

**Prevention Quality Indicators.** The PQIs are valuable tools for identifying potential quality problems in outpatient care that help to set the direction for more in-depth investigation. Because the PQIs are based on readily available data—hospital discharge abstracts—resource requirements are minimal. With uniform definitions and standardized programs, the PQIs will allow comparisons across States, regions, and local communities over time. Despite the unique strengths of the PQIs, there are several issues that should be considered when using these indicators:

- First, for some PQIs, differences in socioeconomic status have been shown to explain a substantial part—perhaps most—of the variation in PQI rates across areas. The complexity of the relationship between socioeconomic status and PQI rates makes it difficult to delineate how much of the observed relationships is due to true access to care difficulties in potentially underserved populations or due to other patient characteristics, unrelated to quality of care, that vary systematically by socioeconomic status. For some of the indicators, patient preferences and hospital capabilities for inpatient or outpatient care might explain variations in hospitalizations. In addition, environmental conditions that are not under the direct control of the health care system can substantially influence some of the PQIs. For example, the COPD and asthma admission rates are likely to be higher in areas with poorer air quality.
- Second, the evidence related to potentially avoidable hospital admissions is limited for each indicator because many of the indicators have been developed as parts of sets. Only five studies have attempted to validate individual indicators rather than whole measure sets. A limitation of this literature is that relatively little is known about which components represent the strongest measures of access and quality. Most of the five papers that did report on individual indicators also used a single variable, such as median area-specific income or rural residence, for construct validation. All but one of these papers included adjustment only for demographic factors (such as age, sex, and race).
- Third, despite the relationships demonstrated at the patient level between higher quality ambulatory care and lower rates of hospital admission, few studies have directly addressed the question of

whether effective treatments in outpatient settings would reduce the overall incidence of hospitalizations. The extent to which the reporting of admission rates for ambulatory care sensitive conditions may lead to changes in ambulatory practices and admission rates also is unknown. Providers may admit patients who do not clinically require inpatient care, or they may do the opposite—fail to hospitalize patients who would benefit from inpatient care.

**Inpatient Quality Indicators.** The IQIs represent the current state of the art in assessing quality of care using hospital administrative data. However, these indicators must be used cautiously because the administrative data on which the indicators are based are not collected for research purposes or for measuring quality of care, but for billing purposes. While these data are relatively inexpensive and convenient to use—and represent a rich data source that can provide valuable information—they should not be used as a definitive source of information on quality of health care. At least three limitations of administrative data warrant caution:

- First, there are coding differences across hospitals. Some hospitals code more thoroughly than others, making “fair” comparisons across hospitals difficult.
- Second, there is a level of ambiguity about when a condition occurs. Most administrative data cannot distinguish unambiguously whether a specific condition was present at admission or whether it occurred during the stay (that is, a possible complication).
- Third, there are limitations in ICD-9-CM coding. The codes themselves are often not specific enough to adequately characterize a patient’s condition, which makes it impossible to perfectly risk-adjust any administrative data set; thus fair comparisons across hospitals become difficult.

**Patient Safety Indicators.** Many important concerns cannot currently be monitored well using administrative data, such as adverse drug events, and using these data tends to favor specific types of indicators. For example, the PSIs evaluated in this software contain a large proportion of surgical indicators, rather than medical or psychiatric, because medical complications are often difficult to distinguish from comorbidities that are present on admission. In addition, medical populations tend to be more heterogeneous than surgical populations, especially elective surgical populations, making it difficult to account for casemix. It is often expressed that indicators are more applicable to patient safety when limited to elective surgical admissions. However, the careful use of administrative data holds promise for screening to target further data collection and analysis. The ability to assess all patients at risk for a particular patient safety problem, along with accessing the relative lowest cost, are particular strengths of these indicators. Two broad areas of concern also hold true for these data sets:

- First, there are questions about the clinical accuracy of discharge-based diagnosis codes leading to concerns about the interpretation of reported diagnoses that may represent safety problems. Specifically, administrative data are unlikely to capture all cases of a complication, regardless of the preventability, without false positives and false negatives (sensitivity and specificity). When the codes are accurate in defining an event, the clinical vagueness inherent in the description of the code itself (for example, “hypotension”) may lead to a highly heterogeneous pool of clinical states represented by that code. Incomplete reporting is an issue in the accuracy of any data source used for identifying patient safety problems, as medical providers might fear adverse consequences as a result of “full disclosure” in potentially public records such as discharge abstracts.
- Second, the information about the ability of these data to distinguish adverse events in which no error occurred from true medical errors is limited. A number of factors contribute to the difficulty in identifying complications that represent medical error or may be at least in some part preventable. These factors include the heterogeneity of clinical conditions included in some codes, lack of information about event timing available in these data sets, and limited clinical detail for risk adjustment.

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## **Case Study: Using the QI Mapping Tool**

AHRQ approached the General Motors (GM) Corporation in early 2004 in an effort to connect large employers with the AHRQ Quality Indicators. At the time, GM was looking for ways to reduce health care costs without compromising patient safety or quality. For GM, the QIs and QI Mapping Tool offered an important opportunity to identify areas for improving health care quality and reduce potentially avoidable hospital admissions and procedures. In addition, a QI Mapping Tool analysis could identify communities for future interventions and track the impact of such interventions over time.

AHRQ provided GM with data and guidance to utilize the tool successfully. As a result of the project, GM has been able to use generated maps and tables to mobilize action on regional health priorities. The AHRQ analysis also highlighted communities with high concentrations of GM employees, dependents, and retirees, enabling GM to focus their efforts.

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