AHRQ Quality Indicators[TM]

QUALITY INDICATORS SOFTWARE INSTRUCTIONS, SAS
Version 4.5

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Abstract

The Agency for Healthcare Research and Quality (AHRQ) Quality Indicators[TM] (QI) were developed specifically to meet the short-term needs for information on healthcare quality using standardized, user-friendly methods and existing sources of data. The AHRQ QI program is unique in that it provides free, publicly-available software tools that calculate the AHRQ QI rates. The software allows users to calculate QI rates based on their own administrative data using a standard desktop computer. Each version of the QIs is released with software in two different platforms: a SAS[®][†] application and a Windows application. The SAS software was first released in the late 1990s. It consists of several modules of SAS code and requires a SAS license to run. The Windows-based software, known as WinQI, was first released in 2005. It was created in order to provide an easy-to-use, low-cost option for calculating the QIs that was not dependent on licensed software. Developed on Microsoft[®] Visual Studio using C# and .NET, AHRQ WinQI runs on Windows operating systems and requires only freely available software components: AHRQ-produced software, Microsoft .NET (for runtime environment and core software libraries), and Microsoft SQL Server Express (for data storage and manipulation). Table 1 lists the differences between SAS QI v4.5 and WinQI v4.5. Both the SAS and WinQI software are available in Version 4.5 as either 32-bit or 64-bit applications. The 32-bit applications are targeted for Windows XP operating systems, and the 64-bit applications are targeted for Windows 7 operating systems.

Table 1. Differences between SAS QI v4.5 and WinQI v4.5

SAS QI v4.5	WinQI v4.5
Requires licensed SAS software	Requires free downloadable software
User can modify the software	User is unable to modify the software
Data load and error checking at the discretion of the user	Includes data load and error checking functions
User must run a set of programs for each module, and all indicators in a module are displayed in output	All four QI modules calculated in a single program, and user can select which indicators to output
Area-level indicator denominators are adjusted based on the combination of county, age, gender and race in the numerator (adjustments are generally small (<.01%) in absolute terms)	Area-level indicators denominators are not adjusted
	Suppresses expected rate, risk-adjusted rate, and smoothed rate of PDI #6 RACHS-1 Pediatric Heart Surgery Mortality Rate
Condition-specific denominators can be used in place of overall population denominators for diabetes-related PQIs using data from the CDC National Diabetes Surveillance System	Condition-specific denominators are not available for any of the PQIs

Both versions of the QI software are updated on an annual basis to reflect changes in the AHRQ QI technical specifications. New software versions and updated technical specifications are released simultaneously. Routine annual updates include yearly International Classification

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of Diseases, 9th revision, Clinical Modification (ICD-9-CM), Medicare severity-Diagnostic Related Groups (MS-DRG), Major Diagnostic Categories (MDC), updated version of the 3M^{TM} APR-DRG grouper, new Census population files, and newly derived risk adjustment parameters.

The AHRQ QI are organized around four collections (modules) of indicators: Inpatient Quality Indicators (IQI), Pediatric Quality Indicators (PDI), Prevention Quality Indicators (PQI), and Patient Safety Indicators (PSI). Data captured by and characteristics of each of the modules are shown in Table 2. Detailed definitions of each indicator, with complete listings of ICD-9-CM and MS-DRG codes specifically included or excluded, are contained in the AHRQ QI *Technical Specifications*. Additional data on the magnitude of each indicator across an aggregation of State Inpatient Databases (SID) files can be found in the *Inpatient Quality Indicator v4.5 Benchmark Data Tables*, *Pediatric Quality Indicator v4.5 Benchmark Data Tables*, *Prevention Quality Indicator v4.5 Benchmark Data Tables*, and *Patient Safety Indicator v4.5 Benchmark Data Tables* documents. See Appendix A for links to these documents as well as additional documentation on the AHRQ QI.

Table 2. Characteristics of AHRQ QI Modules

IQI	PDI	PQI	PSI
• *volume* of certain intensive, high-technology, or highly complex procedures for which evidence suggests that institutions performing more of these procedures may have better outcomes; • *mortality* for inpatient procedures and for inpatient conditions; and • *utilization* indicators which examine procedures whose use varies significantly across hospitals and for which questions have been raised about overuse, underuse, or misuse.	• use indicators from the other three modules with adaptations for use among children and neonates to reflect **quality of care inside hospitals**, as well as **geographic areas**, and **identify potentially avoidable hospitalizations**.	• *potential health care quality problem areas* that might need further investigation. • measure of *primary care access* or outpatient services in a community by using patient data found in a typical hospital discharge abstract.	• *potentially preventable complications* and iatrogenic events for patients treated in hospitals. • *screening tool* for problems that patients experience as a result of exposure to the healthcare system and that are likely amenable to prevention by changes at the system or provider level.

This document contains the instructions for the SAS QI v4.5 software, which is provided for download on the AHRQ QI website (http://www.qualityindicators.ahrq.gov). The SAS program files are organized by module, and the user must execute the files separately for each of the modules. This document will discuss the code for all four modules of indicators, as well as the addition of two standalone software modules to calculate two individual measures. Throughout the document, where there are differences in the software modules they will be highlighted and discussed accordingly. The software was developed in SAS 9.3, for use on a personal computer. AHRQ's goal, by making this tool publicly available, is to assist users in producing information on healthcare quality more cost effectively.

The AHRQ QI software is intended to be used with data that cover an entire patient population (e.g., all discharges from a hospital in a year) or that were sampled from a patient population using simple random sampling. The SAS QI software, beginning with Version 4.1, does not support weighted QI estimates or standard errors for weighted estimates. Thus, analyses using data obtained from a complex sampling design will not produce accurate estimates for the population from which the data were sampled. For a more thorough description of weighted AHRQ QI analyses, see *Guidance for Using the AHRQ Quality Indicators with the Nationwide Inpatient Sample and Other Complex Sampling Designs*, available on the AHRQ QI website.

Acknowledgments

The AHRQ QI program uses the Healthcare Cost and Utilization Project (HCUP) 2010 State Inpatient Databases (SID) to compute reference population data. HCUP is a family of health care databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP databases bring together the data collection efforts of State data organizations, hospital associations, private data organizations, and the Federal government to create a national information resource of encounter-level health care data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, State, and local market levels. The HCUP databases represent 97 percent of all annual discharges in the U.S.

The AHRQ QI program would like to acknowledge the HCUP Partner organizations that participated in the HCUP SID:

Alaska State Hospital and Nursing Home Association
Arizona Department of Health Services
Arkansas Department of Health
California Office of Statewide Health Planning and Development
Colorado Hospital Association
Connecticut Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Health Information Corporation
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health and Hospitals
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Center for Health Information and Analysis
Michigan Health & Hospital Association
Minnesota Hospital Association (provides data for Minnesota and North Dakota)
Mississippi Department of Health
Missouri Hospital Industry Data Institute
Montana MHA - An Association of Montana Health Care Providers
Nebraska Hospital Association
Nevada Department of Health and Human Services
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services

North Dakota (data provided by the Minnesota Hospital Association)
Ohio Hospital Association
Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems
Oregon Health Policy and Research
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina Budget & Control Board
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Health Care Authority
Wisconsin Department of Health Services
Wyoming Hospital Association

For more information on HCUP, visit http://www.hcup-us.ahrq.gov.

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1.0   Introduction

This document describes the SAS® QI Software Version 4.5 (SAS QI v4.5) and highlights features of the analytic approach that may be of particular interest to new users. The SAS QI v4.5 software consists of four main modules: the Inpatient Quality Indicators (IQI) module, the Pediatric Quality Indicators (PDI) module, the Prevention Quality Indicators (PQI) module, and the Patient Safety Indicators (PSI) module. SAS QI v4.5 contains two new modules. The PQI #9 Standalone Module calculates PQI#9 Low Birth Weight Rate without the need to run the full PDI module. The PSI #17 Standalone Module calculates PSI #17 Birth Trauma Rate – Injury to Neonate without the need to run the full PDI module.

The AHRQ QI software is intended to be used with data that cover an entire patient population (e.g., all discharges from a hospital in a year) or that were sampled from a patient population using simple random sample). Beginning with SAS QI Software Version 4.1, the software does not support weighted QI estimates or standard errors for weighted estimates. Thus, analyses using data obtained from a complex sampling design will not produce accurate estimates for the population from which the data were sampled. For a more thorough description of weighted AHRQ QI analyses, see the technical documentation on the AHRQ QI website.

SAS QI v4.5 consists of two additional programs that assist in the calculation of the AHRQ QI^{TM}. The Limited License edition of the 3M^{TM} APR-DRG Grouper Version 30 (APR-DRG Grouper) creates Diagnosis Related Group (DRG) categories and associated risk of mortality data elements. The Prediction Module (PM) estimates the prevalence of conditions when Present on Admission (POA) data are missing. Beginning with Fiscal Year 2008 (October 1, 2007), the Uniform Billing Claim Form 04 (UB-04) data specification manual includes a POA indicator (http://www.cdc.gov/nchs/data/icd9/icdguide09.pdf). POA data may impact the prevalence of the outcome of interest and the risk-adjusted rates by excluding secondary diagnoses coded as complications from the identification of covariates. If the user's input file does not include POA data, an estimation procedure is used to adjust the prevalence of the covariates to account for the missing POA data. You may include POA data for all of your records, some of your records, or none of them. The PM estimation procedure is applied only to those records for which POA data are missing. The PM assumes the use of MS-DRG that includes existing POA data. For a more detailed description of using MS-DRG software that does not account for POA, see the technical documentation on the AHRQ website.

The reference population data used by the software are based on the Healthcare Cost and Utilization Project (HCUP) 2010 State Inpatient Databases (SID). These databases were used to create the regression coefficients applied to risk adjustment (see Section 7.4) and the shrinkage factors used to calculate smoothed rates (see Section 7.5).

The programs documented here were developed for use with SAS[‡]. SAS QI v4.5 is designed as a PC-based single-user application. It has been tested with SAS Version 9.3 (installed in 64-bit native mode and 32-bit compatibility mode) on 64-bit machines running Windows® 7 Professional and on 32-bit machines running Windows® XP Professional 2002. To use SAS QI v4.5, users must have access to a commercially available SAS statistical software package, including Base SAS, SAS/STAT and SAS/ACCESS. AHRQ is releasing two configurations of SAS QI v4.5 – 32-bit and 64-bit versions. If users are running SAS 32-bit, then they must

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‡ SAS is a statistical software package distributed by the SAS Institute, Inc. The company may be contacted directly regarding the licensing of their products. The SAS Institute, Inc., has no affiliation with AHRQ nor involvement in the development of the AHRQ QI. For more information, visit the SAS Institute website at http://www.sas.com.

download and install the corresponding 32-bit components from the AHRQ QI website (i.e., APR-DRG Grouper and PM packages). If users are running SAS 64-bit, then they must download and install the corresponding 64-bit components from the AHRQ QI website (i.e., APR-DRG Grouper and PM packages).

1.1 Naming Conventions of Programs

Most of the SAS QI v4.5 program files use the naming format of *XX*SAS*i*, *XX*SASA*i*, or *XX*SASP*i*. The first two characters, denoted here as *XX* will be designated as "IQ" to indicate an IQI program, "PD" to indicate a PDI program, "PQ" to indicate a PQI program, or "PS" to indicate a PSI program. The next three characters of the program name are "SAS." An image illustrating the program naming convention in the IQI module is shown below:

<div align="center">

IQSAS<u>A</u><u>2</u>.SAS

</div>

IQ = Inpatient Quality Indicator	**A = Area Level**	1= 1st program
PD = Pediatric Quality Indicator	P = Provider Level	**2= 2nd program**
PQ = Prevention Quality Indicator		3=3rd program
PS = Patient Safety Indicator		
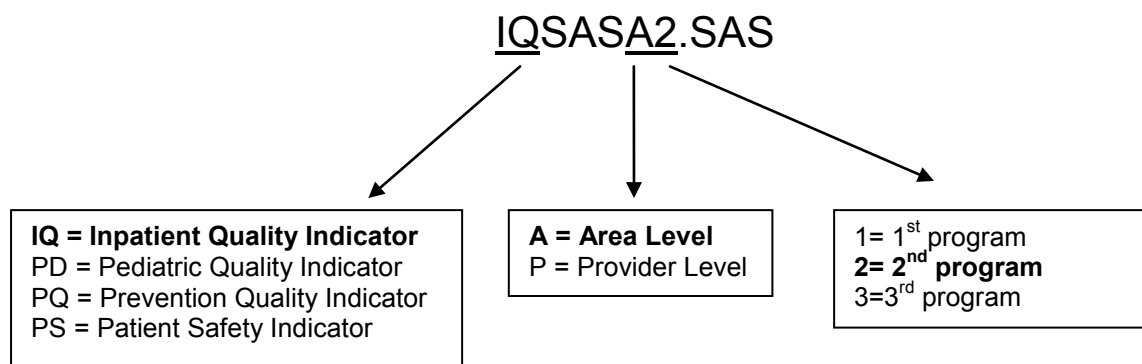
In the programs that are specific to either area-level or provider (facility)-level indicators, the sixth character of the program name is either "A" or "P." The sixth character is an "A" if the program is for the calculation of area-level indicator rates that use county or Office of Management and Budget (OMB) defined metropolitan area populations as denominators. The sixth character is a "P" if the program is for the calculation of provider-level indicator rates that use subsets of the hospital discharge population. The PSI, IQI, and PDI modules have both provider-level and area-level indicators, but the PQI module contains only area-level indicators. See Appendix E for a list of provider-level and area-level indicators. The last character (*i*) of the file name designates the number of the specific program.

Composite programs utilize a different naming convention. These programs begin with the module name using the format *XX*I, then continue with "_COMPOSITE". For example, the IQI composite indicators are calculated by the "IQI_COMPOSITE.sas" program.

1.2 Supporting Documentation

The *Inpatient Quality Indicator v4.5 Benchmark Data Tables*, *Pediatric Quality Indicator v4.5 Benchmark Data Tables*, *Prevention Quality Indicator v4.5 Benchmark Data Tables*, and *Patient Safety Indicator v4.5 Benchmark Data Tables* documents provide benchmark values, including average volumes, provider rates, and population rates across an aggregation of discharges across an aggregation of SID state files, depending on the type of indicator. In addition, the *Technical Specifications* document for each indicator lists all of the International Classification of Diseases, Clinical Modification (ICD-9-CM) and Medicare severity-Diagnostic

Related Group (MS-DRG) codes included in, and excluded from, the numerator and denominator of each indicator. See Appendix A for links to these and other documents, as well as websites that may be of interest to users.

See Appendix B for an explanation of observed, expected, risk adjusted, and smoothed rates and for guidance in the use of these rates.

The main body of this document includes a discussion of the data elements necessary to calculate the AHRQ QI; the uniform coding conventions recommended for those data elements; descriptions of the processing steps in nontechnical language; and detailed descriptions of the functions of each SAS program.

1.3   Installing the Prediction Module Software

Required for provider-level indicators only.

The purpose of the Prediction Module (PM) is to predict, for each discharge record, the expected value of the adverse health outcome for certain *provider-level* indicators. The PM is called by the SAS code in the IQI, PDI, and PSI modules, and it is run on the input dataset regardless of whether POA data are missing. It is important to note that the PM is not used in the PQI modules. The PM assumes that the input dataset includes MS-DRG codes that account for the presence of POA (for a more thorough description of the use of MS-DRG codes that do not account for POA, please see the technical documentation on the AHRQ QI website).When POA data are present, the PM applies the risk-adjustment coefficients estimated from the reference population. When POA data are missing, the PM estimates the expected value of the adverse health outcome using other information from the input file and averaging over the missing POA. Installation of the PM is required for the proper execution of the SAS QI v4.5 software (i.e., if the PM is not used, risk adjustment of the IQI, PDI, and PSI provider-level indicators will not occur). Once completed, PM installation does not need to be repeated unless it is subsequently uninstalled.

Click the "Prediction Module" link appropriate for the user's version of SAS (64-bit or 32-bit) at http://www.qualityindicators.ahrq.gov/software/SAS.aspx.

Follow prompts to download a zip file containing the appropriate PM setup package (hereafter termed the *installation package*): "AHRQ_PM_SAS_Setup-x64 0.9.3.204.msi" for 64-bit SAS and "AHRQ_PM_SAS_Setup 0.9.3.204.msi" for 32-bit SAS.[§] A .msi file is an installation file that contains all of the files, settings, and configuration information necessary for the associated application.

Save the *installation package* (.msi file) to a directory on the local machine.

Double-click *installation package* and proceed through the AHRQ Setup Wizard – this will install the PM executable file and license key in "C:\AHRQQI\AHRQPrediction" (2 files total).

1.4   Saving the Required Files to Run the SAS QI v4.5 Software

Required for provider-level indicators only.

[§] The version of the PM selected (32-bit or 64-bit) must match the user's version of SAS, not the operating system. If SAS is installed in 32-bit compatibility mode on a 64-bit operating system, the 32-bit PM should be used.

Create three sub-folders under "C:\AHRQQI\" named for each of the three modules that use the Prediction Module (i.e., "IQI", "PDI", and "PSI"). The PQI has no provider rates, so the PM is not used for risk adjustment.

The SAS QI v4.5 software packages for IQI, PDI, and PSI each contain another zip file called "*XXX*_GEE_Input_Files.zip", where *XXX* denotes the three letter abbreviation for the module being used (i.e., IQI, PDI or PSI). The files within each zip file need to be extracted to the module's respective sub-folder "C:\AHRQQI*XXX*" (again, replacing the *XXX* with the appropriate three letter abbreviation for the module).

Repeat these steps for each of the modules that you intend to use.

The syntax will compute risk-adjusted rates and observed-to-expected ratios for the pre-defined set of stratification variables (e.g., age, gender, payer, and race). When stratifications other than hospital or area are selected, the RP*XX*nn and RA*XX*nn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables.

2.0   Components of the SAS QI v4.5 Software Modules

As shown in Table 3 below, each of the SAS QI v4.5 main modules consists of various SAS programs and ASCII text files that contain auxiliary data. These programs and text files are described in the subsequent sections of this document.

Table 3. SAS programs and ASCII text files for SAS QI v4.5 software components

IQI	PDI	PQI	PSI
• 8 SAS programs	• 9 SAS programs	• 6 SAS programs	• 7 SAS programs
• 6 ASCII text files	• 9 ASCII text files	• 5 ASCII text files	• 8 ASCII text files
		• New PQI #9 Standalone Module	• New PSI #17 Standalone Module

3.0 Quick References

This section is intended to serve as a set of quick references to assist in reading this documentation and in reviewing the SAS QI v4.5 outputs. Each module has a set of four Quick Reference pages. Processing steps are shown on the first two pages of each reference set, followed by tables explaining the variable naming convention and files used in each module.

3.1 Inpatient Quality Indicators Quick Reference

Figure 1 shows the processing steps for the provider-level indicators in the IQI module, and Figure 2 shows the processing steps for the area-level indicators in the IQI module. Table 4 lists the indicators calculated in the IQI module, arranged by provider-level or area-level.
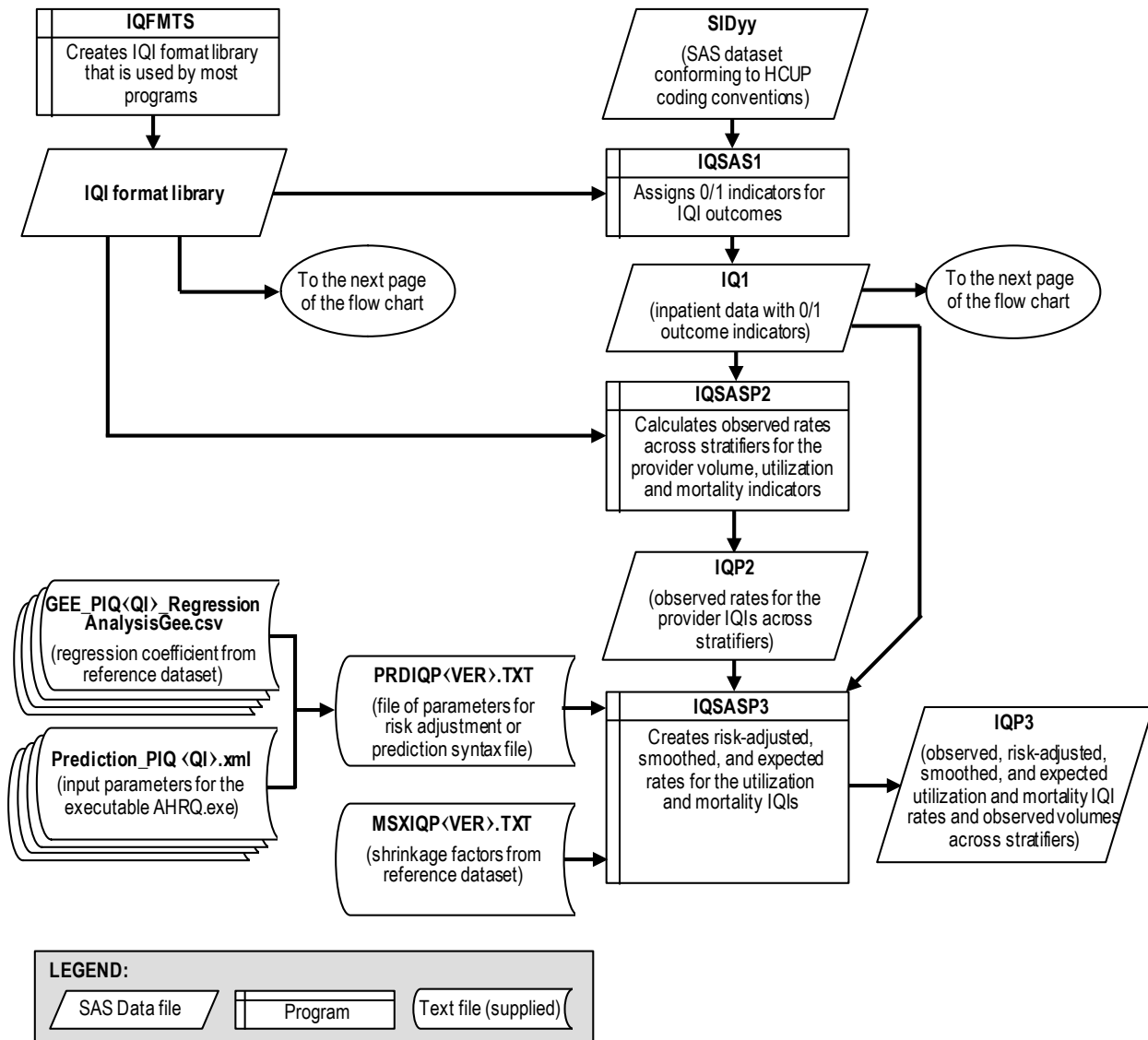
Figure 1. Processing Steps for the Provider-level Indicators in the IQI Module
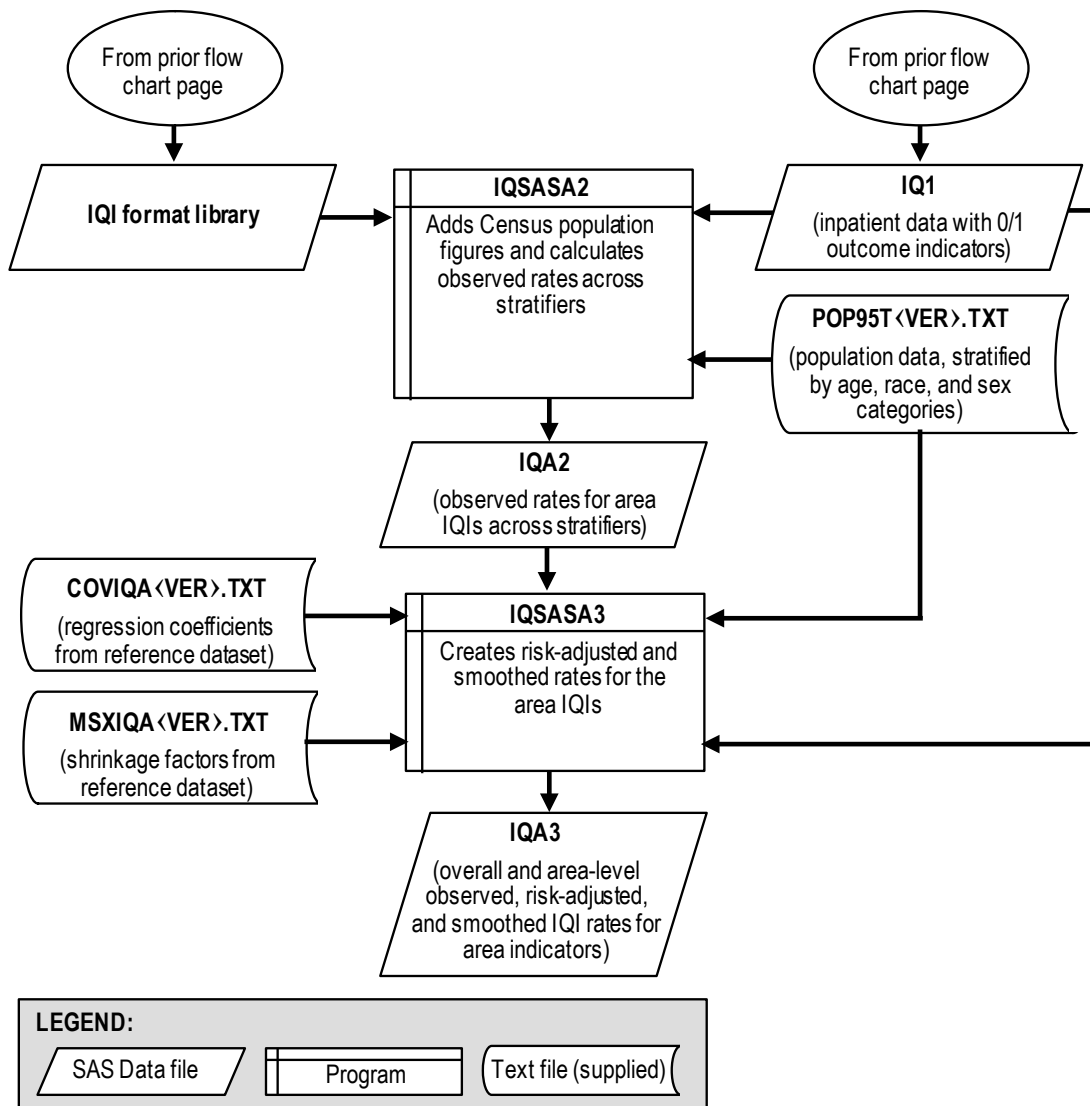
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_IQI.SAS program, which contains code the user must modify in order to run the IQI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data set.

NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_IQI.SAS program, which contains code the user must modify in order to run the IQI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data set.

Figure 2. Processing Steps for the Area-level Indicators in the IQI Module

Table 4. Indicators Computed in the IQI Module and Variable Abbreviation

INDICATOR NAME	ABBREVIATION USED IN SAS VARIABLE NAMES
PROVIDER-LEVEL INDICATORS	
IQI #1 Esophageal Resection Volume	IQ01
IQI #2 Pancreatic Resection Volume	IQ02
IQI #2A Pancreatic Resection Volume – Stratum A	IQ02A
IQI #2B Pancreatic Resection Volume – Stratum B	IQ02B
IQI #4 Abdominal Aortic Aneurysm (AAA) Repair Volume	IQ04
IQI #4A Abdominal Aortic Aneurysm (AAA) Repair Volume – Stratum A	IQ04A
IQI #4B Abdominal Aortic Aneurysm (AAA) Repair Volume – Stratum B	IQ04B
IQI #4C Abdominal Aortic Aneurysm (AAA) Repair Volume – Stratum C	IQ04C
IQI #4D Abdominal Aortic Aneurysm (AAA) Repair Volume – Stratum D	IQ04D
IQI #5 Coronary Artery Bypass Graft (CABG) Volume	IQ05
IQI #6 Percutaneous Coronary Intervention (PCI) Volume	IQ06
IQI #7 Carotid Endarterectomy Volume	IQ07
IQI #8 Esophageal Resection Mortality Rate	IQ08
IQI #9 Pancreatic Resection Mortality Rate	IQ09
IQI #9A Pancreatic Resection Mortality Rate – Stratum A	IQ09A
IQI #9B Pancreatic Resection Mortality Rate – Stratum B	IQ09B
IQI #11 Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate	IQ11
IQI #11A Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate – Stratum A	IQ11A
IQI #11B Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate – Stratum B	IQ11B
IQI #11C Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate – Stratum C	IQ11C
IQI #11D Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate – Stratum D	IQ11D
IQI #12 Coronary Artery Bypass Graft (CABG) Mortality Rate	IQ12
IQI #13 Craniotomy Mortality Rate	IQ13
IQI #14 Hip Replacement Mortality Rate	IQ14
IQI #15 Acute Myocardial Infarction (AMI) Mortality Rate	IQ15
IQI #16 Heart Failure Mortality Rate	IQ16
IQI #17 Acute Stroke Mortality Rate	IQ17
IQI #17A Acute Stroke Mortality Rate – Stratum A	IQ17A
IQI #17B Acute Stroke Mortality Rate – Stratum B	IQ17B
IQI #17C Acute Stroke Mortality Rate – Stratum C	IQ17C
IQI #18 Gastrointestinal Hemorrhage Mortality Rate	IQ18
IQI #19 Hip Fracture Mortality Rate	IQ19
IQI #20 Pneumonia Mortality Rate	IQ20
IQI #21 Cesarean Delivery Rate, Uncomplicated	IQ21
IQI #22 Vaginal Birth After Cesarean (VBAC) Delivery Rate, Uncomplicated	IQ22
IQI #23 Laparoscopic Cholecystectomy Rate	IQ23
IQI #24 Incidental Appendectomy in the Elderly Rate	IQ24
IQI #25 Bilateral Cardiac Catheterization Rate	IQ25
IQI #30 Percutaneous Coronary Intervention (PCI) Mortality Rate	IQ30
IQI #31 Carotid Endarterectomy Mortality Rate	IQ31
IQI #32 Acute Myocardial Infarction (AMI) Mortality Rate, Without Transfer Cases	IQ32
IQI #33 Primary Cesarean Delivery Rate, Uncomplicated	IQ33
IQI #34 Vaginal Birth After Cesarean (VBAC) Rate, All	IQ34

INDICATOR NAME	ABBREVIATION USED IN SAS VARIABLE NAMES
AREA-LEVEL INDICATORS	
IQI #26 Coronary Artery Bypass Graft (CABG) Rate	IQ26
IQI #27 Percutaneous Coronary Intervention (PCI) Rate	IQ27
IQI #28 Hysterectomy Rate	IQ28
IQI #29 Laminectomy or Spinal Fusion Rate	IQ29

The SAS programs in the IQI module use a consistent naming convention for the variables used to store the different indicator results. The first character of the variable name (prefix) indicates what type of result the variable stores (see Table 5). The second character is either "A" if the indicator is area-level or "P" if the indicator is provider-level. The remaining characters are an abbreviation that identifies the indicator by module and number. The first two characters of the abbreviation are "IQ" to indicate the result is associated with the IQI module. The last characters in the abbreviation are numbers and letters matching the indicator number and stratum (if applicable) within the module. Table 4 lists the abbreviations used to name the IQI SAS variables. Examples of this naming convention applied to the IQI module are provided in Table 5. As indicated in Table 5, the smoothed rate and signal posterior standard deviation are not reported for stratified indicators. In the IQI module, this impacts the following indicators: IQI #9A, IQI #9B, IQI#11A, IQI #11B, IQI #11C, IQI #11D, IQI #17A, IQI #17B, and IQI #17C.

Table 5. Prefixes for the Variables Used to Store IQI Results

| PREFIX | TYPE OF RESULT | EXAMPLES | |
		PROVIDER-LEVEL INDICATOR (IQI #8)	AREA-LEVEL INDICATOR (IQI #26)
T	Inpatient numerator (top)	TPIQ08	TAIQ26
P	Population denominator (pop)	PPIQ08	PAIQ26
Q	Present on Admission flag	QPIQ08	N/A
O	Observed rate	OPIQ08	OAIQ26
E	Expected rate	EPIQ08	EAIQ26
R	Risk-adjusted rate	RPIQ08	RAIQ26
L	Lower limit of confidence interval for risk-adjusted rate	LPIQ08	LAIQ26
U	Upper limit of confidence interval for risk-adjusted rate	UPIQ08	UAIQ26
S	Smoothed rate (not reported for strata – i.e., those indicators ending in "A", "B", etc.)	SPIQ08	SAIQ26
X	Signal posterior standard deviation (not reported for strata – i.e., those indicators ending in "A", "B", etc.)	XPIQ08	XAIQ26

Note: Some types of results will not be applicable to certain indicators.

The IQI SAS programs load data from auxiliary files. These auxiliary files are in ASCII text, comma separated value (CSV), or extensible markup language (XML) format. There is no need to convert these files to SAS format for use with the software.

Table 6 lists the SAS programs included in the IQI module and which auxiliary files (if any) are required by those program files. The POP95T13.TXT file is available on the AHRQ QI website as a separate download. All of the other auxiliary files are included in the IQI module download package.

Table 6. Files Included in the IQI Module

SAS PROGRAM FILE NAME	AUXILIARY FILES REQUIRED BY SAS PROGRAM FILE
CONTROL_IQI.SAS	
IQFMTS.SAS	
IQSAS1.SAS	
IQSASP2.SAS	
IQSASP3.SAS	Prediction_P*MMnn*.xml[1] gee_p*mmnn*_RegressionAnalysisGee.csv[1] PRDIQP45.TXT MSXIQP45.TXT
IQSASA2.SAS	POP95T13.TXT
IQSASA3.SAS	MSXIQA45.TXT COVIQA45.TXT
IQI_COMPOSITE.SAS	MSXIQC45.TXT MXIQC45A.TXT

[1] Contained in IQI_GEE_Input_Files.zip. The module contains one of these files for each indicator processed through the PM. The actual file name will contain the module and indicator number in place of "*MMnn*" or "*mmnn*", using the abbreviations in Table 4.

3.2   Pediatric Quality Indicators Quick Reference

Figure 3 shows the processing steps for the provider-level indicators in the PDI module, and Figure 4 shows the processing steps for the area-level indicators in the PDI module. Table 7 lists the indicators calculated in the PDI module, arranged by provider-level or area-level. The module calculates 12 provider-level indicators and five (5) area-level indicators that focus on the pediatric population. In addition, the module calculates three (3) Neonatal Quality Indicators (NQI) focused on neonatal care.

Two indicators that are conceptually related to other modules, PQI #9 Low Birth Weight Rate and PSI #17 Birth Trauma Rate – Injury to Neonate, are calculated within the PDI module because they are based on the number of births. In addition, two standalone modules were introduced with SAS QI v4.5. The PQI #9 Standalone Module and the PSI #17 Standalone Module calculate these two indicators, respectively, without the need to run the entire PDI module. These two standalone modules are available as separate downloads from the AHRQ QI website. The standalone modules include the same processing steps as the area-level PDI module and the provider-level PDI module, respectively, for PQI #9 and PSI #17.
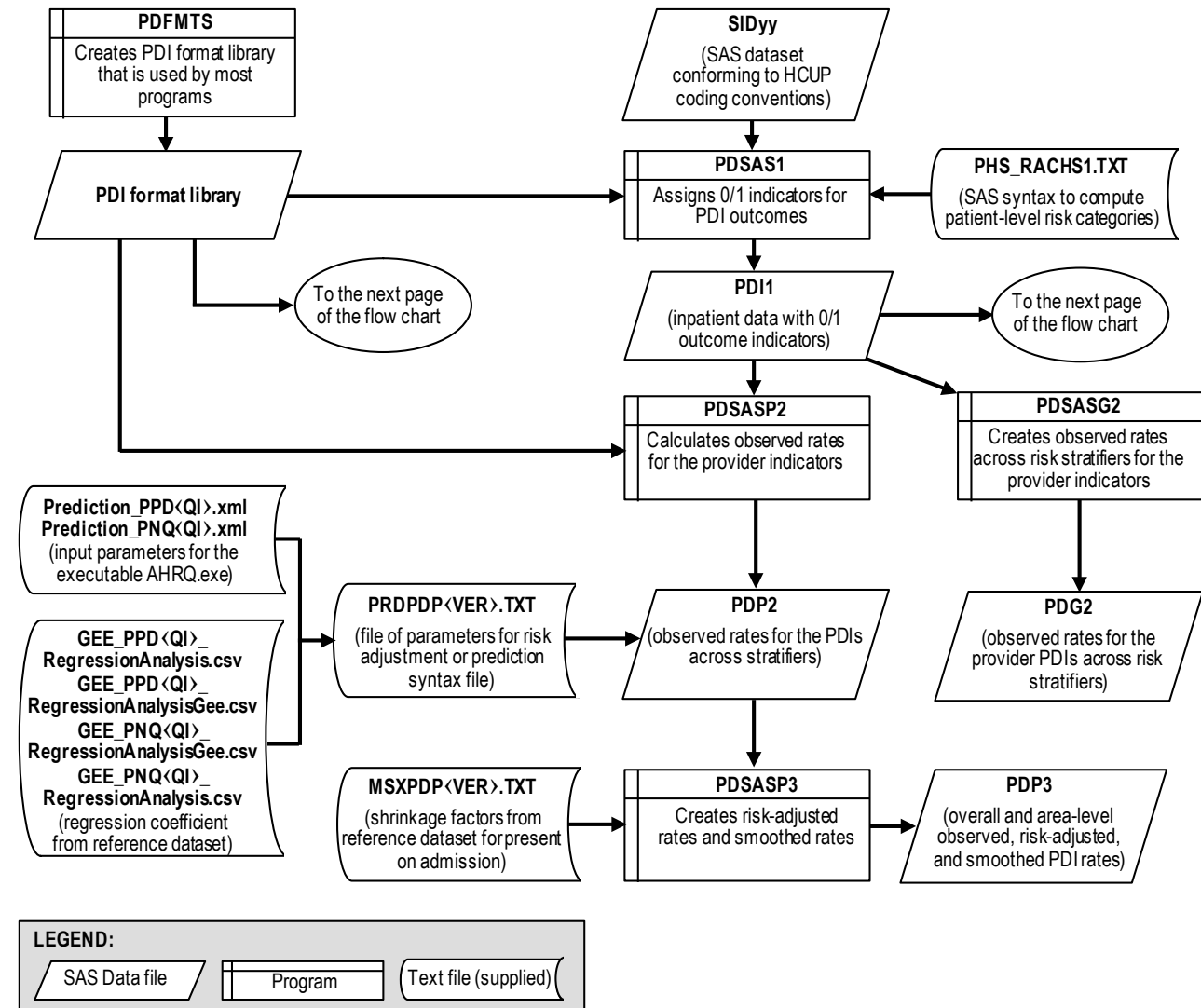
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_PDI.SAS program, which contains code the user **must** modify in order to run the PDI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data set.

Figure 3. Processing Steps for the Provider-level Indicators in the PDI Module
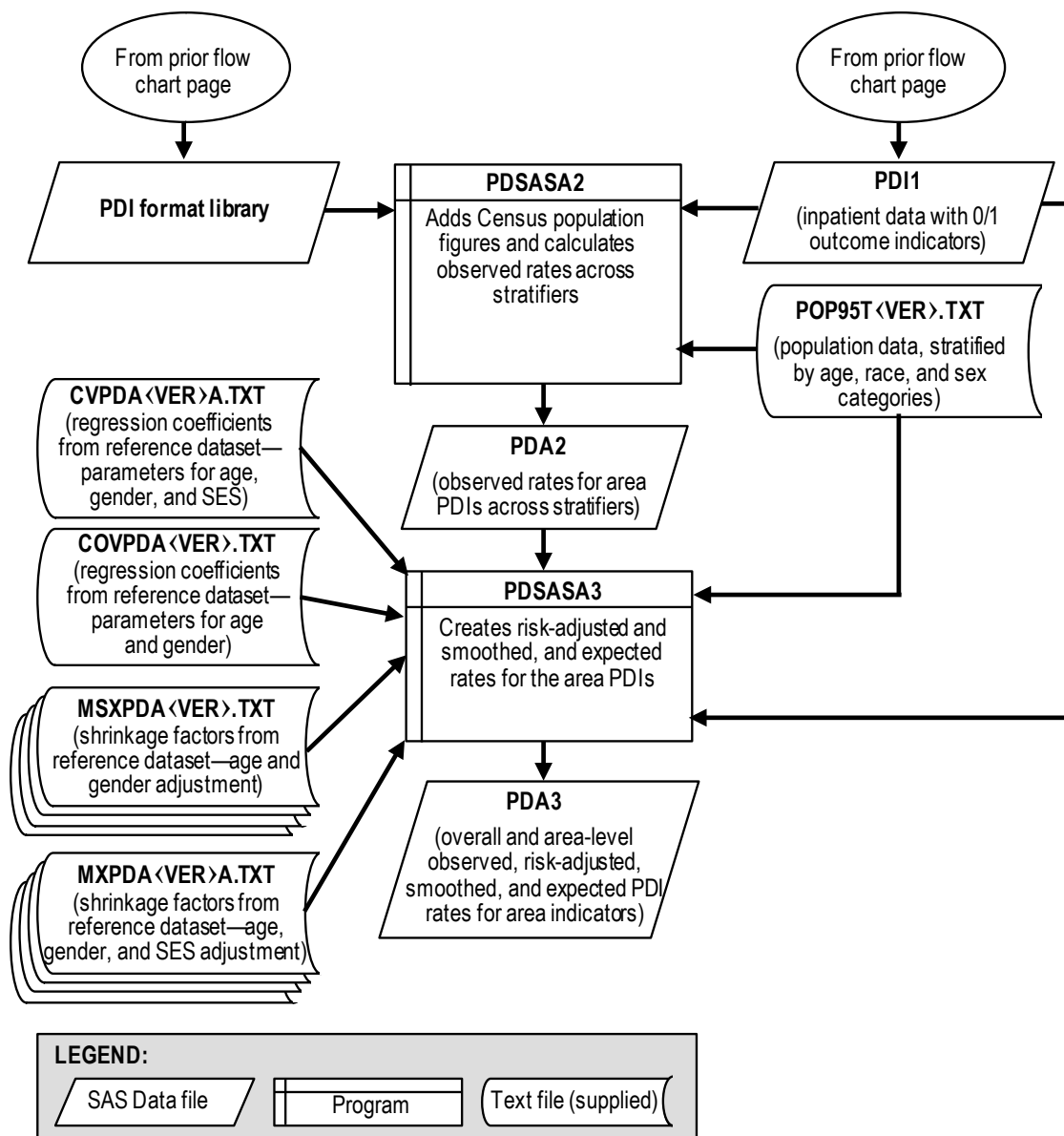
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_PDI.SAS program, which contains code the user must modify in order to run the PDI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data set.

Figure 4. Processing Steps for the Area-level Indicators in the PDI Module

Table 7. Indicators Computed in the PDI Module and Variable Abbreviation

INDICATOR NAME	ABBREVIATION USED IN SAS VARIABLE NAMES
PROVIDER-LEVEL INDICATORS	
NQI #1 Neonatal Iatrogenic Pneumothorax Rate	NQ01
NQI #2 Neonatal Mortality Rate	NQ02
NQI #3 Neonatal Blood Stream Infection Rate	NQ03
PDI #1 Accidental Puncture or Laceration Rate	PD01
PDI #2 Pressure Ulcer Rate	PD02
PDI #3 Retained Surgical Item or Unretrieved Device Fragment Count	PD03
PDI #5 Iatrogenic Pneumothorax Rate	PD05
PDI #6 RACHS-1 Pediatric Heart Surgery Mortality Rate	PD06
PDI #7 RACHS-1 Pediatric Heart Surgery Volume	PD07
PDI #8 Perioperative Hemorrhage or Hematoma Rate	PD08
PDI #9 Postoperative Respiratory Failure Rate	PD09
PDI #10 Postoperative Sepsis Rate	PD10
PDI #11 Postoperative Wound Dehiscence Rate	PD11
PDI #12 Central Venous Catheter-Related Blood Stream Infection Rate	PD12
PDI #13 Transfusion Reaction Count	PD13
PSI #17 Birth Trauma Rate – Injury to Neonate	PS17
AREA-LEVEL INDICATORS	
PDI #14 Asthma Admission Rate	PD14
PDI #15 Diabetes Short-Term Complications Admission Rate	PD15
PDI #16 Gastroenteritis Admission Rate	PD16
PDI #17 Perforated Appendix Admission Rate[1]	PD17
PDI #18 Urinary Tract Infection Admission Rate	PD18
PDI #90 Pediatric Quality Overall Composite	PD90
PDI #91 Pediatric Quality Acute Composite	PD91
PDI #92 Pediatric Quality Chronic Composite	PD92
PQI #9 Low Birth Weight Rate	PQ09

[1] The denominator for PDI #17 includes all hospital admissions for appendicitis in the area.

The SAS programs in the PDI module use a consistent naming convention for the variables used to store the different indicator results. The first character of the variable name (prefix) indicates what type of result the variable stores (see Table 8). The second character is either "A" if the indicator is area-level or "P" if the indicator is provider-level. The remaining characters are an abbreviation that identifies the indicator by module and number. The abbreviation is based on the conceptual module to which the indicator belongs: "PD" for the indicators labeled as PDI, "NQ" for the indicators labeled as NQI, "PQ" for the indicator labeled as a PQI, and "PS" for the indicator labeled as a PSI. The last characters in the abbreviation are numbers matching the indicator number. Table 7 lists the abbreviations used to name the PDI SAS variables. Examples of this naming convention applied to the PDI module are provided in Table 8.

Table 8. Prefixes for the Variables Used to Store PDI Results

PREFIX	TYPE OF RESULT	EXAMPLES	
		PROVIDER-LEVEL INDICATOR (PDI #8)	AREA-LEVEL INDICATOR (PDI #14)
T	Inpatient numerator (top)	TPPD08	TAPD14
P	Population denominator (pop)	PPPD08	PAPD14
Q	Present on Admission flag	QPPD08	N/A
O	Observed rate	OPPD08	OAPD14
E	Expected rate	EPPD08	EAPD14
R	Risk-adjusted rate	RPPD08	RAPD14
L	Lower limit of confidence interval for risk-adjusted rate	LPPD08	LAPD14
U	Upper limit of confidence interval for risk-adjusted rate	UPPD08	UAPD14
S	Smoothed rate	SPPD08	SAPD14
X	Signal posterior standard deviation	XPPD08	XAPD14

Note: Some types of results will not be applicable to certain indicators.

The PDI SAS programs load data from auxiliary files. These auxiliary files are in ASCII text, comma separated value (CSV), or extensible markup language (XML) format. There is no need to convert these files to SAS format for use with the software. Table 9 lists the SAS programs included in the PDI module and which auxiliary files (if any) are required by those program files. The POP95T13.TXT file is available on the AHRQ QI website as a separate download. All of the other auxiliary files are included in the PDI module download package.

Table 9. Files Included in the PDI Module

SAS PROGRAM FILE NAME	AUXILIARY FILES REQUIRED BY SAS PROGRAM FILE
CONTROL_PDI.SAS	
PDFMTS.SAS	
PDSAS1.SAS	PHS_RACHS1.TXT
PDSASA2.SAS	POP95T13.TXT
PDSASA3.SAS	MXPDA45A.TXT MSXPDA45.TXT COVPDA45.TXT CVPDA45A.TXT
PDSASG2.SAS	
PDSASP2.SAS	
PDSASP3.SAS	Prediction_P*MMnn*.xml[1] gee_p*mmnn*_RegressionAnalysisGee.csv or gee_p*mmnn*_RegressionAnalysis.csv[1] PRDPDP45.TXT MSXPDP45.TXT
PDI_COMPOSITE.SAS	MSXPDC45.TXT MXPDC45A.TXT

[1] Contained in PDI_GEE_Input_Files.zip. The module contains one of these files for each indicator processed through the PM. The actual file name will contain the module and indicator number in place of "*MMnn*" or "*mmnn*", using the abbreviations in Table 7.

3.3   Prevention Quality Indicators Quick Reference

   Figure 5 shows the processing steps for the area-level indicators in the PQI module. For certain indicators, the PQI module can calculate admission rates using a denominator based on the prevalence of the condition at the state level. Figure 6 shows the processing steps for these condition specific indicators in the in the PQI module. Table 10 lists the indicators calculated in the PQI module. All indicators calculated by the PQI module are area-level.

   PQI #9 is a pediatric indicator that can be calculated using either the PDI module or the PQI #9 Standalone Module. The ability to calculate PQI #9 separately from the other pediatric indicators is an efficiency enhancement introduced in SAS QI v4.5. The PQI #9 Standalone Module is available as a separate download from the AHRQ QI website.

LEGEND:

| SAS Data file | Program | Text file (supplied) |
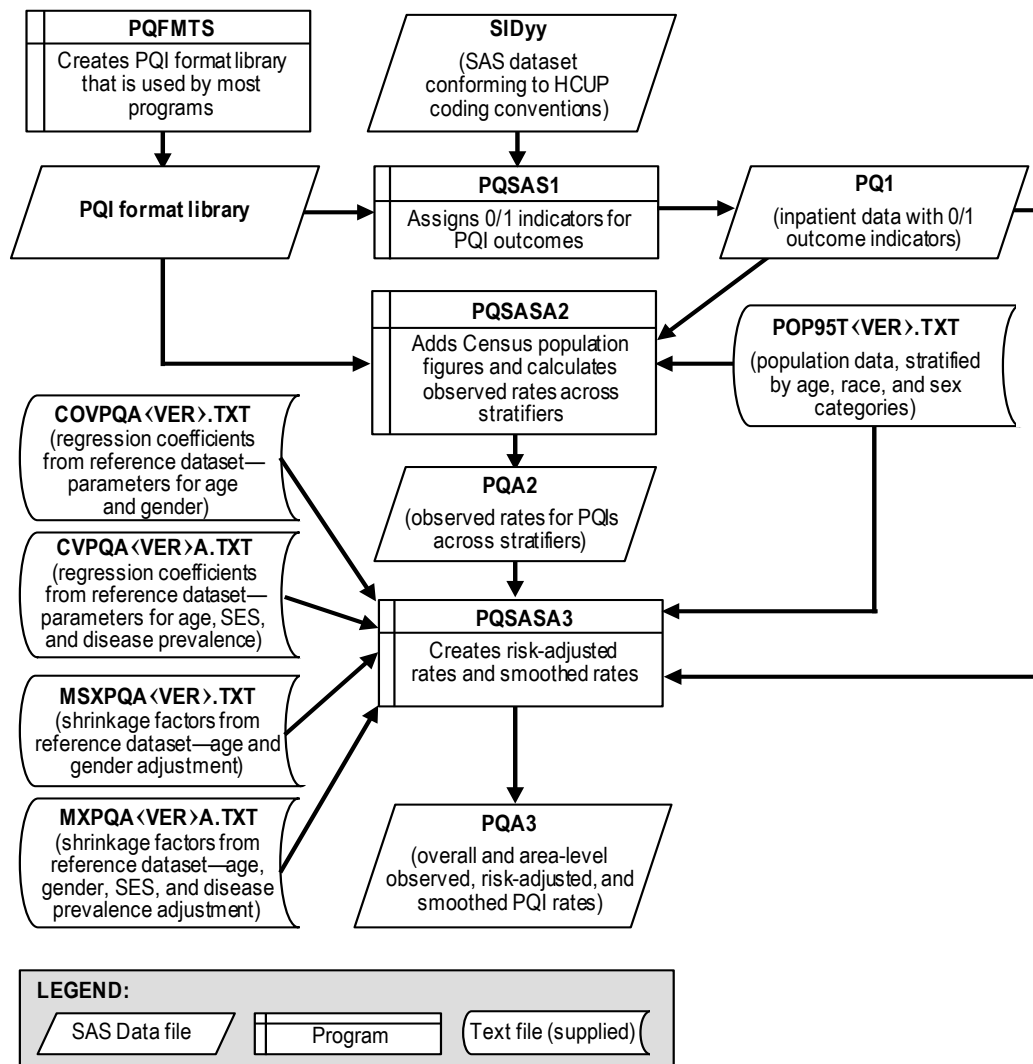
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_PQI.SAS program, which contains code the user must modify in order to run the PQI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data sets.

Figure 5. Processing Steps for the Area-level Indicators in the PQI Module
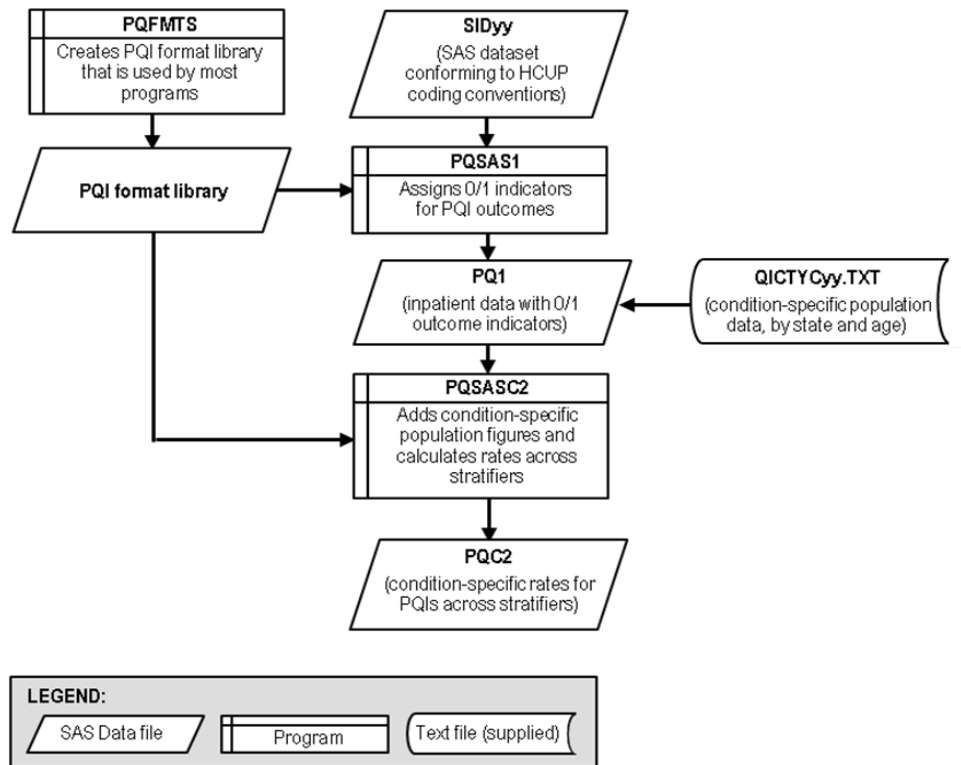
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_PQI.SAS program, which contains code the user must modify in order to run the PQI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data sets.

Figure 6. Processing Steps for the Condition Specific Indicators in the PQI Module

Table 10. Indicators Computed in the PQI Module and Variable Abbreviation

INDICATOR NAME	ABBREVIATION USED IN SAS VARIABLE NAMES
PQI #1 Diabetes Short-Term Complications Admission Rate	PQ01
PQI #2 Perforated Appendix Admission Rate[1]	PQ02
PQI #3 Diabetes Long-Term Complications Admission Rate	PQ03
PQI #5 Chronic Obstructive Pulmonary Disease (COPD) or Asthma in Older Adults Admission Rate	PQ05
PQI #7 Hypertension Admission Rate	PQ07
PQI #8 Heart Failure Admission Rate	PQ08
PQI #10 Dehydration Admission Rate	PQ10
PQI #11 Bacterial Pneumonia Admission Rate	PQ11
PQI #12 Urinary Tract Infection Admission Rate	PQ12
PQI #13 Angina Without Procedure Admission Rate	PQ13
PQI #14 Uncontrolled Diabetes Admission Rate	PQ14
PQI #15 Asthma in Younger Adults Admission Rate	PQ15
PQI #16 Lower-Extremity Amputation among Patients with Diabetes Rate	PQ16
PQI #90 Prevention Quality Overall Composite	PQ90
PQI #91 Prevention Quality Acute Composite	PQ91
PQI #92 Prevention Quality Chronic Composite	PQ92

Note: PQI #9 is calculated in the PDI module.
[1] The denominator for PQI #2 includes all hospital admissions for appendicitis in the area.

The SAS programs in the PQI module use a consistent naming convention for the variables used to store the different indicator results. The first character of the variable name (prefix) indicates what type of result the variable stores (see Table 11). The second character is "A" to note that the indicator is area-level (all indicators calculated by the PQI module are area-level). The remaining characters are an abbreviation that identifies the indicator by module and number. The first two characters of the abbreviation are "PQ" to indicate the result is associated with the PQI module. The last characters in the abbreviation are numbers matching the indicator number within the module. Table 10 lists the abbreviations used to name the PQI SAS variables. Examples of this naming convention applied to the PQI module are provided in Table 11.

Table 11. Prefixes for the Variables Used to Store PQI Results

PREFIX	TYPE OF RESULT	EXAMPLE (PQI #1)
T	Inpatient numerator (top)	TAPQ01
P	Population denominator (pop)	PAPQ01
O	Observed rate	OAPQ01
E	Expected rate	EAPQ01
R	Risk-adjusted rate	RAPQ01
L	Lower limit of confidence interval of risk-adjusted rate	LAPQ01
U	Upper limit of confidence interval of risk-adjusted rate	UAPQ01
S	Smoothed rate	SAPQ01
X	Signal posterior standard deviation	XAPQ01
C	Condition-specific rate	CAPQ01

Note: Some types of results will not be applicable to certain indicators.

The PQI SAS programs load data from auxiliary files. These auxiliary files are in ASCII text format. There is no need to convert these files to SAS format for use with the software. Table 12

lists the SAS programs included in the PQI module and which auxiliary files (if any) are required by those program files. The POP95T13.TXT file is available on the AHRQ QI website as a separate download. All of the other auxiliary files are included in the PQI module download package.

Table 12. Files Included in the PQI Module

SAS PROGRAM FILE NAME	AUXILIARY FILES REQUIRED BY SAS PROGRAM FILE
CONTROL_PQI.SAS	
PQFMTS.SAS	
PQSAS1.SAS	
PQSASA2.SAS	POP95T13.TXT
PQSASA3.SAS	COVPQA45.TXT MSXPQA45.TXT CVPQA45A.TXT MXPQA45A.TXT
PQSASC2.SAS	QICTYC13.TXT

3.4   Patient Safety Indicators Quick Reference

Figure 7 shows the processing steps for the provider-level indicators in the PSI module, and Figure 8 shows the processing steps for the area-level indicators in the PSI module. Table 13 lists the indicators calculated in the PSI module, arranged by provider-level or area-level.

PSI #17 is a pediatric indicator that can be calculated using either the PDI module or the PSI #17 Standalone Module. The ability to calculate PSI #17 separately from the other pediatric indicators is an efficiency enhancement introduced with SAS QI v4.5. The PSI #17 Standalone Module is available as a separate download from the AHRQ QI website.
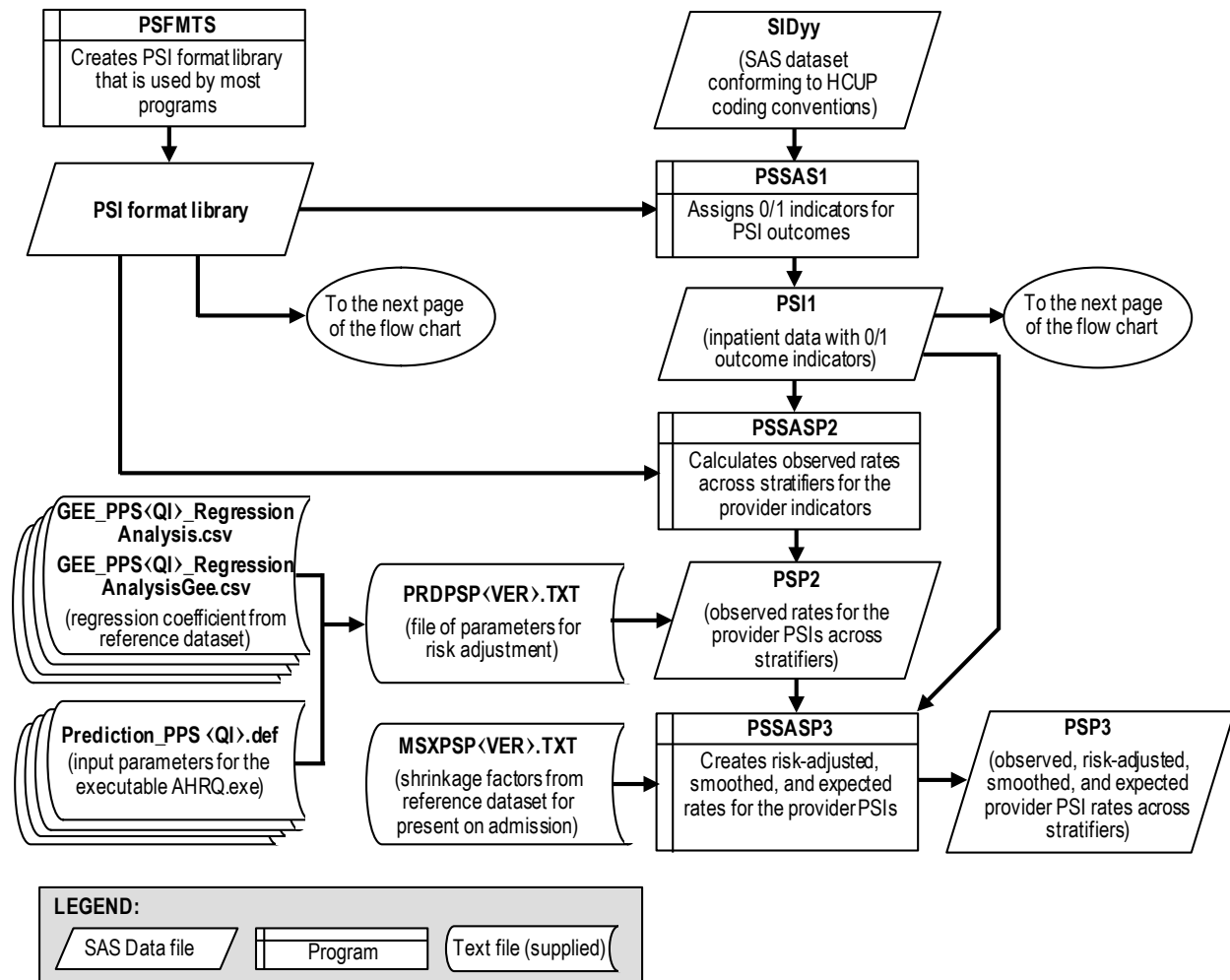
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_PSI.SAS program, which contains code the user must modify in order to run the PSI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data set.

Figure 7. Processing Steps for Provider-level Indicators in the PSI Module
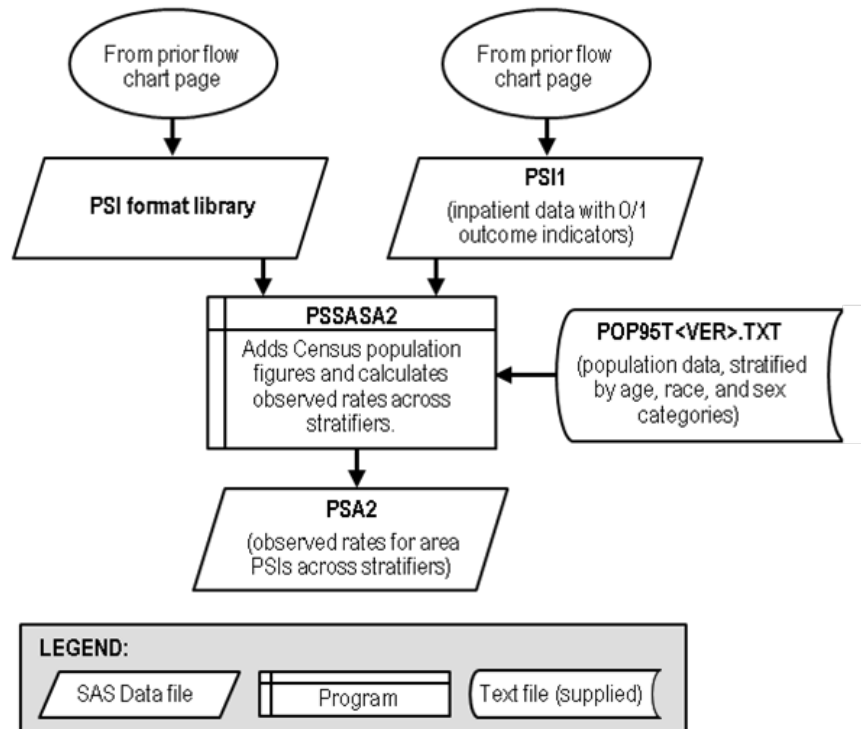
NOTE: Each of the SAS Programs in this figure incorporates the CONTROL_PSI.SAS program, which contains code the user must modify in order to run the PSI software. The modifications include such items as specifying the name and location of the input data set, the population data set, and the output data set.

Figure 8. Processing Steps for the Area-level Indicators in the PSI Module

Table 13. Indicators Computed in the PSI Module and Variable Abbreviation

INDICATOR NAME	ABBREVIATION USED IN SAS VARIABLE NAMES
PROVIDER-LEVEL INDICATORS	
PSI #2 Death Rate in Low-Mortality Diagnosis Related Groups (DRGs)	PS02
PSI #3 Pressure Ulcer Rate	PS03
PSI #4 Death Rate among Surgical Inpatients with Serious Treatable Complications	PS04
PSI #4A Death Rate among Surgical Inpatients with Serious Treatable Complications – Stratum A	PS04A
PSI #4B Death Rate among Surgical Inpatients with Serious Treatable Complications – Stratum B	PS04B
PSI #4C Death Rate among Surgical Inpatients with Serious Treatable Complications – Stratum C	PS04C
PSI #4D Death Rate among Surgical Inpatients with Serious Treatable Complications – Stratum D	PS04D
PSI #4E Death Rate among Surgical Inpatients with Serious Treatable Complications – Stratum E	PS04E
PSI #5 Retained Surgical Item or Unretrieved Device Fragment Count	PS05
PSI #6 Iatrogenic Pneumothorax Rate	PS06
PSI #7 Central Venous Catheter-Related Blood Stream Infection Rate	PS07
PSI #8 Postoperative Hip Fracture Rate	PS08
PSI #9 Perioperative Hemorrhage or Hematoma Rate	PS09
PSI #10 Postoperative Physiologic and Metabolic Derangement Rate	PS10
PSI #11 Postoperative Respiratory Failure Rate	PS11
PSI #12 Perioperative Pulmonary Embolism or Deep Vein Thrombosis Rate	PS12
PSI #13 Postoperative Sepsis Rate	PS13
PSI #14 Postoperative Wound Dehiscence Rate	PS14
PSI #15 Accidental Puncture or Laceration Rate	PS15
PSI #16 Transfusion Reaction Count	PS16
PSI #18 Obstetric Trauma Rate – Vaginal Delivery With Instrument	PS18
PSI #19 Obstetric Trauma Rate – Vaginal Delivery Without Instrument	PS19
AREA-LEVEL INDICATORS	
PSI #21 Retained Surgical Item or Unretrieved Device Fragment Rate	PS21
PSI #22 Iatrogenic Pneumothorax Rate	PS22
PSI #23 Central Venous Catheter-Related Blood Stream Infection Rate	PS23
PSI #24 Postoperative Wound Dehiscence Rate	PS24
PSI #25 Accidental Puncture or Laceration Rate	PS25
PSI #26 Transfusion Reaction Rate	PS26
PSI #27 Perioperative Hemorrhage or Hematoma Rate	PS27

Note: PSI #17 is calculated in the PDI module.

The SAS programs in the PSI module use a consistent naming convention for the variables used to store the different indicator results. The first character of the variable name (prefix) indicates what type of result the variable stores (see Table 14). The second character is either "A" if the indicator is area-level or "P" if the indicator is provider-level. The remaining characters are an abbreviation that identifies the indicator by module and number. The first two characters of the abbreviation are "PS" to indicate the result is associated with the PSI module. The last characters in the abbreviation are numbers and letters matching the indicator number and stratum (if applicable) within the module. Table 13 lists the abbreviations used to name the PSI SAS variables. Examples of this naming convention applied to the PSI module are provided

in Table 14. As indicated in **Table 14**, the smoothed rate and the signal posterior standard deviation are not reported for stratified indicators. In the PSI module, this impacts PSI #4A, PSI #4B, PSI #4C, PSI #4D, and PSI #4E.

Table 14. Prefixes for the Variables Used to Store PSI Results

PREFIX	TYPE OF RESULT	EXAMPLES	
		PROVIDER-LEVEL INDICATOR (PSI #8)	AREA-LEVEL INDICATOR (PSI #23)
T	Inpatient numerator (top)	TPPS08	TAPS23
P	Population denominator (pop)	PPPS08	PAPS23
O	Observed rate	OPPS08	OAPS23
Q	Present on Admission flag	QPPS08	N/A
E	Expected rate	EPPS08	N/A
R	Risk-adjusted rate	RPPS08	N/A
L	Lower limit of confidence interval of risk-adjusted rate	LPPS08	N/A
U	Upper limit of confidence interval of risk-adjusted rate	UPPS08	N/A
S	Smoothed rate (not reported for stratified indicators – i.e., those ending in "A", "B", etc.)	SPPS08	N/A
X	Signal posterior standard deviation (not reported for stratified indicators)	XPPS08	N/A

Note: Some types of results will not be applicable to certain indicators.

The PSI SAS programs load data from auxiliary files. These auxiliary files are in ASCII text, comma separated value (CSV), or extensible markup language (XML) format. There is no need to convert these files to SAS format for use with the software. Table 15 lists the SAS programs included in the PSI module and which auxiliary files (if any) are required by those program files. The POP95T13.TXT file is available on the AHRQ QI website as a separate download. All of the other auxiliary files are included in the PSI module download package.

Table 15. Files Included in the PSI Module

SAS PROGRAM FILE NAME	AUXILIARY FILES REQUIRED BY SAS PROGRAM FILE
CONTROL_PSI.SAS	
PSFMTS.SAS	CMBFQI32.TXT CMBFQI37.TXT
PSSAS1.SAS	CMBAQI32.TXT CMBAQI37.TXT
PSSASA2.SAS	POP95T13.TXT
PSSASP2.SAS	
PSSASP3.SAS	Prediction_P*MMnn*.xml[1] gee_p*mmnn*_RegressionAnalysisGee.csv or gee_p*mmnn*_RegressionAnalysis.csv[1] PRDPSP45.TXT MSXPSP45.TXT
PSI_COMPOSITE.SAS	MSXPSC45.TXT MXPSC45A.TXT

[1] Contained in PSI_GEE_Input_Files.zip. The module contains one of these files for each indicator processed through the PM. The actual file name will contain the module and indicator number in place of "*MMnn*" or "*mmnn*", using the abbreviations in Table 13.

4.0 Background

Each module of the AHRQ QI reflects quality of care measures to highlight potential quality concerns, identify areas that need further study and investigation, and track changes over time. The data required for measuring these indicators come from hospital discharge abstracts or billing claims (administrative data), which are readily available within hospitals or from many state data organizations. The AHRQ QI software is intended to be used with data that cover an entire patient population (e.g., all discharges from a hospital in a year) or that were sampled from a patient population using simple random sample). Beginning with SAS QI Software Version 4.1, the software does not support weighted QI estimates or standard errors for weighted estimates. Thus, analyses using data obtained from a complex sampling design will not produce accurate estimates for the population from which the data were sampled. The residential population data for the area-level utilization indicators are from the U.S. Census Bureau (see *2013 Population File for Use with AHRQ Quality Indicators^{TM}*).

The software generates observed, expected, risk-adjusted, and smoothed rates across the modules for most indicators. Observed rates are the raw rates, which are the count of discharge records including the health outcome of interest divided by the count of discharge records in the patient population at risk. Expected and risk-adjusted rates both acknowledge that individual providers (or areas of the country) are unique and differ in two important ways from the representative profile observed in the reference population. First, there is heterogeneity in the quality of care that is provided. Some providers and areas provide exemplary care. Others provide sub-standard care. This is an important dimension of differences. Second, most individual providers serve patients with a distribution of covariates (demographics and comorbidities) that differs from the reference population. Some providers serve populations who are at higher risk for adverse events, and some serve populations who are at lower risk. This is a dimension that makes it difficult to make meaningful comparisons of observed rates. The expected and risk-adjusted rates each peg one of these two dimensions (quality of care, or patient mix) to that observed in the reference population and then comment on the second dimension, as observed in the local data.

The expected rate answers the question: "What rate of adverse events would we expect to see if this provider (or area) provided the average level of care observed in the reference population, but provided it to patients with the locally observed distribution of characteristics?" (i.e., average performance from the reference population of the universe of patients applied to locally observed mix of patients with their local risk profiles). When the observed rate is smaller than the expected rate (or the observed / expected ratio is < 1) then there is reason to think that the hospital (or area) is performing better than average on this indicator.

The risk-adjusted rate answers the converse question: "What rate of adverse events would we see in this provider (or area) if they provided the locally observed quality of care to patients whose distribution of characteristics matched those in the reference population?" (i.e., locally observed performance on a representative mix of patients from the reference population). Risk-adjusted rates are useful in comparisons between providers or areas. They are evaluated on an identical mix of patients, so calculating them is an attempt to remove the confounding influence of patient mix (different profiles of risk that are not related to care) from the comparison.

The smoothed rate is a weighted average of the reference population rate and the locally observed (provider or area) rate. If the data from the individual provider or area includes many observations and provides a numerically stable estimate of the rate, then the smoothed rate will

be very close to the risk-adjusted rate, and not heavily influenced by the reference population rate. Conversely, the smoothed rate will be closer to the reference population rate if the provider or area rate is based on a small number of observations and may not be numerically stable, especially from year to year.

The software also calculates 95% intervals for some of the rates (confidence intervals in the case of risk-adjusted rates, probability intervals for composite and smoothed rates). These intervals can be used to test whether the computed rate is statistically different from a reference value. If the reference value is *greater than the upper bound of the interval*, then the computed rate is statistically *lower* than the reference value. If the reference value is *less than the lower bound of the interval*, then the computed value is statistically *higher* than the reference value. If the reference value falls *between the lower and upper bounds*, then there is *no statistical difference* between the computed rate and the reference value. For a more thorough explanation of risk-adjusted and smoothed rates, please see the technical documentation on the AHRQ QI website.

4.1   Inpatient Quality Indicators Background

The IQI module contains 32 indicators (plus two composite indicators) that reflect the quality of care inside hospitals. The six volume measures are intended to be paired with the corresponding mortality indicators. The indicators include three groups of measures based on hospital stays.

1. There are six **volume** indicators for inpatient procedures for which there is evidence that a higher volume of procedures is associated with lower mortality. A nontrivial number of these procedures are performed by institutions that do not meet recommended volume thresholds. The volume indicators are measured as counts of admissions in which particular procedures were performed.

2. There are 15 inpatient **mortality** indicators for medical conditions and surgical procedures that have been shown to have mortality rates that vary substantially across institutions and for which evidence suggests that high mortality may be associated with deficiencies in the quality of care. These indicators are measured as rates, the number of deaths divided by the number of admissions for the procedure or condition. Eight of these mortality indicators are for procedures, six of which are also measured by a volume indicator. The other seven mortality indicators are associated with medical conditions.

3. There are eleven **utilization** indicators for procedures for which there are questions of overuse, underuse, or misuse. The usage of the procedures being examined varies significantly across hospitals and areas, and high or low rates by themselves do not represent poor quality of care; rather the information is intended to inform consumers about local practice patterns. Seven of these utilization indicators are rates based on the hospitalized population. Four other utilization indicators are rates based on an area's residential population. Two of these area-level utilization indicators, IQI #26 Coronary Artery Bypass Graft (CABG) Rate and IQI #27 Percutaneous Coronary Intervention (PCI) Rate, have counterparts in the set of volume indicators.

4. There are five indicators which have stratified results reported in SAS QI v4.5. Overall results for these measures are reported as well as results for those discharges with specific medical conditions. The results for IQI #2 Pancreatic Resection Volume and IQI #9 Pancreatic Resection Mortality Rate are reported separately for those patients that have pancreatic cancer and those that do not. The results for IQI #4 Abdominal Aortic Aneurysm (AAA) Repair Volume and IQI #11 Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate are reported separately for patients depending on whether the AAA was ruptured or un-ruptured and whether the repair was open or endovascular. The results for IQI #17 Acute Stroke Mortality Rate are reported separately for those patients with subarachnoid stroke, those with hemorrhagic stroke, and those with ischemic stroke. SAS QI v4.5 does not report smoothed rates for the strata; all other results reported for the overall indicator are also reported for the strata. The strata results may not equal the sum of the overall results because the strata are not mutually exclusive.

5. Beginning in SAS QI v4.5, the software does not report expected rates, risk-adjusted rates, and smoothed rates for the following indicators: IQI #21 Cesarean Delivery Rate, Uncomplicated; IQI #22 Vaginal Birth After Cesarean (VBAC) Delivery Rate, Uncomplicated; IQI #24 Incidental Appendectomy in the Elderly Rate; IQI #25 Bilateral Cardiac Catheterization Rate; IQI #33 Primary Cesarean Delivery Rate, Uncomplicated; and IQI #34 Vaginal Birth After Cesarean (VBAC) Rate, All. These measures are not risk-adjusted, so only the numerators, denominators, and observed rates are reported.

4.2   Pediatric Quality Indicators Background

The PDI module contains 15 indicators that reflect the quality of care inside hospitals and eight indicators that reflect the quality of care outside hospitals. These indicators serve as flags for potential quality problems rather than definitive measures of quality of care. The indicators include two groups of measures based on hospital stays.

1. There are 15 **provider-level** PDI for medical conditions and procedures that have been shown to have complication/adverse event rates that vary substantially across institutions and for which evidence suggests that high complication/adverse event rates may be associated with deficiencies in the quality of care. There are also three indicators for neonates. These indicators are measured as rates—outcome of interest/adverse events divided by the population at risk for the procedure or condition. The adverse event related provider-level indicators usually include only those cases where a secondary diagnosis code flags a potentially preventable complication. A few indicators are based on procedure codes that imply or infer a potential preventable adverse event. Four of the adverse event related indicators are for surgical discharges and seven are for either medical or surgical discharges. Four of the provider-level PDI (PDI #2 Pressure Ulcer Rate, PDI #8 Perioperative Hemorrhage or Hematoma Rate, PDI #9 Postoperative Respiratory Failure Rate, and PDI #11 Postoperative Wound Dehiscence Rate) incorporate information about when procedures were performed (relative to the admission date) if this information is available. Note, however, that if the day of procedure information is missing, the computed rates for these indicators will be slightly

lower than if the information was available. Admission type and point of origin are used by two of the PDI (PDI #8 and PDI #9) to identify elective surgeries.

2. There are eight **area-level** PDI (five individual indicators and three composites).

Note that PQI #9 and PSI #17 are not listed alongside the PDI, but these indicators are calculated using the PDI module since they are based on discharges of patients, ages 17 years and under. PQI #9 uses in-hospital live births as the denominator. PSI #17 uses all in-hospital newborns as the denominator. The PQI #9 Standalone Module and the PSI #17 Standalone Module calculate these two indicators, respectively, without the need to run the entire PDI module. These two standalone modules are available as separate downloads from the AHRQ QI website.

4.3   Prevention Quality Indicators Background

The PQI module contains 13 indicators and three composite indicators that measure adult hospital admissions for ambulatory care sensitive conditions (ACSC) across geographic areas. PQI #9 is not included in the total of 13 indicators because it is based on pediatric discharges and hence is calculated by the PDI module.

ACSCs represent conditions for which hospitalization could be avoided if the patient receives timely and adequate outpatient care. Many factors influence the quality of outpatient care, including access to care and adequately prescribed treatments, once care is obtained. In addition, patient compliance with those treatments and other patient factors may play a role. In general, areas with lower socio-economic status tend to have higher admission rates for ACSCs than areas with higher socio-economic status. As with utilization indicators, there are no "right rates" of admission for these conditions. Very low rates could signal inappropriate underutilization of healthcare resources while very high rates could indicate potential overuse of inpatient care.

Therefore, hospital admission for ACSCs is not a measure of hospital quality but a potential indicator of outpatient and community healthcare need. For example, if an area has a relatively high hospital admission rate for diabetes complications, the local healthcare providers should work with the community to identify reasons and strategies to address the problem.

Except for perforated appendix, each indicator is measured as the number of hospital admissions for a particular ACSC divided by the residential population in an area.

4.4   Patient Safety Indicators Background

The PSI module contains 24 indicators that reflect the quality of care inside hospitals. PSI #17 is not included in the list of 24 PSI since it is based on pediatric discharges and hence is calculated by the PDI module. The indicators include two groups of measures based on hospital stays.

1. There are 17 **provider-level** PSI for medical conditions and surgical procedures that have been shown to have complication/adverse event rates that vary substantially across institutions and for which evidence suggests that high complication/adverse event rates may be associated with deficiencies in the quality of care. These indicators are measured as rates: the number of complications/adverse events divided by the number of

admissions for the procedure or condition. The provider-level indicators include only those cases where a secondary diagnosis code flags a potentially preventable complication.

Eight of these indicators are for surgical discharges, eight are for either medical or surgical discharges, and four are for obstetric discharges. Six of the provider-level PSI (PSI #3 Pressure Ulcer Rate, PSI #9 Perioperative Hemorrhage or Hematoma Rate, PSI #10 Postoperative Physiologic and Metabolic Derangement Rate, PSI #11 Postoperative Respiratory Failure Rate, PSI #12 Perioperative Pulmonary Embolism or Deep Vein Thrombosis Rate, and PSI #14 Postoperative Wound Dehiscence Rate) incorporate information about when procedures were performed (relative to the admission date) if this information is available. Note, however, that if the day of procedure information is missing, the computed rates for these indicators will be slightly lower than if the information was available. Admission type is used by four of the PSI (PSI #10, PSI #11, PSI #13 Postoperative Sepsis Rate and PSI #17) to identify elective surgeries and newborn admissions.

Note that PSI #2 Death Rate in Low-Mortality Diagnosis Related Groups (DRGs) is reported as a single provider-level measure (observed and risk-adjusted). A single measure is necessary to insure adequate reliability of the provider-level rates by pooling an infrequent event over a large group of patients. However, the denominator for the indicator is very heterogeneous, and the mortality rate among the low mortality MS-DRGs varies by MS-DRG type. Users should compare the observed rate to the risk-adjusted rate, which accounts for differences among hospitals in patient case-mix (i.e., age, gender, MS-DRG, and comorbidities). For example, a hospital may have a high PSI #2 observed rate only because the hospital has a higher-than-average share of adult medical MS-DRGs.

2. There are seven area-level PSI. These indicators are identical to provider-level indicators, except that the numerator uses principal diagnosis in addition to secondary diagnoses in order to capture all cases of the complication (as opposed to only those complications that develop during a given hospital admission).

3. SAS QI v4.5 stratifies PSI #4 Death Rate among Surgical Inpatients with Serious Treatable Complications by the five treatable complications contained in the overall indicator: deep vein thrombosis/pulmonary embolism, pneumonia, sepsis, shock/cardiac arrest, and gastrointestinal hemorrhage/acute ulcer. SAS QI v4.5 does not report smoothed rates for the strata; all other results reported for the overall indicator are also reported for the strata. The strata results may not equal the sum of the overall results because the strata are not mutually exclusive.

4. Beginning in SAS QI v4.5, the software does not report expected rates, risk-adjusted rates, and smoothed rates for the following indicators: PSI #17 Birth Trauma Rate – Injury to Neonate; PSI #18 Obstetric Trauma Rate – Vaginal Delivery With Instrument; and PSI #19 Obstetric Trauma Rate – Vaginal Delivery Without Instrument. These measures are not risk-adjusted, so only the numerators, denominators, and observed rates are reported.

5.0   Data Elements and Coding Conventions

See Appendix C for a detailed description of the input data elements and coding conventions used by the SAS QI v4.5 software.

5.1   Software Input Data

This software was written to process data from discharge data abstracts that contain information about hospital stays. However, not all discharge data records should necessarily be included in a data set for analysis. For example, the AHRQ QI focus on acute care, not including hospice or swing bed patients. Discharge records for hospice patients can be dropped from the input data file using either the Type of Bill or Point of Origin data elements. These modules were tested on data from the Healthcare Cost and Utilization Project (HCUP, see Acknowledgments).

❖ *The input data file for the Quality Indicators software must be a SAS data set.*

❖ *It is strongly recommended that users recode data elements in their input file to be consistent with the coding expected by the software. This step will minimize the number of internal changes that will be necessary in the software. For example, recoding the SEX data element in the input file to be consistent with the coding described in Appendix C (i.e., 1 for male and 2 for female) is easier than modifying all uses of the SEX data element in the SAS programs.*

❖ *Not every value for every data element is referenced by the software. For example, only two of the discharge disposition (DISP) data element values are used in the software (DISP value "2" for short-term hospital and value "20" for died in the hospital). However, the complete set of standardized values is included, based on HCUP specifications (see Appendix A) to assist users of the uniform HCUP data files.*

❖ *To minimize internal changes to the software, all required data elements should be present in the input data file. If a required data element is not available, a placeholder data element (i.e., a variable with the same name and format as the required data element but with missing values) should be provided. Failure to provide a placeholder data element will result in errors during the execution of the SAS programs.*

❖ *Six of the indicators (PDI #8, PDI #9, PSI #4, PSI #10, PSI #11, and PSI #13) use admission type (ATYPE) to identify elective surgeries. If admission type is not available in the user's data, the user may want to evaluate other data in the file to create a proxy to identify elective admission types.*

❖ *The SAS QI software does not recognize E-code variable names explicitly. If the input data file contains E-code variables, these need to be recoded as diagnosis codes (DXn) for the software to utilize the contents of these fields. This is accomplished by simply renaming the E-code fields in the input file before running the SAS QI software. For example, an input data file containing 20 diagnosis code variables and*

five E-code variables would initially contain the following variables: DX1-DX20 and ECODE1-ECODE5. These E-code variables must be renamed as DX21-DX25 (bringing the total number of diagnostic codes to 25) prior to running the software. If the E-code variables have corresponding POA flags, the flag variables should be renamed to match the secondary diagnosis POA variables (DXPOAn).

The data elements listed in Appendix C are those required for the input data files for all four of the SAS QI v4.5 modules. When a variable is not required for the program, the notation "Not used by the QI program" will be present in the Comments column. Standardizing the variables and data values in the input data file will be helpful for ease of use with any of the SAS QI v4.5 software modules.

❖ *Appendix C has been standardized to represent the input data file specifications required for use with any of the software modules. If a specific variable is not used by the program, it is not necessary to create a placeholder variable in the input data file. For example, the variable APR_DRG is used only by the IQI module, so it is not necessary to have this data element in the input data file or create a placeholder variable for the PDI, PQI, and PSI modules to run correctly.*

The data element HOSPSTCO has been renamed to PSTCO to emphasize the importance of calculating the area-level indicators by the location of the patient residence. If the user wants to calculate the area-level indicators based on the population of the metropolitan area or county associated with the patient residence, the values for this variable should be the FIPS state/county code associated with each individual patient's place of residence. If the patient information is not available or the user wants to calculate the area-level indicators using the population associated with the hospital location as the denominator, the values for this variable should be the individual hospital FIPS state/county codes.

❖ *If the hospital FIPS code is used in PSTCO, users should be aware that rates may be biased for hospitals that serve as regional referral centers. These hospitals are likely to treat patients from outside the metropolitan area, county, or even the state in which the facility is located.*

❖ *Users no longer have to use the modified FIPS codes assignment for area denominators. However, that option is still available. In the modified FIPS codes, certain independent cities (e.g., Baltimore City, Carson City, and St. Louis City), and areas within Hawaii and Virginia, are assigned to different area groupings in the modified FIPS categories.*

❖ *Using the patient FIPS state/county code for analysis may more accurately reflect the true population at risk. Using the hospital FIPS state/county code for analysis should be done with caution, and at larger levels of geographic area to minimize the bias with patients that come from a different county than the hospital location.*

❖ *It is possible that some records in the input data file may be missing the patient FIPS code. Users should be aware that any records with missing values for PSTCO are*

excluded from the calculations of observed, risk-adjusted, and smoothed area-level rates. They will be included in the output from the first program of each module (IQSAS1.SAS, PDSAS1.SAS, PQSAS1.SAS, and PSSAS1.SAS).

❖ *The software will generate area-level rates for each county included in the PSTCO data field. If using the hospital FIPS state/county code for analysis, users are encouraged to limit cases in their input file to those patients discharged from the geographic area of interest. For example, if you are using data from the State of Wisconsin and are interested in generating a rate for Wisconsin, you should remove the cases where the patient's county of residence (FIPS code) is from another state. Otherwise the total or overall rate will include the population at risk from the counties outside Wisconsin.*

The software provides the user with the option of producing output by metropolitan area or by county. When metropolitan area is selected, urban areas are always defined by metropolitan areas. When county is selected, urban areas will be defined by county. Rural areas are always defined by county.

❖ *In the software programs, the MALEVL parameter should be set as follows:*
0 = County level with U.S. Census FIPS
1 = County level with modified FIPS
2 = Metro Area with OMB 1999 definition
3 = Metro Area with OMB 2003 definition.

The metropolitan area definitions are from three different sources:

1. The "modified FIPS" definition is from the Area Resource File. The mapping is from county to modified FIPS county (e.g., Baltimore city to Baltimore County).

2. The "1999 OMB" definition is from OMB circular 99-04 (Last Revised May 6, 2002). The mapping is from county to Metropolitan Statistical Area (MSA), except in New England where counties are assigned to New England County Metropolitan Area (NECMA). OMB defines NECMA as a county-based alternative to the city- and town-based New England MSA and Consolidated MSA (CMSA). For example, Hampden and Hampshire Counties in western Massachusetts are assigned to the Springfield, MA, NECMA, even though the town of Holland in Hampden County is part of the Boston MSA.

3. The "2003 OMB" definition is from OMB circular 03-04 (Last Revised December 4, 2005). The mapping is from county to either MSA or Micropolitan Statistical Area.

5.2   Coding of Diagnoses, Procedures, MS-DRGs, and MDCs

❖ *Diagnoses and procedures must be coded using the International Classification of Diseases, 9ᵗʰ Revision, Clinical Modification (ICD-9-CM).*

❖ *Significant modifications to ICD-9-CM codes occurred in the early 1990s. AHRQ QI definitions only reflect codes valid on and after October 1, 1994, so the software may not accurately analyze data collected before October 1994.*

Diagnosis and procedure codes should be in character strings. Diagnosis and procedure codes should not contain any decimal points. Diagnosis and procedure codes should be left justified. Diagnosis codes with fewer than five digits should be padded with spaces (not zeros) on the right. Procedure codes with fewer than four digits should be padded with spaces (not zeros) on the right.

❖ *The SAS QI v4.5 software assumes accurate and specific coding of ICD-9-CM codes. If an ICD-9-CM code is specified using five digits, the software recognizes only five-digit versions of that code and not versions truncated at three or four digits. Similarly, if an ICD-9-CM code is specified using four digits, the software recognizes only four-digit versions of that code and not versions truncated at three digits. For example, 4281 is the ICD-9-CM diagnosis code for left heart failure. If your data are coded less specifically (i.e., 428 is used to designate "heart failure"), these less specific codes are not recognized by the software and will result in undercounting cases.*

Medicare severity-Diagnostic Related Groups (MS-DRGs) and Major Diagnostic Categories (MDC) are those derived from the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics and Centers for Medicare & Medicaid Services (CMS) Medicare grouper. The software expects that these values will be in your input file and that you will be using the MS-DRG effective on the discharge date. The software accepts data elements DRG and MDC, accounting for the presence of present on admission (POA) data.. Your data should be coded accordingly. The software may be modified at the user's option to use other types of DRG. However, the impact of using other types of DRG should be evaluated carefully before making such a change. See the technical documentation on the AHRQ QI website for a detailed discussion of the use of MS-DRGs that do not account for POA.

❖ *SAS QI v4.5 accounts for ICD-9-CM and MS-DRG coding effective through September 30, 2013.*

Since the software was originally developed using the HCUP State Inpatient Databases (SID), the data elements in the SAS QI v4.5 software are based on the coding specifications used in those databases. The SID coding specifications are similar to the UB-04 but not identical. For data elements used in the software, crosswalks between the SID and UB-04 coding specifications are included in the SID documentation available at http://hcup-us.ahrq.gov/db/state/siddbdocumentation.jsp.

5.3   APR-DRG Variables

It is required that users either use their own grouper software or download and run APR-DRG Grouper on their patient discharge data before running the IQI module. The APR-DRG Grouper is available on the IQI module download page (see Appendix A for link). Two versions of the APR-DRG Grouper software are provided on the download page: one for users of 32-bit

SAS and one for users of 64-bit SAS. The user must run the executable file included in the APR-DRG Grouper zip package to install the required support files for the software – "vcredist_x86.EXE" (32-bit) or "vcredist_x64.EXE" (64-bit). If users are running SAS 32-bit, then they must download and install the corresponding 32-bit components (i.e., APR-DRG Grouper, PM, and Visual C++ library). If users are running 64-bit SAS, then they must download and install the corresponding 64-bit components (i.e., APR-DRG Grouper, PM and Visual C++ library.

The APR-DRG Grouper software creates APR-DRG categories and associated risk of mortality data elements. These APR-DRG variables are used to enhance the risk adjustment of selected IQI provider indicators.

❖ *APR-DRG Grouper software must be downloaded and run separately.*

❖ *Download the version of the APR-DRG Grouper software that matches the architecture of the user's **SAS installation** (32-bit or 64-bit).*

❖ *Users who wish to use APR-DRG results to risk-adjust the provider IQI rates should run the APR-DRG Groper software on their patient discharge data **before** running the IQI SAS programs. The SAS program APR_DRG_Limited_License.SAS has been provided for this purpose.*

5.4   Use of External Cause of Injury Codes

External cause of injury codes (E-codes) are used to classify environmental events, circumstances and conditions as the cause of injury, poisoning, or other adverse events. The use of E-codes is not always required by a state uniform billing committee or a state data organization. Users should be knowledgeable of the E-code requirements and practices of hospitals represented in the input data file. Several of the indicators use E-codes in their numerator or denominator definitions. These indicators are PSI #5, PSI #8, PSI #15, PSI #16, PSI #21, PSI #25, PSI #26, PDI #1, PDI #3, and PDI #13. AHRQ has done some methodological work in understanding the completeness of E-coding in hospital billing data. Reports can be found at http://www.hcup-us.ahrq.gov/reports/methods/methods_topic.jsp.

The AHRQ QI SAS software does not recognize E-code variable names explicitly. If the input data file contains E-code variables, these need to be recoded as secondary diagnosis codes (DX*n*) for the software to utilize the contents of these fields. This is accomplished by simply renaming the E-code fields in the input file before running the AHRQ QI SAS software. For example, an input data file containing 20 diagnosis code variables and five E-code variables would initially contain the following variables: DX1-DX20 and ECODE1-ECODE5. These E-code variables must be renamed as DX21-DX25 (bringing the total number of diagnostic codes to 25) prior to running the software. If the E-code variables have corresponding POA flags, the flag variables should be renamed to match the secondary diagnosis POA variables (DXPOA*n*).

5.5   Use of Weights from Complex Surveys

The AHRQ QI software is intended to be used with data that cover an entire patient population (e.g., all discharges from a hospital in a year) or that were sampled from a patient

population using simple random sampling. The SAS QI software, beginning with Version 4.1, does not support weighted QI estimates or standard errors for weighted estimates. Thus, analyses using data obtained from a complex sampling design will not produce accurate estimates for the population from which the data were sampled. For a more thorough description of weighted AHRQ QI analyses, see *Guidance for Using the AHRQ Quality Indicators with the Nationwide Inpatient Sample and Other Complex Sampling Designs*, available on the AHRQ QI website.

In SAS QI v4.5, the variable DISCWT was set equal to 1 and the variable DISCWT was removed from the KEEP statement associated with the input file. This change ensures that the SAS programs do not account for complex sampling design when calculating QI estimates and standard errors. The SAS QI software versions prior to 4.1 supported weighted analyses with appropriate standard errors using discharge-level weights supplied by the user. Beginning with Version 4.1 and the introduction of the Prediction Module that handles missing POA data, the SAS QI software retained the weighting procedures in the SAS programs but did not account for complex sampling design and weighting without further manipulation of the SAS programs by users.

5.6   Missing Values

The SAS QI v4.5 programs do not distinguish among different types of missing values.

> ❖ *Cases that are missing data in fields used for indicator definitions or for risk adjustment (such as age and sex) will be excluded from analysis.*

Data files of hospital discharge abstract data may have numeric data elements coded using special SAS missing "dot" values. For example, besides the standard SAS value of "." for missing data, there might also be present values of ".A" for invalid data, ".B" for data unavailable from a particular source, or ".C" for inconsistent data. However, the SAS QI v4.5 software does not distinguish among the different types of missing codes. Therefore, all types of missing values in the input data must be represented by a single value – missing data (.) for numeric variables and blank (' ') for character variables.

5.7   Treatment of Missing Data

The software is designed to handle missing data in a particular manner; specifically, the software requires confirmation for the assignment of a poor outcome or negative event. For instance, in order to be assigned as a death, each case must actually be coded as a death. Missing data are considered neutral. Missing data for some data elements result in the exclusion of that case from the denominator. For other data elements, the case is retained. Table 16 through Table 19 list the impact of missing data for key data elements in the SAS QI v4.5 software.

Table 16. Treatment of Missing Data Elements in IQI Module

VARIABLE	LABEL	D	N	E	S	TREATMENT OF MISSING DATA
AGE	Age In Years At Admission	X	X		X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
ASOURCE	Admission Source			X		Case excluded from denominator where used in specification (e.g., IQI 32).
DISP	Disposition Status		X	X		Case excluded from denominator where used in specification (e.g., IQI 15).
DQTR	Discharge Quarter	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
DX1	Principal Diagnosis Code	X	X	X	X	Record excluded from analysis
SEX	Patient Gender	X	X		X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
PAY 1	Payer				X	Classified As "Other."
POINTOFORIGINUB04	Point of Origin	X		X		Missing values of POINTOFORIGINUB04 result in a case being excluded from the denominator for IQI 32 (along with ASOURCE)
PSTCO	Location of Patient Residence or Hospital Location Modified FIPS State/County Code	X				Dropped from denominator in rate calculations (stratified by county or Metro Area), case will appear in calculation of the overall rate.
RACE	Race				X	Classified As "Other."
YEAR	Discharge Year	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).

Note. D = Denominator; N = Numerator; E = Exclusion; S = Stratification.

Table 17. Treatment of Missing Data Elements in PDI Module

VARIABLE	LABEL	D	N	E	S	TREATMENT OF MISSING DATA
AGE	Age In Years At Admission	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
AGEDAY	Age in days (coded only when the age in years is less than 1)					The value is treated as if it was less than 29 days.
ATYPE	Admission Type	X				Case excluded from denominator where used in specification.
DISP	Disposition Status		X	X		Case excluded from denominator where used in specification (i.e., PDI 6 and NQI 2).
DQTR	Discharge Quarter	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
DX1	Principal Diagnosis Code	X	X	X	X	Record excluded from analysis
LOS	Length of Stay	X		X		Case excluded from denominator where used in specification.
SEX	Patient Gender	X	X		X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
PAY1	Payer				X	Classified as "Other."
PSTCO	Location of Patient Residence or Hospital Location Modified FIPS State/County Code	X				Dropped from denominator in rate calculations (stratified by county or Metro Area), case will appear in calculation of the overall rate.
RACE	Race				X	Classified As "Other."
YEAR	Discharge Year	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).

Note. D = Denominator; N = Numerator; E = Exclusion; S = Stratification.

Table 18. Treatment of Missing Data Elements in PQI Module

VARIABLE	LABEL	D	N	E	S	TREATMENT OF MISSING DATA
AGE	Age In Years At Admission	X	X		X	Case excluded from all analysis (e.g., dropped from numerator of all population based measures and from the denominator of the discharge based indicator, PQI 2.
DQTR	Discharge Quarter	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
DX1	Principal Diagnosis Code	X	X	X	X	Record excluded from analysis
SEX	Patient Gender	X	X		X	Case excluded from all analysis (e.g., dropped from numerator of all population based measures and from the denominator of the discharge based indicator, PQI 2.
PAY 1	Payer				X	Classified As "Other."
PSTCO	Location of Patient Residence or Hospital Location Modified FIPS State/County Code	X			X	Dropped from denominator in rate calculations (stratified by county or Metro Area), case will appear in calculation of the overall rate.
RACE	Race				X	Classified As "Other"
YEAR	Discharge Year	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).

Note. D = Denominator; N = Numerator; E = Exclusion; S = Stratification.

Table 19. Treatment of Missing Data Elements in PSI Module

VARIABLE	LABEL	D	N	E	S	TREATMENT OF MISSING DATA
AGE	Age In Years At Admission	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
ATYPE	Admission Type	X				Case excluded from denominator where used in specification (e.g., PSI 10).
DISP	Disposition Status		X	X		Case excluded from denominator where used in specification (e.g., PSI 4 and PSI 5).
DQTR	Discharge Quarter	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
DX1	Principal Diagnosis Code	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
LOS	Length of Stay	X		X		Case excluded from denominator where used in specification (e.g., PSI 3).
SEX	Patient Gender	X	X		X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).
PAY1	Payer				X	Classified as "Other"
PSTCO	Location of Patient Residence or Hospital Location Modified FIPS State/County Code	X				Dropped from denominator in rate calculations (stratified by county or Metro Area), case will appear in calculation of the overall rate.
RACE	Race				X	Classified As "Other."
YEAR	Discharge Year	X	X	X	X	Case excluded from all analysis (e.g., dropped from the denominator of the discharge based indicators and from numerator of all population based measures).

Note. D = Denominator; N = Numerator; E = Exclusion; S = Stratification.

6.0   User Feedback for Future Updates

The SAS QI v4.5 software reflects its development and implementation with discharge data available to AHRQ through the HCUP program. The goal was to develop the tools, illustrate their use, and then encourage others to adopt and use the tools for their own applications. As a result, users are encouraged to consider how AHRQ may modify or enhance the software to better serve their measurement needs and interests.

> ❖ *Modifications to the definitions of outcomes of interest (numerators) or populations at risk (denominators) are possible but not desirable. Maintaining consistent definitions is important. Once definitions are altered, the ability to make comparisons of indicators based on original definitions is lost. Users are encouraged to identify ways to improve the AHRQ QI methodology and to share their suggestions with AHRQ for future software updates.*

AHRQ provides public access to HCUPnet (http://hcupnet.ahrq.gov/), which is an interactive tool for identifying, tracking, analyzing, and comparing statistics on hospital care. HCUPnet and the *National Healthcare Quality Report* generate statistics in a table format using data from the NIS and SID, using modified version of the SAS QI software. HCUPnet includes statistics based on SAS QI v4.1 which have been applied to the HCUP NIS. For information on the calculation of these rates using the modified version of SAS QI v4.1, see http://www.hcup-us.ahrq.gov/reports/methods/2012_03.pdf.

7.0   Producing Quality Indicator Rates: Processing Steps

The six steps below describe the AHRQ QI calculations. The next section of this document describes the specifics of each software component of the SAS QI v4.5 software.

An outcome of interest is the number of cases with the indicator outcome, such as mortality or a procedure.

The AHRQ QI are expressed as a volume, a count, or a rate depending on the indicator. For indicators that are expressed as a rate, the calculation of the observed rate is shown below:

$$\frac{Outcome\ of\ interest}{Population\ at\ risk}$$

{or}

$$\frac{Numerator}{Denominator}$$

A multiplier can be applied to the observed rate. In common practice, observed rates are multiplied by 100,000 to produce the rates per 100,000 for the population at risk or by 1,000 to produce rates per 1,000 discharges. The SAS QI v4.5 software does not apply multipliers to the observed rates. However, the user is encouraged to transform the rates obtained from the software to a more meaningful unit of measurement.

Conceptually, five steps are necessary to produce most of the AHRQ QI rates (six steps are required for PQI rates). The following instruction describes the steps and how the software performs them.

Note
In the sections that follow, a graphic like this one will appear wherever one or more modules or indicators diverge from the steps being discussed.

These graphics will contain information on exceptions to the rule, relevant substitution steps, and other indicator- or module- specific instructions.
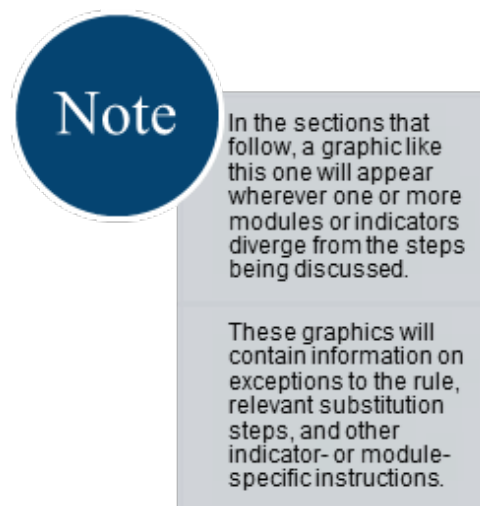
7.1 Step 1. Identify Outcomes in Inpatient Records

Inpatient records are marked to indicate whether they contain the outcome of interest (numerator or "T" for "top") for each of the AHRQ QI indicators.

Records are marked by setting a series of flag variables, each of which corresponds to the numerator for a particular indicator. For example, if the inpatient record meets the conditions for inclusion in the outcome for IQI #1, then the outcome variable for IQI #1 (TPIQ01) is set to one by the SAS QI v4.5 software.

This step requires one pass through the discharge-level data and outputs a discharge-level SAS data set containing the flag indicator variables for the outcomes for each indicator in its respective module. This data set also contains the original input variables except for the diagnosis and procedure variables, which have been removed to reduce the size of the file.

IQI PSI PDI

The IQI, PSI, and PDI modules contain some indicators that are expressed as counts or volumes. For these indicators, Step 1 is all that is necessary to calculate the results.

The remaining steps are relevant for the indicators which are expressed as rates as opposed to volumes or counts.

7.2 Step 2. Identify Populations at Risk

For provider-level indicators, the populations at risk (the denominators for calculating the indicator rates, or "pop") are derived from the hospital discharge records.

For the area-level indicators, the populations at risk (the denominators for calculating the indicator rates) are derived from U.S. Census population figures defined by county in all areas of the U.S., or by metropolitan area in urban areas and by county in rural areas.

7.3 Step 3. Calculate Observed Quality Indicator Rates

Using the output SAS dataset from Step 1 and either hospital discharge or U.S. Census population data from Step 2, the indicator rates are calculated for user-specified combinations of stratifiers. These stratifiers include hospitals, age groups, race/ethnicity categories, sex, and payer categories for the provider-level indicators; and areas (counties or metropolitan areas), age groups, race/ethnicity categories, and sex for the area-level indicators. This step outputs the observed rates for user-specified categories, alone or in combination. For example, observed rates for provider-level indicators could be output at the hospital level, at the payer level, or at the hospital level by payer.

❖ *The software calculates observed rates regardless of the number of cases available (above a minimum of 3). However, rates based on only a few cases should be interpreted with caution.*

In some performance measurement work, it is often recommended that rates be suppressed when there are fewer than 30 cases in the denominator. This exclusion rule serves two purposes:

it eliminates unstable estimates based on too few cases, and it helps to protect the identities of hospitals and patients.

7.4   Step 4. Risk-Adjust the Quality Indicator Rates

Regression coefficients from a reference population database (reflecting a large proportion of the U.S. population) are applied to the individual cases in the risk-adjustment process. These reference population file regression coefficients are provided as part of the SAS QI v4.5 software. The risk-adjusted rates for the provider-level indicators will then reflect the age, sex, condition/severity, and comorbidity distribution in the reference population rather than the distribution for the hospitals in the user's data. Similarly, the risk-adjusted rates for the area-level indicators will reflect the age and sex distribution in the reference population rather than the distribution for the areas in the user's data. This approach will allow risk-adjusted rates produced by various users to be compared directly to one another. The regression coefficients were derived from the HCUP SID and, for area-level indicators, U.S. Census Data. The code to generate these reference population coefficients is not part of the SAS QI v4.5 software.

> QI This step applies to both provider- and area-level indicators.
>
> Indicators that are not risk-adjusted are noted in the risk-adjustment tables available on the applciable module resources page on the AHRQ QI^{TM} website (http://www.qualityindicators.ahrq.gov/modules/Default.aspx)

❖ *The software calculates risk-adjusted rates regardless of the number of cases available (above a minimum of 3). However, rates based on only a few cases should be interpreted with caution.*

7.5   Step 5. Create MSX Smoothed Rates

Shrinkage factors are applied to the risk-adjusted rate for each indicator in a process called multivariate signal extraction (MSX). These shrinkage factors were calculated from the HCUP SID database. For each indicator, the shrinkage estimate reflects an adjustment unique to that indicator. The less consistent estimates of the indicator (i.e., less reliable or stable) are over time and across hospitals or areas, the more the estimate "shrinks" the indicator toward the overall mean. The resulting rate will appear "smoother" than the observed rate, meaning that the year-to-year fluctuations in performance are likely to be reduced. For stratified indicators, smoothed rates are not calculated for the strata composing the overall indicator; the

> QI This step applies to provider-level and area-level indicators, even those that are not risk-adjusted.

shrinkage factors for the strata are set to zero. The shrinkage factors are provided as part of the SAS QI v4.5 software and do not need to be calculated by users. More information on interpreting smoothed rates is contained in Appendix B.

7.6   Step 6. Calculate Condition-Specific Rates (PQI Only)

For selected PQI, data are available on the prevalence of the relevant condition. The SAS QI v4.5 software incorporates State-level estimates of diabetes prevalence by age from the CDC National Diabetes Surveillance System (see Appendix A). The four PQI related to diabetes (PQI #1 Diabetes Short-Term Complications Admission Rate, PQI #3 Diabetes Long-Term Complications Admission Rate, PQI #14 Uncontrolled Diabetes Admission Rate, and PQI #16 Lower-Extremity Amputation among Patients with Diabetes Rate) can be calculated using the number of diabetics in the state as the denominator, stratified by age.

8.0   Program Descriptions

This section describes the SAS QI v4.5 programs that assign, calculate, and print the results (see Table 20).

For each program, there is a description, a list of input and output files, and an explanation of changes to the program code that may be required by the user. The flow of data through the programs is shown in the flowcharts in Section 3.0.

❖ *All of the naming conventions for the programs have been standardized in this manual so that "XX" in a program file name denotes the specific module. For example, XXFMTS can be interpreted as IQFMTS, PDFMTS, PQFMTS or PSFMTS, depending on which module is being run (IQI, PDI, PQI or PSI, respectively).*

❖ *Two new standalone modules have been provided for SAS QI v4.5 – PQI #9 Standalone Module and PSI #17 Standalone Module. These modules allow users to calculate rates for PQI #9 and PSI #17 without the need to run the complete PDI module. Each of these new standalone modules are implemented the same way as the complete PDI module (described below).*

Table 20. Summary of SAS Programs

FUNCTION	MODULE			
	IQI	**PDI**	**PQI**	**PSI**
File Locations & Options	CONTROL_IQI.SAS	CONTROL_PDI.SAS	CONTROL_PQI.SAS	CONTROL_PSI.SAS
Create Format File	IQFMTS.SAS	PDFMTS.SAS	PQFMTS.SAS	PSFMTS.SAS
Identify Discharges in Numerator and Denominator	IQSAS1.SAS	PDSAS1.SAS	PQSAS1.SAS	PSSAS1.SAS
Stratified Risk Categories	-	PDSASG2.SAS	-	-
Provider Observed Rates	IQSASP2.SAS	PDSASP2.SAS	-	PSSASP2.SAS
Provider Risk Adjusted & Smoothed Rates	IQSASP3.SAS	PDSASP3.SAS	-	PSSASP3.SAS
Area Observed Rates	IQSASA2.SAS	PDSASA2.SAS	PQSASA2.SAS	PSSASA2.SAS
Area Risk Adjusted & Smoothed Rates	IQSASA3.SAS	PDSASA3.SAS	PQSASA3.SAS	-
Condition-specific Rates	-	-	PQSASC2.SAS	-

If you desire to create and examine observed rates, then the CONTROL_*XX*I, *XX*FMTS, and the *XX*SAS1 programs will need to be used, followed by *XX*SASP2 (for provider-level indicators) and/or *XX*SASA2 (for area-level indicators) programs. If you also wish to create risk-adjusted and smoothed rates, then you will need to run the *XX*SASP3 (for provider-level indicators) and/or the *XX*SASA3 (for area-level indicators) programs.

PDI The PDI module offers two alternatives for analyzing provider level rates, stratification and risk adjustment.

If you wish to create stratified provider-level PDI, you will need to run PDSASG2.

PQI If you wish to create condition-specific (diabetes) rates in the PQI module, you will need to run the PQSASC2 program.

PSI For the PSI, risk-adjusted and smoothed rates are only calculated for provider-level indicators, not for area-level indicators.

8.1 Modify Statements in the CONTROL_*XX*I.SAS Program

The CONTROL_*XX*I.SAS program contains most of the SAS statements that you need to modify in order to run the remaining module programs. This location is where you specify, for example, the path names of all your input and output data sets. There is also a TITLE line that the user can fill in. The items that need to be changed in order to run the *XX*SAS1, *XX*SASP2, PDSASG2, PQSASC2, *XX*SASP3, *XX*SASA2, and *XX*SASA3 programs are described below.

❖ *The CONTROL_XXI.SAS program is automatically executed by the remaining module programs. You do not need to run CONTROL_XXI.SAS program separately.*

❖ *All of the changes needed for the CONTROL_XXI.SAS program are listed in the following descriptions for the other module programs. Each program description contains a section labeled "Changes" that enumerates the modifications for CONTROL_XXI.SAS that are associated with that particular program.*

❖ *Lines of SAS code to be modified are identified by the comment "<===USER MUST modify," which means the user must make the change or by "<===USER MAY modify," which means the modification is optional.*

In all of the remaining programs included with the SAS QI v4.5 modules, there is one line of code near the beginning of each program that needs to be modified. This line of code starts with the phrase "FILENAME CONTROL." You **must** modify this line to point to the path name where you stored your modified copy of the CONTROL_*XX*I.SAS file. Path names should not exceed 255 characters in length.

CONTROL_*XX*I.SAS creates a collection of SAS libraries for accessing input and output data sets from different file paths. For example, "LIBNAME IN0" points to the location of your input data set for program *XX*SAS1, and "LIBNAME OUT1" points to the location of the output data set created by the *XX*SAS1 program. The user must specify path names for these SAS libraries, which may be different from one another. If you wish to read in and write out all of the data to the same location, it is recommended that you make a global change in CONTROL_*XX*I.SAS, changing "C:\pathname" to the single directory location that you wish to use.

There is a global PRINT parameter in CONTROL_*XX*I.SAS that may be used to print all of the output summary records at the end of the *XX*SASP2, *XX*SASP3, PDSASG2, PQSASC2, *XX*SASA2, and *XX*SASA3 programs. These printouts may be quite large if you have a large database with many hospitals and/or many areas (e.g., counties, metropolitan areas) and if you choose the results to be finely stratified. Set PRINT equal to zero to turn this feature off, and Set PRINT equal to 1 to turn this feature on. The feature is turned off by default.

> ❖ *The MALEVL global parameter in the CONTROL_XXI.SAS program instructs all programs on how to define geographic areas (see Section 5.1). By default, this parameter is set to use county for geographic area.*

8.2   Run *XX*FMTS

The *XX*FMTS program defines a format library, which contains the diagnosis and procedure screens necessary for assigning the outcomes of interest. This format library is used by most of the other SAS programs.

The first few formats in this program are for the stratifiers (i.e., age, sex, race/ethnicity and payer). These are followed by formats that are used for the identification of outcomes of interest in the *XX*SAS1 program, and by formats that map FIPS county codes to metropolitan areas in the *XX*SAS1, *XX*SASA2 and *XX*SASA3 programs. At the end of the program are formats used to assign age, modified MS-DRG and comorbidity categories for the risk adjustment process implemented in *XX*SASP3 and *XX*SASA3, and formats used with APR-DRG categories in *XX*SASP3.

Input: None.

Output: Permanent SAS format library (FMTLIB).

Changes:
1. You must modify the "FILENAME CONTROL" statement at the beginning of the program to change the path, so it points to your location of the CONTROL_*XX*I.SAS code.

2. In CONTROL_*XX*I.SAS, specify the location (path) of the format library in the "LIBNAME LIBRARY" statement.

8.3 Run *XX*SAS1

The *XX*SAS1 program processes hospital discharge abstract data and flags inpatient records if they contain outcomes of interest. Outcome indicator names, or numerators, have a prefix of "T" (indicating Top). Stratifier variables are constructed at the beginning of the program.

This program assumes that the input data file (consisting of inpatient discharge abstract data) conforms to specific variable names, attributes and coding conventions. See Quick References section for variable names and attributes for the input data file.

Input:
1. User supplied SAS inpatient data set consisting of administrative hospital discharge abstract data. This data set is a discharge level file with an array of diagnosis and procedure codes, among other data elements.

    PDI and PSI

    In the PDI and PSI modules, the dataset also includes variables identifying POA conditions for provider-based outcomes of interest (QPPDxx and QPPSxx, respectively).

2. SAS format library (FMTLIB) created from the *XX*FMTS program.

Output:
1. SAS dataset containing inpatient records with input variables, stratifiers, comorbidity variables, and flag indicators (TP*XX*nn and TA*XX*nn, where *XX* refers to the QI set and nn refers to the indicator number) for the outcomes of interest that will later form the numerators for the QI rates.

2. PROC MEANS (with N, NMISS, MIN, MAX, MEAN and SUM) of all of the numeric variables and a PROC CONTENTS of the output dataset are written to hardcopy.

3. A PROC PRINT of the first 24 observations in the output dataset is written to hardcopy.

Changes:
1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_*XX*I.SAS code.

2. In CONTROL_*XX*I.SAS, specify the locations (paths) of the input and output files in the "LIBNAME IN0" and "LIBNAME OUT1" statements.

3. In CONTROL_*XX*I.SAS, specify the names of the input and output files in the "INFILE0" and "OUTFILE1" statements. Note that SAS file references must not include file extensions. The default file name may be used for "OUTFILE1".

4. To define urban areas by metropolitan area rather than by county, change the MALEVL parameter in CONTROL_*XX*I.SAS from 0 to 1, 2 or 3. Rural areas will be defined by county no matter how MALEVL is specified. Refer to Section 5.1 for a list of values for the MALEVL parameter.

❖ *The QI modules assume that your starting SAS dataset contains 30 diagnoses and 30 procedures. If these numbers are different in your input inpatient data, then modify the NDX and NPR parameters in CONTROL_XXI.SAS.*

❖ *If your variables are named differently from those used in the SAS QI v4.5 software (see Section 3.0), you MUST either rename those variables prior to running this program or modify XXSAS1 to include the renaming of your variables to match those expected by the software. Similarly, if your variables are not the same type, i.e., character or numeric, as those expected by the software, you MUST modify your variables prior to running this program.*

Additional Changes for the IQI Module:

5. In the IQI module, if you wish to use APR-DRG variables in the later IQSASP3 program to risk-adjust the provider-level indicators, then in CONTROL_IQI.SAS, set the APRDRGFG flag parameter to one. If you do not intend to run IQSASP3 to risk-adjust the provider-level indicators or if you do not have the APR-DRG variables available to you, then set APRDRGFG to zero. See Table 21 below.

IQI
Additional changes for the IQI module

6. Also in the IQI module, if you wish to risk-adjust the provider-level indicators by later running the IQSASP3 program, then in CONTROL_IQI.SAS, set the three APRDRG, APRDRG_RISK_MORTALITY, and XPRDRG_RISK_MORTALITY parameters to be the names of the DRG category variable, and the mortality indicators created by APR-DRG software. If you do not intend to use APR-DRG software, then set the three APRDRG, APRDRG_RISK_MORTALITY, and XPRDRG_RISK_MORTALITY parameters to equal zero. See Table 21 below.

Table 21. How to set up IQI parameters and your data for using APR-DRG variables

	IF YOU DO NOT INTEND TO RISK-ADJUST THE PROVIDER INDICATORS	IF YOU ARE GOING TO RUN IQSASP3 TO RISK ADJUST THE PROVIDER INDICATORS:	
		IF YOU HAVE APR-DRG SOFTWARE AVAILABLE	IF YOU DO NOT HAVE APR-DRG SOFTWARE AVAILABLE
Preliminary data processing	None	Run APR-DRG software to create APR-DRGs, and mortality indicators	None
Setting the APRDRGFG parameter in CONTROL_IQI.SAS	Set to equal zero.	Set to equal one.	Set to equal zero.
Setting the APR_DRG, APRDRG_RISK_MORTALITY, and XPRDRG_RISK_MORTALITY parameters in CONTROL_IQI.SAS	No action required.	Set to equal the names of the variables output from the APR-DRG software.	Set to equal zero.

8.4   Run *XX*SASP2

The *XX*SASP2 program calculates the observed rates for the provider-level indicators (except for those in the IQI module that are reported as a volume), using the data derived in a previous step (*XX*SAS1). These observed rates are stratified by combinations of providers, sex, age, race, and payer categories. The program first totals the indicator flags created by the *XX*SAS1 program and then for each of the desired stratifiers divides these totals by the hospital discharges in the at-risk population for the indicator. The population denominators are stored in variables with names that have a prefix of "P". The observed rates are stored in variables that have a prefix of "O".

The *XX*SASP2 program does not apply to the PQI module, as those indicators are all area-level measures. If only using the PQI module or if provider-level estimation is not desired, refer to Section 8.6 for details related to area-level estimation.

PQI — The XXSASP2 program does not apply to the PQI module.

PQI indicators are all area-level measures.

IQI — The XXSASP2 program does not apply to the volume indicators in the IQI module.

The IQI volume indicators are IQI #1 through IQI #7.
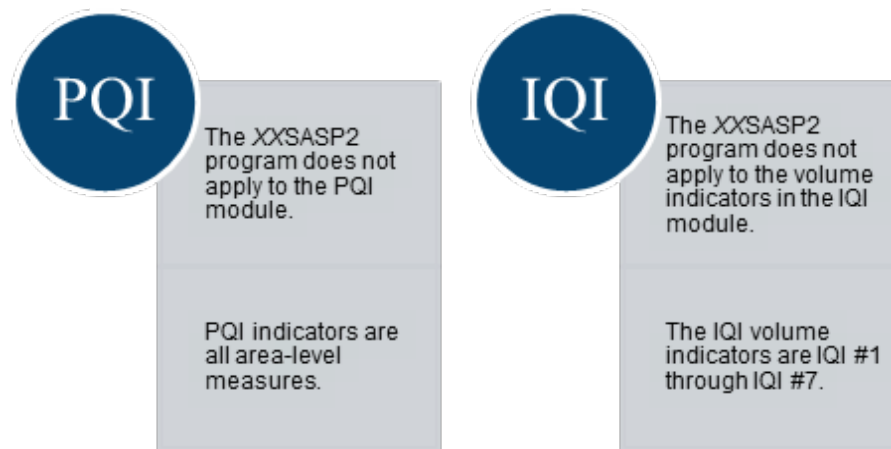
Input:

1. The SAS dataset that was created in the XXSAS1. This dataset is a discharge-level file that contains inpatient records with input variables, stratifiers and the flag indicators for the QI Provider outcomes of interest.

2. SAS format library (FMTLIB) created from the XXFMT program.

Output:

1. SAS dataset with summary records that contain observed rates (OPXXnn variables where "nn" refers to the indicator number), the counts of outcomes that formed the numerators of the rates (TPXXnn variables), and the hospital discharge totals that formed the denominators of the observed rates (PPXXnn variables). It also includes variables identifying present on admission (POA) conditions for provider-level outcomes of interest (QPXXnn). The output file has records summarized to the various combinations of stratifiers specified in the TYPELVLP parameter that is described in the "**Changes**" section below. Note that the observed rates and the denominator totals are not generated for the provider volume indicators (IQI 1-7).

2. An optional ASCII (comma delimited) text file that the user can then import into a spreadsheet. This text file contains the same information as the SAS output dataset. The text file will contain the OPXXnn observed rates, the TPXXnn counts of outcomes that formed the numerators of the rates and the PPXXnn counts of outcomes that formed the denominators of the rates. The different records/rows in the text file will correspond to the different TYPELVLP stratification combinations.

3. A PROC MEANS (with N, NMISS, MIN, MAX, MEAN, and SUM) of the provider-level summary records that shows statistics for the OPXXnn observed rates, the TPXXnn counts of outcomes that formed the numerators of the rates, and the PPXXnn counts of outcomes that formed the denominators of the rates. These means will only

be generated if the user included a value of 16 for IQI and PSI or 64 for PDI for the TYPELVLP parameter discussed in the "**Changes**" section below.

4. A PROC CONTENTS of the output SAS summary dataset is generated in the SAS output window/results viewer.

5. A PROC PRINT of the output summary dataset may be generated in the SAS output window/results viewer. This printout may be quite large depending on the number and the types of stratifications that the user requests with the TYPELVLP parameter discussed in the "**Changes**" section below. If the user does not wish to generate this printout, then the global "PRINT" parameter in CONTROL_*XX*I.SAS code should be set to zero.

6. The output summary dataset may be written to a comma-delimited CSV file. If the user wishes to create this file, then the global "TEXTP2" parameter CONTROL_*XX*I.SAS code should be set to one.

Changes:
1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_*XX*I.SAS code.

2. In CONTROL_*XX*I.SAS, specify the locations (paths) of the input and output SAS files in the "LIBNAME IN1" and "LIBNAME OUTP2" statements.

3. In CONTROL_*XX*I.SAS, specify the names of the input and output files in the "INFILE1" and "OUTFILP2" statements. The name that you specify with INFILE1 should be for the file that you created using the *XX*SAS1 program. The default names for these files may be used.

4. In CONTROL_*XX*I.SAS, specify the levels of aggregation for the observed rates. This step is done by specifying numbers between 0 and 31 (for IQI and PSI) or 0 and 127 (for PDI) in the "%LET TYPELVLP =" statement. Each number corresponds to a different level or combination of levels as shown in Table 22 and Table 23. The default values of 0 and 16 (for IQI and PSI) or 0 and 64 (for PDI), will provide an overall total and provider-level totals.

❖ *If TYPELVLP includes the value 0, then the first observation in the output summary data file will contain the overall totals and observed rates for the entire database created with the XXSAS1 program.*

❖ *For example, if you are using a state inpatient hospital database, you might specify the following TYPELVLP values for the IQI module:*
   0 – provides overall rates for your entire state
   8 – provides overall rates for your state, broken down by age groups
   16 – provides rates for providers within your state
   24 – provides rates for age groups within these providers

5. In CONTROL_*XX*I.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then specify the path (including the file name) for this ASCII text file in the "FILENAME *XX*TEXTP2" statement, and set the TEXTP2 parameter to 1. Otherwise, the default value of zero for TEXTP2 will skip the code that would generate this file.

Table 22. IQSASP2 and PSSASP2 Aggregation Possibilities

TYPELVLP	STRATIFICATION									
0					Overall					
1										Race
2							Payer			
3							Payer	*		Race
4					Sex					
5					Sex	*				Race
6					Sex	*	Payer			
7					Sex	*	Payer	*		Race
8		Age								
9		Age	*							Race
10		Age	*				Payer			
11		Age	*				Payer	*		Race
12		Age	*	Sex						
13		Age	*	Sex	*					Race
14		Age	*	Sex	*	Payer				
15		Age	*	Sex	*	Payer	*			Race
16	Provider									
17	Provider	*								Race
18	Provider	*					Payer			
19	Provider	*					Payer	*		Race
20	Provider	*			Sex					
21	Provider	*			Sex	*				Race
22	Provider	*			Sex	*	Payer			
23	Provider	*			Sex	*	Payer	*		Race
24	Provider	*	Age							
25	Provider	*	Age	*						Race
26	Provider	*	Age	*			Payer			
27	Provider	*	Age	*			Payer	*		Race
28	Provider	*	Age	*	Sex					
29	Provider	*	Age	*	Sex	*				Race
30	Provider	*	Age	*	Sex	*	Payer			
31	Provider	*	Age	*	Sex	*	Payer	*		Race

Note: TYPELVLP values of 0 (overall) and 16 (provider) are the default values for the levels of stratification provided in the software.

Table 23. PDSASP2 Aggregation Possibilities

TYPELVLP	STRATIFICATION									
0						Overall				
1										Race
2									Payer	
3									Payer	*	Race
4								Sex		
5								Sex	*		Race
6								Sex	*	Payer	
7								Sex	*	Payer	*	Race
8							Age			
9							Age	*			Race
10							Age	*		Payer	
11							Age	*		Payer	*	Race
12							Age	*	Sex		
13							Age	*	Sex	*		Race
14							Age	*	Sex	*	Payer	
15							Age	*	Sex	*	Payer	*	Race
16					Ageday					
17					Ageday	*					Race
18					Ageday	*				Payer	
19					Ageday	*				Payer	*	Race
20					Ageday	*			Sex		
21					Ageday	*			Sex	*		Race
22					Ageday	*			Sex	*	Payer	
23					Ageday	*			Sex	*	Payer	*	Race
24					Ageday	*	Age			
25					Ageday	*	Age	*			Race
26					Ageday	*	Age	*		Payer	
27					Ageday	*	Age	*		Payer	*	Race
28					Ageday	*	Age	*	Sex		
29					Ageday	*	Age	*	Sex	*		Race
30					Ageday	*	Age	*	Sex	*	Payer	
31					Ageday	*	Age	*	Sex	*	Payer	*	Race
32		Bwht							
33		Bwht	*							Race
34		Bwht	*						Payer	
35		Bwht	*						Payer	*	Race
36		Bwht	*					Sex		
37		Bwht	*					Sex	*		Race
38		Bwht	*					Sex	*	Payer	
39		Bwht	*					Sex	*	Payer	Race
40		Bwht	*				Age			
41		Bwht	*				Age	*			Race
42		Bwht	*				Age	*		Payer	
43		Bwht	*				Age	*		Payer	*	Race
44		Bwht	*				Age	*	Sex		
45		Bwht	*				Age	*	Sex	*		Race

TYPELVLP	STRATIFICATION										
46	Bwht	*			Age	*	Sex	*	Payer		
47	Bwht	*			Age	*	Sex	*	Payer	*	Race
48	Bwht	*	Ageday								
49	Bwht	*	Ageday	*							Race
50	Bwht	*	Ageday	*					Payer		
51	Bwht	*	Ageday	*					Payer	*	Race
52	Bwht	*	Ageday	*			Sex				
53	Bwht	*	Ageday	*			Sex	*			Race
54	Bwht	*	Ageday	*			Sex	*	Payer		
55	Bwht	*	Ageday	*			Sex	*	Payer	*	Race
56	Bwht	*	Ageday	*	Age						
57	Bwht	*	Ageday	*	Age	*					Race
58	Bwht	*	Ageday	*	Age	*			Payer		
59	Bwht	*	Ageday	*	Age	*			Payer	*	Race
60	Bwht	*	Ageday	*	Age	*	Sex				
61	Bwht	*	Ageday	*	Age	*	Sex	*			Race
62	Bwht	*	Ageday	*	Age	*	Sex	*	Payer		
63	Bwht	*	Ageday	*	Age	*	Sex	*	Payer	*	Race
64	Provider										
65	Provider	*									Race
66	Provider	*							Payer		
67	Provider	*							Payer	*	Race
68	Provider	*					Sex				
69	Provider	*					Sex	*			Race
70	Provider	*					Sex	*	Payer		
71	Provider	*					Sex	*	Payer	*	Race
72	Provider	*			Age						
73	Provider	*			Age	*					Race
74	Provider	*			Age	*			Payer		
75	Provider	*			Age	*			Payer	*	Race
76	Provider	*			Age	*	Sex				
77	Provider	*			Age	*	Sex	*			Race
78	Provider	*			Age	*	Sex	*	Payer		
79	Provider	*			Age	*	Sex	*	Payer	*	Race
80	Provider	*	Ageday								
81	Provider	*	Ageday	*							Race
82	Provider	*	Ageday	*					Payer		
83	Provider	*	Ageday	*					Payer	*	Race
84	Provider	*	Ageday	*			Sex				
85	Provider	*	Ageday	*			Sex	*			Race
86	Provider	*	Ageday	*			Sex	*	Payer		
87	Provider	*	Ageday	*			Sex	*	Payer	*	Race
88	Provider	*	Ageday	*	Age						
89	Provider	*	Ageday	*	Age	*					Race
90	Provider	*	Ageday	*	Age	*			Payer		
91	Provider	*	Ageday	*	Age	*			Payer	*	Race
92	Provider	*	Ageday	*	Age	*	Sex				

TYPELVLP	STRATIFICATION												
93	Provider	*			Ageday	*	Age	*	Sex	*			Race
94	Provider	*			Ageday	*	Age	*	Sex	*	Payer		
95	Provider	*			Ageday	*	Age	*	Sex	*	Payer	*	Race
96	Provider	*	Bwht										
97	Provider	*	Bwht	*									Race
98	Provider	*	Bwht	*							Payer		
99	Provider	*	Bwht	*							Payer	*	Race
100	Provider	*	Bwht	*					Sex				
101	Provider	*	Bwht	*					Sex	*			Race
102	Provider	*	Bwht	*					Sex	*	Payer		
103	Provider	*	Bwht	*					Sex	*	Payer		Race
104	Provider	*	Bwht	*			Age						
105	Provider	*	Bwht	*			Age	*					Race
106	Provider	*	Bwht	*			Age	*			Payer		
107	Provider	*	Bwht	*			Age	*			Payer	*	Race
108	Provider	*	Bwht	*			Age	*	Sex				
109	Provider	*	Bwht	*			Age	*	Sex	*			Race
110	Provider	*	Bwht	*			Age	*	Sex	*	Payer		
111	Provider	*	Bwht	*			Age	*	Sex	*	Payer	*	Race
112	Provider	*	Bwht	*	Ageday								
113	Provider	*	Bwht	*	Ageday	*							Race
114	Provider	*	Bwht	*	Ageday	*					Payer		
115	Provider	*	Bwht	*	Ageday	*					Payer	*	Race
116	Provider	*	Bwht	*	Ageday	*			Sex				
117	Provider	*	Bwht	*	Ageday	*			Sex	*			Race
118	Provider	*	Bwht	*	Ageday	*			Sex	*	Payer		
119	Provider	*	Bwht	*	Ageday	*			Sex	*	Payer	*	Race
120	Provider	*	Bwht	*	Ageday	*	Age						
121	Provider	*	Bwht	*	Ageday	*	Age	*					Race
122	Provider	*	Bwht	*	Ageday	*	Age	*			Payer		
123	Provider	*	Bwht	*	Ageday	*	Age	*			Payer	*	Race
124	Provider	*	Bwht	*	Ageday	*	Age	*	Sex				
125	Provider	*	Bwht	*	Ageday	*	Age	*	Sex	*			Race
126	Provider	*	Bwht	*	Ageday	*	Age	*	Sex	*	Payer		
127	Provider	*	Bwht	*	Ageday	*	Age	*	Sex	*	Payer	*	Race

Note: TYPELVLP values of 0 (overall) and 64 (provider) are the default values for the levels of stratification provided in the software.

8.5   Run *XX*SASP3

The *XX*SASP3 program calculates risk-adjusted rates by patient age, sex, birth weight (in the PDI module only), modified MS-DRG, Clinical Classifications Software (CCS) comorbidity, and APR-DRG, if available, for each QI and then calculates smoothed rates. The risk-adjusted and smoothed rates are not calculated for the provider volume indicators in the IQI module (IQI #1 to IQI #7) just as observed rates were not calculated for these indicators.

The *XX*SASP3 program does not apply to the PQI module, as those indicators are all area-level measures.

❖ *The programs calculate risk-adjusted rates regardless of the number of cases available. However, rates based on only a few cases should be interpreted with caution.*

The output SAS dataset has records summarized to the various combinations of stratifiers that were specified in the TYPELVLP parameter of the preceding *XX*SASP2 program. See Table 22 and Table 23 above.

Input:

1. SAS format library (FMTLIB) created from the *XX*FMT program.

2. The discharge-level file that was created with the *XX*SAS1 program.

3. The SAS dataset with summary records that was created with the *XX*SASP2 program.

4. A text file containing logistic regression coefficients from a regression that was run on a reference SID dataset. These coefficients will be used in the risk-adjustment process. Two files are provided as part of the SAS QI software.

   • Gee_p*XX*nn_RegressionAnalysisGee.csv contains the regression coefficients.
   • Prediction_P*XX*nn.xml contains the input parameters for the executable AHRQ.exe.

❖ *Users must create a directory "C:\AHRQQI\XXI" and copy the zip file XXI_GEE_Input_Files.zip to that directory. Extract all of the files from XXI_GEE_Input_Files.zip into the directory "C:\AHRQQI\XXI." (See Section 1.0)*

5. A text file containing two (in PDI) or three (in IQI and PSI) arrays for use in the smoothing process. The arrays contain noise variance estimates, signal variance estimates and mean area rates for each QI. Specify file MSX*XX*P45.TXT. The text file does not need to be converted to a SAS file for use with the software.

Output:

1. A SAS dataset with an overall summary record and with provider-level summary records that contain the three types of indicator rates, along with the components of the initial raw rates. Depending on the QI module, the file may contain the observed rates (OP*XX*nn variables), the risk-adjusted rates (RP*XX*nn variables), the smoothed rates (SP*XX*nn variables), the expected rates (EP*XX*nn variables), risk adjusted rate confidence intervals (LPPSnn variables for lower bounds and UPPSnn variables for upper bounds), the counts of outcomes that formed the numerators of the observed rates (TP*XX*nn variables), the smoothed rate standard errors (XPPSnn) and the hospital discharge totals that formed the denominators of the observed rates (PP*XX*nn variables). When stratifications other than hospital are selected, the RP*XX*nn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk-adjustment variables.

2. An optional ASCII (comma delimited) text file that the user can then import into a spreadsheet. This text file contains the same information as the SAS output dataset. The text file will contain the OP*XX*nn observed rates and their TP*XX*nn and PP*XX*nn numerator and denominator components, the RP*XX*nn risk-adjusted rates with upper (UPPSnn) and lower (LPPSXX) limits, the SP*XX*nn smoothed rates with their standard errors (XPPSnn), and the EP*XX*nn expected rates. Each record or row in the text file will correspond to a specification group.

PSI

Also included in the PSI module are the counts of outcomes that formed the numerators of the observed rates (TPPSxx variables), and the residential population totals that formed the denominators of the observed rates (PPPSxx variables).

The VPPSxx variables are the variances for respective indicators.

In previous versions, these quantities were not saved if the standard error or confidence intervals were presented. For recent versions, this information is required by the composite indicator programs and so is retained.

3. A PROC MEANS (with N, NMISS, MIN, MAX, MEAN, and SUM) of the provider-level summary records that shows statistics for the observed, risk-adjusted and smoothed rates and statistics for the counts of outcomes that formed the numerators and denominators of the observed rates. These means will only be generated if the user included a value of 16 (for IQI and PSI) or a value of 64 (for the PDI) for the TYPELVLP parameter of the preceding *XX*SASP2 program (see Table 22 and Table 23).

4. A PROC CONTENTS of the output SAS summary dataset is generated in the SAS output window/results viewer.

5. A PROC PRINT of the output summary dataset may be generated in the SAS output window/results viewer. This printout may be quite large depending on the number and the types of stratifications that the user requested with the TYPELVLP parameter of the preceding *XX*SASP2 program (see Table 22 and Table 23). If the user does not wish to generate this printout, then the global "PRINT" parameter in CONTROL_*XX*I.SAS code should be set to zero.

Changes:

1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_*XX*I.SAS code.

2. In CONTROL_*XX*I.SAS, specify the locations (paths) of the input and output SAS files in the "LIBNAME IN1," "LIBNAME INP2," and "LIBNAME OUTP3" statements.

3. In CONTROL_*XX*I.SAS, specify in the "INFILE1" statement the name of the discharge-level file that you created with the *XX*SAS1 program. The default file name may be used.

4. In CONTROL_*XX*I.SAS, specify in the "INFILEP2" statement the name of the summary file that you created with the *XX*SASP2 program. The default file name may be used.

5. In CONTROL_*XX*I.SAS, specify in the "FILENAME MSXP" statement the path (including the file name) for the ASCII text file that contains the estimates to smooth the indicator rates. This file is provided as part of the module. Specify file name as MSX*XX*P45.TXT.

6. In CONTROL_*XX*I.SAS, specify in the "OUTFILP3" statement the name that you wish the output file to have. The default file name may be used.

7. In CONTROL_*XX*I.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then specify the path (including the file name) for this ASCII text file in the "FILENAME *XX*TEXTP3" statement, and set the TEXTP3 parameter to 1. Otherwise, the default value of zero for TEXTA3 will skip the code that would generate this file.

8.6   Run *XX*I_COMPOSITE

The *XX*I_COMPOSITE program calculates the rates for the provider-level composite QI, using the data derived from the *XX*SASP3 program. The provider-level composite rate is the weighted average of the observed-to-expected ratios of its component indicators (see the *Technical Specification* document for a particular composite indicator for a list of that composite's component indicators). The weights include component weights and shrinkage weights. The component weights are denominator weights, defined as the relative frequency of the denominators for the component indicators in the reference population. The shrinkage weights are the signal-to-noise ratio, where the signal variance is estimated from the reference population, and the noise variance is estimated from the user's data and is unique to each provider in the user's data.

Rates for the area-level composite QI are calculated in the same programs that calculate the rates for the non-composite area-level indicators. The IQI, PDI, and PSI modules contain provider-level composite indicators. The PQI module contains only area-level composite indicators, and no separate composite file is provided for that module. For each composite indicator in the module, the *XX*I_COMPOSITE program computes the composite rate, the variance and standard error for the composite rate, the weighted denominator, and a confidence interval for the composite rate.

Input:
1. The SAS dataset with an overall summary record and provider-level summary records that was created with the *XX*SASP3 program.

2. A text file containing one array of shrinkage weights for all provider-level composite indicators in the module and, for each provider-level composite in the module, two additional arrays. One of the additional arrays contains the variances and covariances among the component indicators. The other additional array provides an index for mapping the variances and covariances to component indicators. Two separate text files are provided, and the one used by the program depends on whether POA data are available on the input data file. The file MS*XX*C45.TXT contains the arrays to be used when POA data are present, and the file M*XX*C45A contains the arrays to be used when POA data are not present.

Output:
1. A SAS dataset *XX*C3 with an overall summary record and with provider-level summary records that contain, for each composite indicator, the composite rate, the variance of the composite rate, the standard error of the composite rate, the weighted denominator of the composite rate, and the lower and upper bounds of a 95% confidence interval around the composite rate.

2. A PROC MEANS (with N and MEAN) of the provider-level summary records that shows statistics for the composite rate, variance of the composite rate, standard error of the composite rate, and weighted denominator of the composite rate.

Changes:
1. At the beginning of the program, specify the locations (paths) for the library containing the *XX*P3 dataset produced by the *XX*SASP3 program, for the library where the output dataset *XX*C3 should be stored, and for the location of the text files MS*XX*C45.TXT and M*XX*C45A.TXT.

2. If you wish to modify the denominator weights, change the W*nn* values in the program, where *nn* is the number of the component indicator. Note that any weights provided for a composite must sum to one.

8.7   Run *XX*SASA2

The *XX*SASA2 program calculates the observed rates for the area-level QI, using the data derived in a previous step (*XX*SAS1). These observed rates can be stratified by combinations of area, sex, age, and race categories. The program first totals the area indicator flags created by the *XX*SAS1 program, and then for each of the desired stratifiers divides these totals by the pertinent residential population. The population denominators are stored in variables with names that have a prefix of "P". The observed rates are stored in variables that have a prefix of "O".

Input:
1. The SAS dataset that was created in the *XX*SAS1 program. This dataset is a discharge-level file that contains inpatient records with input variables, stratifiers, and the new flag indicators for the QI Area-level outcomes of interest.

2. A text file with Census area residential populations, stratified by area, age, sex, and ethnicity categories. The file POP95T13.TXT is currently provided on the AHRQ website as a separate download. The user should set POPYEAR to the year that best matches the user's discharge data file (yyyy).

❖ *Users do **not** need to convert the ASCII text file to a SAS dataset for use with the software.*

3. SAS format library (FMTLIB) created from the *XX*FMT program.

Output:

1. SAS dataset with summary records that contain observed rates (OA*XX*nn variables, where *XX* refers to the QI module and nn refers to the indicator number), the counts of outcomes that formed the numerators of the rates (TA*XX*nn variables) and the residential population totals that formed the denominators of the observed rates (*PAXXnn* variables). The output file has records summarized to the various combinations of stratifiers specified in the TYPELVLA parameter that is described in the "**Changes**" section below.

2. An optional ASCII (comma delimited) text file that the user can then import into a spreadsheet. This text file contains the same information as the SAS output dataset. The text file will contain the OA*XX*nn observed rates, the TA*XX*nn counts of outcomes that formed the numerators of the rates, and the PA*XX*nn residential population totals. The different records/rows in the text file will correspond to the different TYPELVLA stratification combinations.

3. A PROC MEANS (with N, NMISS, MIN, MAX, MEAN, and SUM) of the area-level summary records that shows statistics for the OA*XX*nn observed rates, the TA*XX*nn counts of outcomes that formed the numerators of the rates and the PA*XX*nn residential populations totals. These means will only be generated if the user included a value of 8 for the TYPELVLA parameter discussed in the "**Changes**" section below.

4. A PROC CONTENTS of the output SAS summary dataset is generated in the SAS output window/results viewer.

5. A PROC PRINT of the output summary dataset may be generated in the SAS output window/results viewer. This printout may be quite large depending on the number and the types of stratifications that the user requests with the TYPELVLA parameter discussed in the "**Changes**" section below. If the user does not wish to generate this printout, then the global "PRINT" parameter in CONTROL_*XX*I.SAS code should be set to zero.

Changes:

1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_XXI.SAS code.

2. In CONTROL_XXI.SAS, specify the locations (paths) of the input and output SAS files in the "LIBNAME INA2" and "LIBNAME OUTA2" statements.

3. In CONTROL_XXI.SAS, specify the names of the input and output files in the "INFILE1" and "OUTFILA2" statements. The name that you specify with INFILE1 should be for the file that you created using the XXSAS1 program. The default file names may be used.

4. In CONTROL_XXI.SAS, specify the path (including the file name) for the ASCII population text file in the "FILENAME POPFILE" statement. The file name will be POP95T13.TXT. The user should set POPYEAR to the year that best matches the user's discharge data file (yyyy).

5. In CONTROL_XXI.SAS, specify the levels of aggregation for the observed rates. This change is done by specifying numbers between 0 and 15 in the "%LET TYPELVLA =" statement. Each number corresponds to a different level or combination of levels. The default values of 0 (overall) and 8 (area) will provide an overall total and the area-level totals.

❖ *WARNING: TYPELVLA must include the values 0 (overall) and 8 (area) if you wish to subsequently run program XXSASA3 for risk-adjusted and smoothed rates.*

❖ *If TYPELVLA includes the value 0 (overall), then the first observation in the output summary data file will contain the overall totals and observed rates for the entire database created with the XXSAS1 program.*

❖ *For example, if you are using a state inpatient hospital database, you might specify the following TYPELVLA values for the IQI module:*
   0 – provides overall rates for your entire state
   4 – provides overall rates for your state, broken down by age groups
   8 – provides rates for areas within your state
   12 – provides rates for age groups within these areas

6. In CONTROL_XXI.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then specify the path (including the file name) for this ASCII text file in the "FILENAME XXTEXTA2" statement, and set the TEXTA2 parameter to 1. Otherwise, the default value of zero for TEXTA2 will skip the code that would generate this file.

Table 24. IQSASA2, PDSASA2, PQSASA2, and PSSASA2 Aggregation Possibilities

TYPELVLA	STRATIFICATION						
0		Overall					
1							Race
2				Sex			
3				Sex	*		Race
4		Age					
5		Age	*				Race
6		Age	*	Sex			
7		Age	*	Sex	*		Race
8	Area						
9	Area	*					Race
10	Area	*		Sex			
11	Area	*		Sex	*		Race
12	Area	*	Age				
13	Area	*	Age	*			Race
14	Area	*	Age	*	Sex		
15	Area	*	Age	*	Sex	*	Race

Note: TYPELVLA values of 0 (overall) and 8 (area) are the default values for the levels of stratification provided in the software.

8.8 Run PDSASG2

The PDSASG2 program calculates the observed rates for the provider-level PDI, using the data derived in a previous step (PDSAS1). These observed rates are stratified by risk group categories that are specific to each indicator. The program first sums the indicator flags created by the PDSAS1 program (numerator) and then divides this sum by the count of the hospital discharges (denominator) for each of the risk group stratifiers. The stratifiers are stored in variables with names that have a prefix of "G" (indicating Group). The numerators are stored in variables with names that have a prefix of "T" (indicating Top). The population denominators are stored in variables with names that have a prefix of "P". The observed rates are stored in variables that have a prefix of "O".

PDI

This PDSASG2 program is only used in the PDI module

Input:

1. The SAS dataset that was created in the PDSAS1. This dataset is a discharge-level file that contains inpatient records with input variables, stratifiers, and the 13 new flag indicators for the PDI hospital outcomes of interest. Only six (6) of these indicators have risk group stratifiers and are included as input into the G2 module (PDI #1, #2, #8, #10, #11 and #12).

2. SAS format library (FMTLIB) created from the PDFMT program.

Output:

1. SAS dataset with summary records that contain observed rates (OPPDnn variables where nn refers to the indicator number), the counts of outcomes that formed the numerators of the rates (TPPDnn variables), and the hospital discharge totals that formed the denominators of the observed rates (PPPDnn variables). It also includes variables identifying present on admission (POA) conditions for provider-level outcomes of interest (QPPDnn). The output file has records summarized to the indicator-specific pre-defined risk group stratifiers.

2. An optional ASCII (comma delimited) text file that the user can then import into a spreadsheet. This text file contains the same information as the SAS output dataset. The text file will contain the OPPDnn observed rates, the TPPDnn counts of outcomes that formed the numerators of the rates and the PPPDnn counts of outcomes that formed the denominators of the rates. The different records/rows in the text file will correspond to the indicator-specific pre-defined risk group stratifiers

3. A PROC MEANS (with N, NMISS, MIN, MAX, MEAN and SUM) of the hospital-level summary records that show statistics for the OPPDnn observed rates, the TPPDnn counts of outcomes that formed the numerators of the rates, the QPPDnn POA flags, and the PPPDnn counts of outcomes that formed the denominators of the rates. These means are generated by the indicator-specific pre-defined risk group stratifiers.

4. A PROC CONTENTS of the output SAS summary dataset is generated in the SAS output window/results viewer.

5. A PROC PRINT of the output summary dataset may be generated in the SAS output window/results viewer. If the user does not wish to generate this printout, then the global "PRINT" parameter in CONTROL_PDI.SAS code should be set to zero.

Changes:
1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_PDI.SAS code.

2. In CONTROL_PDI.SAS, specify the locations (paths) of the input and output SAS files in the "LIBNAME IN1" and "LIBNAME OUTG2" statements.

3. In CONTROL_PDI.SAS, specify the names of the input and output files in the "INFILE1" and "OUTFILG2" statements. The name that you specify with INFILE1 should be for the file that you created using the PDSAS1 program. The default file names may be used.

4. In CONTROL_PDI.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then set the TEXTG2 parameter to 1. Otherwise, the default value of zero for TEXTG2 will skip the code that would generate this file.

5. In CONTROL_PDI.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then specify the path (including the file name) for this ASCII text file in the "FILENAME PDTEXTG2" statement.

8.9 Run *XX*SASA3

The *XX*SASA3 program calculates age and sex risk-adjusted rates for each area-level QI (overall rates and rates by area), and then calculates smoothed rates. This program does not apply to the PSI module.

Input:

1. SAS format library (FMTLIB) created from the *XX*FMT program.

2. The discharge-level file that was created with the *XX*SAS1 program.

3. The SAS dataset with summary records that was created with the *XX*SASA2 program.

4. A text file with Census area residential populations (stratified by area, sex and discrete age categories). One file is currently provided along with the QI software. The file is POP95T13.TXT. The user should set POPYEAR to the year that best matches the user's discharge data file (yyyy). The text file does not need to be converted to a SAS file for use with the software.

Additional Input Specific to the PDI and PQI Modules:

5. Two text files containing logistic regression coefficients from a regression that was run on the reference SID dataset. These coefficients will be used in the risk adjustment process. COVPDA45.TXT or COVPQA45.TXT should be used with risk adjustment for age and gender only, for the PDI and PQI modules, respectively. CVPDA45A.TXT or CVPQA45A.TXT should be used with adjustment for age, gender, and socioeconomic status (SES), for the PDI and PQI modules, respectively. These files are provided to you as part of the QI software and do not need to be converted to a SAS file for use with the software.

6. Two text files containing two arrays for use in the smoothing process. The arrays contain noise variance estimates, signal variance estimates, and mean area rates for each QI. MSXPDA45.TXT or MSXPQA45.TXT should be used with adjustment for age and gender only, for the PDI and PQI modules, respectively. MXPDA45A.TXT or MXPQA45A.TXT should be used with adjustment for age, gender and SES, for the PDI and PQI modules, respectively. These files are provided to you as part of the QI software and do not need to be converted to a SAS file for use with the software.

<u>Output</u>:

1. A SAS dataset with an overall summary record and with area-level summary records that contain the three types of indicator rates, along with the components of the initial raw rates. Specifically, the file contains the observed rates (OA*XX*nn variables), the risk-adjusted rates (RA*XX*nn variables), the smoothed rates (SA*XX*nn variables), the lower and upper confidence intervals (LA*XX*nn and UA*XX*nn, respectively), the counts of outcomes that formed the numerators of the observed rates (TA*XX*nn variables) and the residential population totals that formed the denominators of the observed rates (PA*XX*nn variables). When stratifications other than area are selected, the RA*XX*nn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk-adjustment variables.

2. An optional ASCII (comma delimited) text file that the user can then import into a spreadsheet. This text file contains the same information as the SAS output dataset. The text file will contain the OA*XX*nn observed rates and their TA*XX*nn and PA*XX*nn components, the RA*XX*nn risk-adjusted rates, and the SA*XX*nn smoothed rates. Each record or row in the text file will correspond to a different area.

3. A PROC MEANS (with N, NMISS, MIN, MAX, MEAN, and SUM) of the area-level summary records that shows statistics for the OA*XX*nn observed rates and their TA*XX*nn and PA*XX*nn components, the RA*XX*nn risk-adjusted rates, and the SA*XX*nn smoothed rates.

4. A PROC CONTENTS of the output SAS summary dataset is generated in the SAS output window/results viewer.

5. A PROC PRINT of the output summary dataset may be generated in the SAS output window/results viewer. If the user does not wish to generate this printout, then the global "PRINT" parameter in CONTROL_*XX*I.SAS code should be set to zero.

6. Outputs to hardcopy are PROC MEANS (with N, NMISS, MIN, MAX, MEAN, and SUM) of risk-adjusted and smoothed rates in two intermediate work files and of all of the numeric variables in the final output data file.

<u>Changes</u>:

1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_*XX*I.SAS code.

2. In CONTROL_*XX*I.SAS, specify the locations (paths) of the input and output SAS files in the "LIBNAME IN1," "LIBNAME INA2," and "LIBNAME OUTA3" statements.

3. In CONTROL_*XX*I.SAS, specify in the "INFILE1" statement the name of the discharge-level file that you created with the *XX*SAS1 program. The default file name may be used.

4. In CONTROL_*XX*I.SAS, specify the path (including the file name) for the ASCII population text file in the "FILENAME POPFILE" statement. The file name is POP95T13.TXT. These files are provided along with the software. The file used should be the one that is closest to the year associated with your particular data. These files contain Census residential population estimates by area, gender and discrete age categories.

5. In CONTROL_*XX*I.SAS, specify in the "FILENAME COVARA" statement the path (including the file name) for the ASCII text file that contains regression coefficients from a logistic regression that was run on reference SID dataset.

6. In the PDI and PQI modules, to perform the risk adjustment by age and gender, use COVPDA45.TXT or COVPQA45.TXT for the PDI and PQI modules, respectively. To perform the risk adjustment by SES, use CVPDA45A.TXT or CVPQA45A.TXT for the PDI and PQI modules, respectively.

    PDI and PQI — Additional changes for the PDI and PQI modules

7. In CONTROL_*XX*I.SAS in the PDI and PQI modules, specify in the "FILENAME MS*X*" statement the path (including the file name) for the ASCII text file that contains the estimates to smooth the indicator rates. Use MSXPDA45.TXT or MSXPQA45.TXT for age and gender risk adjustment in the PDI and PQI modules, respectively and MXPDA45A.TXT or MXPQA45A.TXT for age, gender and SES risk adjustment in the PDI and PQI modules, respectively.

8. In CONTROL_*XX*I.SAS, specify in the "INFILEA2" statement the name of the summary file that you created with the *XX*SASA2 program. The default file name may be used.

9. In CONTROL_*XX*I.SAS, specify in the "OUTFILA3" statement the name that you wish the output file to have. The default file name may be used.

10. In CONTROL_*XX*I.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then specify the path (including the file name) for this ASCII text file in the "FILENAME *XX*TEXTA3" statement, and set the TEXTA3 parameter to 1. Otherwise, the default value of zero for TEXTA3 will skip the code that would generate this file.

8.10 Run PQSASC2

This program is only for use in the PQI module. The PQSASC2 program calculates condition-specific rates for the four diabetes area-level Prevention Quality Indicators (PDI 15, PQI 1, 3, 14, and 16), using the data derived in the previous step (PQSAS1). These condition-specific rates are stratified by state

PQI — The PQSASC2 program is for use in the PQI module only.
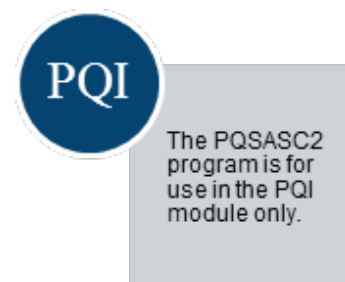
and age categories. The program first totals the indicator flags created by the PQSAS1 program, and then for each of the stratifiers divides these totals by the pertinent condition-specific population. The condition-specific denominators are stored in variables with names that have a prefix of "P" (Pop). The condition-specific rates are stored in variables that have a prefix of "C."

Input:

1. The SAS dataset that was created in the previous step (PQSAS1). This is a discharge-level file that contains inpatient records with input variables, stratifiers, and the 4 new flag indicators for the selected PQI outcomes of interest (i.e., PQI 1, 3, 14 and 16).

2. A text file with diabetes populations, stratified by state and age categories. The file currently provided along with the PQI module software is QICTYC13.TXT. The user should select the file for the year that best matches the user's discharge data file.

❖ *Users do **not** need to convert the ASCII text file to a SAS dataset for use with the software.*

3. SAS format library (FMTLIB) created from the PQFMTS program.

Output:

1. SAS dataset with summary records that contain condition-specific rates (CAPQnn variables where nn refers to the indicator number), the counts of outcomes that formed the numerators of the rates (TAPQnn variables), and the condition-specific population totals that formed the denominators of the observed rates (PAPQnn variables). The output file has records for the overall state rate and by age.

2. An optional ASCII (comma delimited) text file that the user can then import into a spreadsheet. This text file contains the same information as the SAS output dataset. The text file will contain the CAPQnn condition-specific rates, the TAPQnn counts of outcomes that formed the numerators of the rates, and the PAPQnn condition-specific population totals. The different records/rows in the text file will correspond to the overall state rate and by age.

3. A PROC MEANS (with N, NMISS, MIN, MAX, MEAN, and SUM) of the area-level summary records that shows statistics for the CAPQnn condition-specific rates, the TAPQnn counts of outcomes that formed the numerators of the rates, and the PAPQnn condition-specific populations totals. These means will be generated for the overall state rate and by age.

4. A PROC CONTENTS of the output SAS summary dataset is output to hardcopy.

5. A PROC PRINT of the output summary dataset is provided at the end of the hardcopy printout. If the user does not wish to generate this printout, then the global "PRINT" parameter in CONTROL_PQI.SAS code should be set to zero.

Changes:

1. The "FILENAME CONTROL" statement at the beginning of the program must be changed to reflect the location of the CONTROL_PQI.SAS code.

2. In CONTROL_PQI.SAS, specify the locations (paths) of the input and output SAS files in the "LIBNAME INC2" and "LIBNAME OUTC2" statements.

3. In CONTROL_PQI.SAS, specify the names of the input and output files in the "INFILE1" and "OUTFILC2" statements. The name that you specify with INFILE1 should be for the file that you created using the previous PQSAS1 program.

4. In CONTROL_PQI.SAS, specify the path (including the file name) for the ASCII population text file in the "FILENAME POPFILE2" statement. The file name will be QICTYC13.TXT. These files are provided to you as part of the PQI module. The file used should be the one that is closest to the year associated with your particular data.

5. In CONTROL_PQI.SAS, if you wish to create an ASCII (comma delimited) text file that you can import into a spreadsheet, then specify the path (including the file name) for this ASCII text file in the "FILENAME PQTEXTC2" statement, or set the TEXTC2 parameter to 1. Otherwise, the default value of zero for TEXTC2 will skip the code that would generate this file.

9.0   Reviewing the Printed Output

This section contains tips for reviewing some of the printed output from the QI modules. These tips are oriented toward explaining the interrelationships between printout items from different programs and hopefully will help to reveal the nature and structure of the module outputs. See Appendix D for each module's output data dictionary.

> ❖ *Depending on the QI module and whether or not you have elected to risk-adjust and smooth the data, the final output may be a PROC PRINT from XXSASP2, XXSASP3, XXSASA2 and/or XXSASA3. All interim printouts are for checking and trouble-shooting.*

9.1   *XX*SAS1

The initial printout from the *XX*SAS1 program contains **PROC MEANS** for all of the numeric variables (including the comorbidity indicators) in the output discharge-level dataset. It will contain information for the newly constructed TA*XX*nn and TP*XX*nn flag variables that will later form the numerators for the indicator rates. For each TA*XX*nn and TP*XX*nn flag variable:

- The SUM will contain the total number of observations in the dataset that were found to have the particular outcome of interest.
- For most of the area indicators, the MEAN, MINIMUM, and MAXIMUM will usually be the value 1 since the flag variables have either been set to missing ('.') or to a value of 1.

The exceptions to this are PQI 2 and PDI 17 for perforated appendix and PQI 9 for low birth weight, which are based on a subset of the hospitalized population rather than the area residential population. For these indicators, a value of 0 was assigned to the TA*XX*nn flag if a particular observation was part of the population for the rate denominator but did not have the particular outcome of interest to be included in the rate numerator. So for example, TAPQ02 = 0 implies a patient who had an appendectomy performed, but did not have a perforated appendix. For PQI 2, the MEAN will contain a close approximation of the eventual overall observed indicator rate. The value will change slightly after PQSASA2 has applied additional parts of the indicator definition.
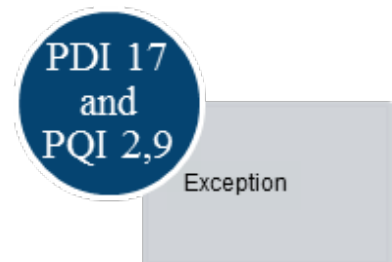
Most of the provider indicators will have a value of 1, 0, or missing ('.'). For these indicators, a value of 0 was assigned to the TP*XX*nn flag if a particular observation was part of the population at risk for a particular indicator but did not have the particular outcome of interest. So for example, TPIQ21 = 1 indicates a patient who had a Cesarean section, while TPIQ21 = 0 identifies a patient who had a delivery but not a C-section.

For most of the provider indicators, the MEANs will contain a close approximation of the eventual overall observed indicator rates. The values will change slightly after *XX*SASP2 has applied additional parts of the indicator definitions.

N lists the number of observations in the dataset with non-missing values. For the area indicators, N for TA*XX*nn will be the same as the SUM. For most of the provider-level indicators, including PQI 2, N will contain the denominator for the observed indicator rate.

For the six IQI provider volume indicators, the MEAN, MINIMUM, and MAXIMUM will usually be the value one since the flag variables have either been set to missing ('.') or to a value of 1. Also, N for TPIQnn or TAIQnn will be the same as the SUM. Note: the N's or denominators for six of the IQI mortality indicators (i.e., IQI 08-12, 30, and 31) will be similar to the Ns and SUMs for the six IQI volume indicators (TPIQ01-TPIQ02 TPIQ04-TPIQ07), but often they will not be exactly identical (e.g., the mortality indicators exclude discharges that were transferred to other hospitals).

There may be differences in the output from *XX*SAS1.SAS and XXSASA2.SAS and *XX*SASA3.SAS programs based on missing data. If any cases are missing the FIPS codes, they will be included in the output from *XX*SAS1.SAS but will be excluded from the subsequent analyses (the second and third programs).

The *XX*SAS1 printout also contains a **PROC CONTENTS** that lists all of the variables in the output dataset, including the character variables that are present, and a **PROC PRINT** of the first 24 observations in the output dataset.

9.2 *XX*SASP2

The purpose of this printout is to provide the observed rates for all provider-level indicators. The default printout shows results by provider, but other levels of output can be specified as well. Note that risk-adjusted and smoothed rates are shown in the output from the next program.

The printout from the *XX*SASP2 program contains **PROC MEANS** on the provider-level summary records for all of the numeric variables in the output summary dataset. It will contain information for the newly constructed OP*XX*nn rates, the PP*XX*nn denominators, and the TP*XX*nn numerators.

The _TYPE_ variable described in the MEANS table identifies the stratification level for the records in the output data set. The _TYPE_ variable corresponds to the TYPELVLP parameter values that were specified (see the "**Changes**" section for the *XX*SASP2 program). In this case, _TYPE_ always assumes the value of 16 (for IQI and PSI) or 64 (for PDI), since only the provider-level records are selected.

The N statistic for _TYPE_ contains the number of providers in the output summary data set. A TP*XX*nn numerator variable with a value for N that is lower than the N value for _TYPE_ indicates that there were no outcomes of interest for some of the providers. Similarly, a PP*XX*nn denominator variable with a lower value for N than _TYPE_ indicates that for some providers, there were no hospital discharges with the outcome of interest.

The MINIMUM value for most of the numerators will usually be zero since values of zero were assigned for observations that were part of the population for the rate denominator but did not have the particular outcome of interest to be included in the rate numerator. For the IQI volume indicators, (TPIQ01 - TPIQ02 and TPIQ04 - TPIQ07), the MINIMUM value will be one or higher.

> ❖ *For the observed rates, the user should **NOT** report the MEANS displayed here, but instead should refer to the overall means in the output dataset that are also present in the subsequent PROC PRINT. The MEANS given here are means of hospital means; i.e., all hospitals are given equal weight, regardless of the number of discharges in the different hospitals.*

The SUMs for the counter variables TP*XX*nn and PP*XX*nn will contain overall file totals for these data elements. The SUMs for the observed rates have no intuitive meaning.

If the "PRINT" parameter in the CONTROL_*XX*I.SAS program is set to one, the subsequent **PROC PRINT** output contains a complete dump of the output summary file. Listed for each record are the stratification values, the PP*XX*nn population denominators for the provider indicators, the TP*XX*nn outcome numerators for the provider indicators and the OP*XX*nn observed rates.

9.3 *XX*SASP3

The **PROC PRINT** at the end of this program provides your **final output**. (This printout appears if the "PRINT" parameter in the CONTROL_*XX*I.SAS program is set to one.)

Table 25 lists the column headers shown on the printed output and describes each. Each indicator is reported in a separate section, where *XX* refers to the QI module and "nn" corresponds to the two-digit indicator number.

Table 25. Provider-level printed output

COLUMN HEADING	DESCRIPTION
Obs	Observation 1 (with HOSPID = ".") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).
HOSPID	Identifier for each provider in the dataset.
AGECAT	Age stratification category – See Table 22 and Table 23 for TYPELVLP settings.
SEXCAT	Gender stratification category – See Table 22 and Table 23 for TYPELVLP settings.
PAYCAT	Payer stratification category – See Table 22 and Table 23 for TYPELVLP settings.
RACECAT	Race stratification category – See Table 22 and Table 23 for TYPELVLP settings.
TP*XX*nn	Number of cases in the numerator.
PP*XX*nn	Number of cases in the denominator (population at risk).
OP*XX*nn	Observed (raw) rate – Numerator divided by Denominator.
EP*XX*nn	Expected rate – Rates the provider would have if it performed the same as the reference population given the provider's actual case-mix (e.g., age, gender, modified MS-DRG and comorbidities)
RP*XX*nn	Risk-adjusted rate – Accounts for the difference between the case-mix of the reference population and the provider's case-mix. When stratifications other than hospital or area are selected, the RP*XX*nn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables.
LP*XX*nn	Lower limit of confidence interval of risk-adjusted rate.
UP*XX*nn	Upper limit of confidence interval of risk-adjusted rate.
SP*XX*nn	Smoothed rate – Rates with removal of fluctuation over time.
XP*XX*nn	Standard error of smoothed rate.

Observation 1 (with HOSPID = .) is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16). Data will appear under the column headers, AGECAT, SEXCAT, PAYCAT, and RACECAT, if you specify these levels of aggregation.

You may wish to express the results in more understandable terms:

Multiply the mortality rates by 1,000 to express them as per 1,000 discharges (e.g., 0.0338 * 1,000 = 33.8 deaths per 1,000 discharges)

Multiply the utilization rates by 1,000 to express them as per 1,000 discharges (e.g., 0.2040 * 1,000 = 204 procedures per 1,000 discharges).

The MEANS table is generated from the permanent provider-level output file and is provided for trouble-shooting and understanding your data, but not for reporting. The means are provided just for the provider-level summary records.

The N for all but the TP*XX*nn counter variables should contain the number of providers in the user's database.

The MEANS, MINIMUMs, and MAXIMUMs have their normal meaning and provide comparisons among the different hospitals or providers in your database.

❖ *For the (observed, risk-adjusted, or smoothed) rates, the user should **NOT** report the MEANS displayed here, but instead refer to the overall means in the output dataset in the PROC PRINT labeled "FINAL OUTPUT." The MEANS given here are means of hospital means; i.e., all hospitals are given equal weight, regardless of the number of discharges in the different hospitals.*

Note, the denominators for six of the IQI mortality indicators (IQI #8 to #12, #30, and #31) will be similar to the totals for the six IQI volume indicators (IQI #1 to IQI #7), but often they will not be exactly identical (e.g., the mortality indicators exclude discharges that were transferred to other hospitals).

If the "PRINT" parameter in the CONTROL_*XX*I.SAS program is set to one, at the end of the printout is a **PROC PRINT** on the final provider-level output file. Listed for each level of stratification are the stratifiers, the numerator and denominator totals for the observed rates, and the observed, risk-adjusted, and smoothed rates.

9.4   *XX*SASA2

The purpose of this printout is to provide the observed rates for all area-level indicators. The default printout shows overall results and results by area, but other levels of output can be specified as well. Note that risk-adjusted and smoothed rates are shown in the output from the next program.

The printout from the *XX*SASA2 program contains **PROC MEANS** for all of the numeric variables in the output summary dataset. It will contain information for the newly constructed OA*XX*nn rates, the PA*XX*nn denominators, and the TA*XX*nn numerators.

The _TYPE_ variable described in the first row of the MEANS table identifies the stratification level for the records in the output data set. The _TYPE_ variable corresponds to the TYPELVLA parameter values that were specified (see the "**Changes**" section for the *XX*SASA2 program). In this case, _TYPE_ always assumes the value of 8, since only the area-level records are selected.

The N statistic for _TYPE_ contains the number of areas in the output summary data set. A TA*XX*nn numerator variable with a lower value for N than _TYPE_ indicates that there were no outcomes of interest for some of the areas.

The MINIMUM value for the TA*XX*nn numerators will be one or higher.

> ❖ *For the observed rates, the user should **NOT** report the MEANS displayed here, but instead should refer to the overall means in the output dataset that are also present in the subsequent PROC PRINT. The MEANS given here are means of the area means; i.e., all areas are given equal weight, regardless of the population in the different areas.*

In the PQI module, the MINIMUM value for the perforated appendix TAPQnn numerator will usually be zero since values of zero were assigned for observations that were part of the population for the rate denominator but did not have the particular outcome of interest to be included in the rate numerator. For the other 12 indicators, based on the residential area population, the MINIMUM value will be one or higher.

The SUMs for the counter variables TA*XX*nn and PA*XX*nn will contain overall file totals for these data elements. The SUMs for the observed rates have no intuitive meaning.

If the "PRINT" parameter in the CONTROL_*XX*I.SAS program is set to one, the subsequent **PROC PRINT** output contains a complete dump of the output summary file. Listed for each record are the stratification values, the PA*XX*nn population denominators for the indicators, the TA*XX*nn outcome numerators for the indicators, and the OA*XX*nn observed rates.

Table 26 lists the column headers shown on the printed output and describes each. Each indicator is reported in a separate section, where *XX* refers to the QI module and "nn" corresponds to the two-digit indicator number.

Table 26. Area-level printed output

COLUMN HEADING	DESCRIPTION
Obs	Observation 1 is the overall average for the entire dataset (TYPELVLA = 0). The remaining observations are individual areas (TYPELVLA = 8).
Area	Identifier in the dataset for area.
TA*XX*nn	Number of cases in the numerator.
PA*XX*nn	Number of cases in the denominator (population at risk).
OA*XX*nn	Observed (raw) rate - Numerator divided by Denominator.
RA*XX*nn	Risk-adjusted rate - Accounts for the difference between the case-mix of the reference population and the area's case-mix. When stratifications other than area are selected, the RAPDnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables
SA*XX*nn	Smoothed rate - Rates with removal of fluctuation over time.

Observation 1 (with AREA = *blank*) is the overall average for the entire dataset (TYPELVLA = 0). The remaining observations are individual areas (TYPELVLA = 8).

You may wish to express the results in more understandable terms. Multiply the utilization rates by 100,000 to express them as a rate per 100,000 population (e.g., 0.000494 * 100,000 = 49.4 pediatric heart surgeries per 100,000 population).

The MEANS table is generated from the permanent area-level output file. The means are provided just for the area-level summary records.

The N for all but the TA*XX*nn counter variables should contain the number of different areas (Metro Areas and counties) in your database.

The means, minimums, and maximums have their normal meaning and provide comparisons among the different areas in your database. Note that the maximums for the counter variables (the TA*XX*nn and PA*XX*nn variables) are associated with specific areas, and therefore these maximums may not match those in the prior *XX*SAS2 printouts, since that run typically will include a record for the entire database.

9.5 *XX*SASA3

The PROC PRINT at the end of this program provides your final output. (This printout appears if the "PRINT" parameter in the CONTROL_*XX*I.SAS program is set to one.) Table 27 lists the column headers shown on the printed output and describes each. Each indicator is reported in a separate section, where *XX* refers to the QI module and "nn" corresponds to the two-digit QI number.

Table 27. Final Area-level printed output

COLUMN HEADING	DESCRIPTION
OBS	Observation 1 is the overall average for the entire dataset (TYPELVLA = 0). The remaining observations are individual areas (TYPELVLA = 8).
AREA	Identifier in the dataset for area.
TA*XX*nn	Number of cases in the numerator.
PA*XX*nn	Number of cases in the denominator (population at risk).
OA*XX*nn	Observed (raw) rate - Numerator divided by Denominator.
RA*XX*nn	Risk-adjusted rate - Accounts for the difference between the case-mix of the reference population and the provider's case-mix. When stratifications other than area are selected, the RA*XX*nn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables.
LA*XX*nn	Lower limit of confidence interval of risk-adjusted rate.
UA*XX*nn	Upper limit of confidence interval of risk-adjusted rate.
SA*XX*nn	Smoothed rate - Rates with removal of fluctuation over time.
XA*XX*nn	Standard error of smoothed rate.
EA*XX*nn	Expected rate - Rates the area would have if it performed the same as the reference population given the area's actual case-mix (e.g., age, gender, modified MS-DRG and comorbidities)

Observation 1 (with AREA = *blank*) is the overall average for the entire dataset (TYPELVLA = 0). The remaining observations are individual areas (TYPELVLA = 8).

You may wish to express the results in more understandable terms. Multiply the utilization rates by 100,000 to express them as a rate per 100,000 population (e.g., 0.000494 * 100,000 = 49.4 hysterectomies per 100,000 population).

The MEANS table is generated from the permanent area-level output file. The means are provided just for the area-level summary records.

The N for all but the TA*XX*nn counter variables should contain the number of different areas (Metro Areas and counties) in your database

The means, minimums, and maximums have their normal meaning and provide comparisons among the different areas in your database. Note that the maximums for the counter variables (the TA*XX*nn and PA*XX*nn variables) are associated with specific areas, and therefore these maximums may not match those in the prior *XX*SAS2 printouts since that run typically will include a record for the entire database.

> ❖ *For the (observed, risk-adjusted, or smoothed) rates, the user should **NOT** report the means displayed here, but instead refer to the overall means in the output dataset that are also present in the subsequent PROC PRINT. The means given here are means of area means; i.e., all areas are given equal weight, regardless of the number of discharges in the different areas.*

The sums of the counter variables (the TA*XX*nn and PA*XX*nn variables) yield the overall database totals.

9.6   PQSASC2

This program and its output are specific to the PQI module. The purpose of this printout is to provide the condition-specific rates for selected area-level indicators. The default printout shows results by state and age category. The printout from the PQSASC2 program contains **PROC MEANS** on the state-level summary records for all of the numeric variables in the output summary dataset. It will contain information for the newly constructed CAPQnn rates, the PAPQnn denominators, and the TAPQnn numerators.
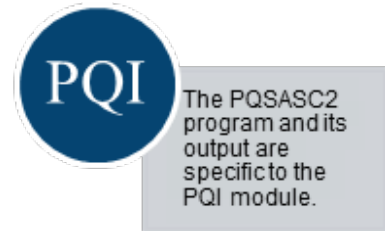
The _TYPE_ variable described in the first column of the MEANS table identifies the stratification level for the records in the output data set. The _TYPE_ value of 1 corresponds to the state level, while a value of 3 corresponds to the state*age category level.

The N statistic contains the number of states in the output summary data set.

The minimum value will be one or higher (for PAPQnn and TAPQnn) or zero or higher (for CAPQnn).

For the condition-specific rates, the user should **NOT** report the means displayed here, but instead should refer to the overall means in the output dataset that are also present in the subsequent PROC PRINT. The means given here are means of area means; i.e., all areas are given equal weight, regardless of the populations in the different areas.

The sums for the counter variables TAPQnn and PAPQnn will contain overall file totals for these data elements. The SUMs for the *condition-specific* rates have no intuitive meaning.

If the "PRINT" parameter in the CONTROL_PQI.SAS program is set to one, the subsequent PROC PRINT output contains a complete dump of the output summary file. Listed for each record are the stratification values, the PAPQnn population denominators for the four (4) indicators, the TAPQnn outcome numerators for the 16 indicators, and the four (4) CAPQnn condition-specific rates.

10.0 Sample Runtimes

The sample runtimes given below for IQI and PQI are from runs made on a Windows XP workstation, with a Pentium 4 CPU 2.80 GHz processor, 512 MB of RAM, and an IDE hard drive. The datasets contained 757,624 observations with 15 diagnosis fields and 15 procedure fields. The runtimes provided below should be used as rough guidance only, as a number of other variables impact runtimes. These variables include but are not limited to: the location of the source and output data files (on a network or stored in a local folder), network speed, and memory/disk space in use versus that which is available.

STEP	RUN TIME (IN SECONDS)
Run IQFMTS to create the format library	2
Run IQSAS1	157
Run IQSASP2	21
Run IQSASP3	86
Run IQSASA2	10
Run IQSASA3	185

STEP	RUN TIME (IN SECONDS)
Run PQFMTS to create the format library	2
Run PQSAS1	66
Run PQSASA2	16
Run PQSASA3	55
Run PQSASC2	3

The benchmark runtimes given below for PSI are from runs made on a Microsoft Windows 2000 workstation, with Pentium 4, 2.8 GHZ processor, and 1 GB of RAM. The dataset contained 498,515 observations with 15 diagnosis fields and 15 procedure fields.

STEP	RUN TIME (IN SECONDS)
Run PSFMTS to create the format library	4
Run PSSAS1	232
Run PSSASP2	2
Run PSSASP3	1533
Run PSSASA2	3

The benchmark runtimes given below for PDI are from runs made on a Windows XP workstation, with an Intel® Xeon® CPU 2.53 GHz processor, and 3.87 GB of RAM. The dataset contained 1,585,109 observations with 30 diagnosis fields and 30 procedure fields.

STEP	RUN TIME (IN SECONDS)
Run PDFMTS to create the format library	29
Run PDSAS1	429
Run PDSASP2	116
Run PDSASP3	596
Run PDSASG2	53
Run PDSASA2	122
Run PDSASA3	123

The benchmark runtimes given below for the PM are from runs made on a Windows 7 workstation, with an Intel® Xeon® CPU 2.53 GHz processor and 8.00 GB of RAM. The original input dataset for each module contained 140,061 records[**] and contained 37 diagnosis fields and 31 procedure fields.

STEP	RUN TIME (IN SECONDS)
Run Prediction Module (IQI)	66
Run Prediction Module (PDI)	29
Run Prediction Module (PSI)	722
Run Prediction Module (All Three Modules)	**817**

[**] The number of records actually processed by the PM is indicator- and age-dependent.

11.0 User Support

Technical assistance for the QI software is available through an electronic user support system monitored by the AHRQ QI support team. The same e-mail address may be used to communicate to AHRQ any suggestions for QI enhancements, general questions, and any QI related comments you may have. AHRQ welcomes your feedback.

The e-mail address for user support and feedback is: support@qualityindicators.ahrq.gov.

AHRQ also offers a listserv to keep you informed on the Quality Indicators. The listserv is used to announce any QI changes or updates, new tools and resources, and to distribute other QI related information. This is a free service. Simply follow the process described below to begin receiving important QI information. All you need is a computer, Internet access, and an e-mail address. It works just like other electronic distribution lists.

Here's how to register:

1. Send an e-mail message to: listserv@qualityindicators.ahrq.gov.

2. On the subject line, type: Subscribe.

3. In the body of the message type: sub Quality_Indicators-L and your full name. For example: **sub Quality_Indicators-L John Doe**

4. You will receive a message confirming that you are signed up.

If you have any questions, contact AHRQ QI Support at the e-mail noted above. You should receive an automatic response e-mail message confirming receipt. If you do not receive a confirmation message, call (888) 512-6090.

Appendix A: Links

The following links may be helpful to users of the AHRQ Quality Indicators:

http://www.qualityindicators.ahrq.gov/modules/iqi_resources.aspx
http://www.qualityindicators.ahrq.gov/modules/pdi_resources.aspx
http://www.qualityindicators.ahrq.gov/modules/pqi_resources.aspx
http://www.qualityindicators.ahrq.gov/modules/psi_resources.aspx
http://www.qualityindicators.ahrq.gov/software/default.aspx.

Table 28. AHRQ Quality Indicators Version 4.5 Documents and Software

TITLE	DESCRIPTION
IQI Technical Specifications PDI Technical Specifications PQI Technical Specifications PSI Technical Specifications	Provide detailed definitions of each indicator (including composites), including all ICD-9-CM and MS-DRG codes that are included in or excluded from the numerator and denominator. Note that exclusions from the denominator are automatically applied to the numerator.
IQI v4.5 Benchmark Data Tables PDI v4.5 Benchmark Data Tables PQI v4.5 Benchmark Data Tables PSI v4.5 Benchmark Data Tables	These documents provide the average volume, provider rate, and population rate, as appropriate, for each indicator.
Log of Changes to IQI Documents and Software Log of Changes to PDI Documents and Software Log of Changes to PQI Documents and Software Log of Changes to PSI Documents and Software	The Change Log document provides a cumulative summary of all changes to the software, software documentation, and other documents made since the release of version 2.1 of the software in March 2003. This document also summarizes changes to indicator definitions resulting from all fiscal year changes to ICD-9-CM coding and MS-DRG changes. Changes to indicator specifications that were not a result of new ICD-9-CM and MS-DRG codes are also described in the Change Log.
IQI Risk Adjustment Coefficient Tables PDI Risk Adjustment Coefficient Tables PQI Risk Adjustment Coefficient Tables PSI Risk Adjustment Coefficient Tables	Tables for each indicator provide the stratification and coefficients used to calculate the risk-adjusted rate for each stratum.
Quality Indicators Software Instruction	This software documentation provides detailed instructions on how to use the SAS® version of the software including data preparation, calculation of the rates, and interpretation of output.
SAS IQI Software SAS PDI Software SAS PQI Software SAS PSI Software	Requires the SAS® statistical program distributed by the SAS Institute, Inc. The company may be contacted directly regarding the licensing of its products: http://www.sas.com
Limited License edition of the 3M™ APR-DRG Grouper Version 30	Creates APR-DRG variables for use with SAS version of IQI software. Instructions for running the software are included in the Zip file.

TITLE	DESCRIPTION
AHRQ QI Population File	Population data that are constructed from public-use Census data and provided for use with the Quality Indicators syntax for area-level analyses.
Version 4.5 Listserv announcement	This document announces the release of Version 4.5 of the AHRQ QI software and documentation, and provides a summary of changes and links to relevant pages.
IQI User Guide: Composite Measures PDI User Guide: Composite Measures PQI User Guide: Composite Measures PSI User Guide: Composite Measures	These user guides provide technical overviews of the composite measures.

Windows QI Software Version 4.5

The Windows QI Software Version 4.5 calculates rates for all of the AHRQ QI modules and does not require SAS software. It is available at:

http://www.qualityindicators.ahrq.gov/software/default.aspx

Additional Documents

A number of documents are catalogued within the "Archive" section of the AHRQ QI Web page for historical purposes:

http://www.qualityindicators.ahrq.gov/Archive/default.aspx

Additional documents may be accessed at the AHRQ QI Modules Web page:

http://www.qualityindicators.ahrq.gov/modules/Default.aspx

Examples of documents available at this link include:
- AHRQ QI Measure Development, Implementation, Maintenance and Retirement
- ICD-9-CM to ICD-10-CM/PCS Conversion of AHRQ QI, March 2011
- AHRQ QI Empirical Methods, May 2011
- Guidance for Using the AHRQ Quality Indicators for Hospital-level Public Reporting or Payment, August 2004
- AHRQ Summary Statement on Comparative Hospital Public Reporting, December 2005
- Appendix A: Current Uses of AHRQ Quality Indicators and Considerations for Hospital-level
- Comparison of Recommended Evaluation Criteria in Five Existing National Frameworks
- List of AHRQ QI Endorsed by the National Quality Forum

Other documents, including newsletter archives, can be viewed or downloaded from the AHRQ QI News Web page:

http://www.qualityindicators.ahrq.gov/news/default.aspx
http://www.qualityindicators.ahrq.gov/Archive/News.aspx

Other Tools and Information

QI 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/about/geo/codes.html

AHRQ provides a free, on-line query system based on HCUP data that provides access to health statistics and information on hospital stays at the national, regional, and State level. It is available at:

http://hcupnet.ahrq.gov/

Information on the 3M™ APR-DRG system is available at:

http://solutions.3m.com/wps/portal/3M/en_US/3M_Health_Information_Systems/HIS/?WT.mc_id=www.3m.com/us/healthcare/his/

The CDC National Diabetes Surveillance System provides state level estimates of diabetes prevalence by age.

http://apps.nccd.cdc.gov/DDTSTRS/default.aspx

Appendix B: Using Different Types of QI Rates

When should you use the observed, expected, risk adjusted, and/or smoothed rates generated by the AHRQ QI software? Here are some guidelines.

If the user's primary interest is to identify cases for further 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 identify areas to focus on 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, MS-DRG and comorbidity categories).

If the observed 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), then the implication is that the provider performed worse than the reference population for that particular indicator. Users may want to focus on these indicators for quality improvement.

If the observed 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), then the implication is that the provider performed better than the reference population. Users may want to focus on these indicators for identifying best practices.

Users can also compare the expected rate to the reference population rate reported in the AHRQ QI software or Comparative Data document to determine how their case-mix compares to the reference population. The population rate refers to the overall rate for the reference population. The reference population is defined in the Comparative Data Document. 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.

We use 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 which 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 "shrinkage" rate to determine whether this 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 stability 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 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.

Appendix C: Data Dictionary

Table 29. QI Program Input Data Dictionary

VARIABLE NAME	DESCRIPTION	FORMAT	VALUE DESCRIPTION	COMMENTS
KEY	Sequence number. Unique case identifier.	Numeric	User defined unique numeric identifier for each discharge record	Used by the QI programs for sorting discharge records, and may facilitate possible exploration; allows user to link the records from the *XX*SAS1.SAS program output file back to the original input data file.
AGE	Age in years at admission	Numeric	Age in years	If this data element is missing the discharge record will be excluded from analysis.
AGEDAY	Age in days (coded only when the age in years is less than 1)	Numeric	Age in days	Not used in the IQI program. If not present in the input data file it is not necessary to create a placeholder variable for this module.
RACE	Race of patient.	Numeric 1 2 3 4 5 6	White Black Hispanic Asian or Pacific Island Native American Other	The values of 1-5 are used directly in the QI software. All other ethnicity codes are mapped to an 'other' category.
SEX	Sex of patient	Numeric 1 2	Male Female	If this data element is missing the discharge record will be excluded from the analysis.
PAY1	Expected primary payer	Numeric 1 2 3 4 5 6	Medicare Medicaid Private, incl. HMO Self-pay No charge Other	The values of 1, 2, 3, and 4 are used directly in the QI software. All other payer codes are mapped to an 'other' category This data element is used to stratify only the Provider-level IQI (01 to 25 and 30 to 34); Provider-level PDI (01 to 13); and Provider-level PSI (02 to 19).
PAY2 (SAS Only)	Expected secondary payer	Numeric 1 2 3 4 5 6	Medicare Medicaid Private, incl. HMO Self-pay No charge Other	Use is optional, but must be present in data (set to missing if data element not available)
PSTCO	Location of patient residence or hospital location (FIPS† State/county code)	Numeric ssccc	Modified Federal Information Processing Standards State/county code[1]	See Appendix A for link to most recent list of codes. If this data element is missing the discharge record will be excluded from rate calculations.

VARIABLE NAME	DESCRIPTION	FORMAT	VALUE DESCRIPTION	COMMENTS
HOSPID	Data Source hospital number	Numeric (default) or String[2]	Hospital identification number	Used to facilitate data exploration and possible trouble shooting. May also be selected as a stratifier (see Table 22 and Table 23 for provider-level aggregation possibilities).
DISP	Disposition of patient	Numeric 1 2 3 4 5 6 7 20	Routine Short-term hospital Skilled nursing facility Intermediate care Another type of facility Home health care Against medical advice Died in the hospital	The values 2 and 20 are referenced by the QI code (to identify transfers to another short-term hospital, and patients who died in the hospital). All other non-missing values are considered valid disposition codes. This convention is different from that of the AHRQ QI Windows application.
MORT30 (SAS Only)	30-Day Mortality Indicator	Numeric	0 – Did not die within 30-days from admission 1 – Died within 30-days from admission	Use is optional, but must be present in data (set to missing if data element not available)
DNR (SAS Only)	Do Not Resuscitate Indicator	Numeric	0 – No "Do Not Resuscitate" Indicator 1 – "Do Not Resuscitate" Indicator	Use is optional, but must be present in data (set to missing if data element not available)
ATYPE	Admission Type	Numeric 1 2 3 4 5 6	Emergency Urgent Elective Newborn Trauma Center[3] Other	Not used by the IQI or PQI programs. The values 3 and 4 are referenced by the PDI and PSI code (to identify elective surgeries and newborn admissions). PDI 8 and 9; PSI 10, 11, 13, and 17 will be affected if ATYPE values are missing.
ASOURCE	Admission Source	Numeric 1 2 3 4 5	ER Another hospital Another facility including LTC Court/law enforcement Routine/birth/other	The values 2 and 3 are referenced by the QI code (to identify transfers from another hospital or facility).
LOS	Length of Stay	Numeric	Number of days from admission to discharge	Not used by the IQI program.

VARIABLE NAME	DESCRIPTION	FORMAT	VALUE DESCRIPTION	COMMENTS
APR_DRG	APR-DRG category	Numeric	APR-DRG from 3M™ software.	Although program options allow the IQI module to operate without these variables, users should run APR-DRG software on their raw data to assign this variable to each case. See Section 5.3 on page 33. Not used by the PDI, PQI, or PSI programs. If not present in the input data file, it is not necessary to create a placeholder variable to run these three modules.
APRDRG_ RISK_ MORTALITY	APR-DRG Mortality Score	Numeric	APR-DRG Risk of Mortality Score from 3M™ software.	See Section 5.3 on page 33. Not used by the PDI, PQI, or PSI programs. If not present in the input data file, it is not necessary to create a placeholder variable to run these three modules.
XPRDRG_ RISK_ MORTALITY	APR-DRG Mortality Score with POA	Numeric	APR-DRG Risk of Mortality Score from 3M™ Software using POA information.	See Section 5.3 on page 33. Not used by the PDI, PQI, or PSI programs. If not present in the input data file, it is not necessary to create a placeholder variable to run these three modules.
DRG[4]	Medicare severity Diagnosis Related Group	Numeric	MS-DRG from federal (CMS) MS-DRG Grouper. The MS-DRG provided should account for present on admission (POA) data.	
DRGVER	Medicare severity Diagnosis Related Group Version	Numeric	Version of federal (CMS) MS-DRG Grouper	e.g., Version 30 for FY2013
MDC	Major Diagnostic Category	Numeric	MDC from federal (CMS) MS-DRG grouper	
DX1 – DX30	ICD-9-CM diagnosis codes. DX1 is the principal diagnosis, DX2-DX30 are secondary diagnoses.	String, 3, 4 or 5 characters (do not include decimal point)	Diagnosis codes	Users with more or fewer secondary diagnoses must modify the number of diagnoses in the parameter &NDX in CONTROL_XXI.SAS programs. The software can accept more than 30 diagnosis codes. The number provided here is the default. Seven of the PSI rely on External Cause of Injury codes (E-codes). If the data set contains E-codes in user-defined variables, these variables should be renamed to secondary diagnosis codes (e.g., E-codes would be labeled as DX10 in a data file where the last secondary DX field is DX9).
DXPOA1-DXPOA30-	Present on admission indicator for each diagnosis code	String	1 = present at the time of inpatient admission	These data will be used in risk adjustment and smoothing if the alternative parameter files of risk-adjustment covariates and population rates are specified.
			('Y','W','E','1')	
			0 = not present at the time of inpatient admission	
			('N','U','0',' ')	

VARIABLE NAME	DESCRIPTION	FORMAT	VALUE DESCRIPTION	COMMENTS
PR1 – PR30	ICD-9-CM procedure codes. PR1 is the principal procedure, PR2-PR30 are secondary procedures.	String, 3 or 4 characters (do not include decimal point)	Procedure code	Users with more or fewer secondary procedures must modify the parameter &NPR in CONTROL_*XX*I.SAS to reflect the number of procedures. The software can accept more than 30 procedure codes. The number provided here is the default.
POINTOFORIGINUB04	Point of Origin	String, 1 character	4 Transfer from a hospital 5 Transfer from a skilled Nursing Facility (SNF) or Intermediate Care Facility (ICF) 6 Transfer from another health care facility	Only these values are used by the QI programs.
			IF ATYPE = 4 (Newborn)	
			5 Born inside this hospital	
			6 Born outside of this hospital	
PRDAY1 – PRDAY30	Days from admission to procedure. PR1 is the principal procedure, PR2-PR30 are secondary procedures.	Numeric	Days from Admission to Procedure[5]	Not used by the PQI program. If not present in the input data file it is not necessary to create a placeholder variable for this module. Necessary variables if the user sets the &PRDAY parameter in CONTROL_*XX*I.SAS (for PDI, IQI, and PSI) to equal one. In this case, it is expected that the number of PRDAY variables agrees with the number of Procedure codes present. (See note below for method of calculation). These variables are not needed if the user sets the &PRDAY parameter in CONTROL_*XX*I.SAS to equal zero, indicating that there is no procedure day information available.
YEAR	Year of discharge. The patient's year of discharge. For example, a patient discharged on July 7, 2004 would have a discharge year of '2004.'	Numeric	YYYY	
			Discharge year should be within the range of 1997 to 2013.	
DQTR	Quarter of discharge. The calendar quarter of the patient's discharge. For example, a patient discharged on July 7, 2004 would have a discharge quarter of '3.'	Numeric	1 January-March 2 April-June 3 July-September 4 October-December	

[1] Federal Information Processing Standard, as defined by the U.S. Department of Commerce, National Institute of Standards and Technology (formerly National Bureau of Standards). Note: Certain independent cities (Baltimore City, Carson City and St. Louis City), and areas within Hawaii and Virginia, are assigned to different area groupings in the Modified FIPS categories as compared to the U.S. Census Bureau groupings. The AHRQ QI software uses the Modified FIPS code assignment of these areas. Failure to use the Modified FIPS codes assignment will result in the use of incorrect denominator estimates for area indicators. A list is available at http://www.census.gov/popest/geographic/codes02.pdf

[2] If HOSPID is not numeric, the user must modify the PRD*XX*P45.TXT file(s) and the *XX*SASP3.SAS programs to accommodate character values in this field, since the SAS code is written to handle numeric HOSPID values by default.

[3] The ATYPE value "5" was used to indicate delivery only in the 1988 to 1997 HCUP data files. The UB standards currently use "5" to indicate Trauma Center.

[4] See http://hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp.

[5] Variables PRDAY1 to PRDAY30 are defined as the number of days from date of admission to date of procedure for each procedure. For example, if the patient was admitted on June 15th and had two procedures - the principal procedure on June 15th and a second procedure on June 18th – then the value of PRDAY1 would be zero (0) and the value of PRDAY2 would be three (3). For more information, consult the HCUP data documentation at http://www.hcup-us.ahrq.gov/db/vars/prdayn/nisnote.jsp.

Appendix D: SAS Output Data Dictionaries

Table 30. SAS IQI Provider Output

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
Obs	Observation 1 (with HOSPID = "." or "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric	
HOSPID	Identifier for each provider in the dataset.	Text or Numeric	Depends on format of HOSPID in source data set
AGECAT	Age stratification category	Numeric range	
SEXCAT	Gender stratification category	Numeric	1 = male; 2 = female
PAYCAT	Payer stratification category	Numeric	1 = Medicare ; 2 = Medicaid ; 3 = Private, incl. HMO ; 4 = Self-pay ; 5 = No charge ; 6 = Other
RACECAT	Race stratification category	Numeric	1 = White ; 2 = Black ; 3 = Hispanic ; 4 = Asian or Pacific Island ; 5 = Native American ; 6 = Other
TPIQnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric	
PPIQnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric	
OPIQnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric	
EPIQnn	Rate calculated by assuming an "average" performance for each patient group based on the reference population, but with the provider's actual case-mix	Numeric	
RPIQnn	The estimated rate calculated by adjusting to an "average" case-mix	Numeric	When stratifications other than hospital or area are selected, the RPIQnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
LPIQnn	The lower confidence bound of the risk adjusted rate	Numeric	
UPIQnn	The upper confidence bound of the risk adjusted rate	Numeric	
SPIQnn	The smoothed rate calculated using multivariate signal extraction (MSX)	Numeric	
XPIQnn	Standard error of smoothed rate	Numeric	
VPIQnn	Variance for respective indicators	Numeric	

Table 31. SAS IQI Area Output

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
Obs	Observation 1 (with MAREA = "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric	
MAREA	Identifier in the dataset for area	Text	
TAIQnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric	
PAIQnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric	
OAIQnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric	
RAIQnn	The estimated rate calculated by adjusting to an "average" case-mix	Numeric	When stratifications other than hospital or area are selected, the RAIQnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables
SAIQnn	The smoothed rate calculated using multivariate signal extraction (MSX)	Numeric	

Table 32. SAS PDI Provider Output

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
Obs	Observation 1 (with HOSPID = "." or "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric	
HOSPID	Identifier for each provider in the dataset.	Text or Numeric	Depends on format of HOSPID in source data set
AGECAT	Age stratification category	Numeric range	
SEXCAT	Gender stratification category	Numeric	1 = male; 2 = female
PAYCAT	Payer stratification category	Numeric	1 = Medicare ; 2 = Medicaid ; 3 = Private, incl. HMO ; 4 = Self-pay ; 5 = No charge ; 6 = Other
RACECAT	Race stratification category	Numeric	1 = White ; 2 = Black ; 3 = Hispanic ; 4 = Asian or Pacific Island ; 5 = Native American ; 6 = Other
TPPDnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric	
PPPDnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric	
OPPDnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric	
EPPDnn	Rate calculated by assuming an "average" performance for each patient group based on the reference population, but with the provider's actual case-mix	Numeric	
RPPDnn	The estimated rate calculated by adjusting to an "average" case-mix	Numeric	When stratifications other than hospital or area are selected, the RPPDnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables
LPPDnn	The lower confidence bound of the risk adjusted rate	Numeric	
UPPDnn	The upper confidence bound of the risk adjusted rate	Numeric	

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
SPPDnn	The smoothed rate calculated using multivariate signal extraction (MSX)	Numeric	
XPPDnn	Standard error of smoothed rate	Numeric	
VPPDnn	Variance for respective indicators	Numeric	

Table 33. SAS PDI Area Output

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
Obs	Observation 1 (with MAREA = "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric	
MAREA	Identifier in the dataset for area	Text	
AGECAT	Age stratification category	Numeric range	
SEXCAT	Gender stratification category	Numeric	
PAYCAT	Payer stratification category	Numeric	
RACECAT	Race stratification category	Numeric	
TAPDnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric	
PAPDnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric	
OAPDnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric	
RAPDnn	The estimated rate calculated by adjusting to an "average" case-mix	Numeric	When stratifications other than hospital or area are selected, the RAPDnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables
SAPDnn	The smoothed rate calculated as a weighted average of the risk-adjusted and reference population rates	Numeric	

Table 34. SAS PQI Area Output

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
Obs	Observation 1 (with MAREA = "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric	
MAREA	Identifier in the dataset for area	Text	
TAPQnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric	
PAPQnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric	
OAPQnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric	
RAPQnn	The estimated rate calculated by adjusting to an "average" case-mix	Numeric	When stratifications other than hospital or area are selected, the RAPQnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables
LAPQnn	The lower confidence bound of the risk adjusted rate	Numeric	
UAPQnn	The upper confidence bound of the risk adjusted rate	Numeric	
SAPQnn	The smoothed rate calculated using multivariate signal extraction (MSX)	Numeric	
XAPQnn	Standard error of smoothed rate	Numeric	
EAPQnn	Rate calculated by assuming an "average" performance for each patient group based on the reference population, but with the provider's actual case-mix	Numeric	

Table 35. SAS PSI Provider Output

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
Obs	Observation 1 (with HOSPID = "." or "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric	
HOSPID	Identifier for each provider in the dataset.	Text or Numeric	Depends on format of HOSPID in source data set
AGECAT	Age stratification category	Numeric range	
SEXCAT	Gender stratification category	Numeric	1 = male; 2 = female
PAYCAT	Payer stratification category	Numeric	1 = Medicare ; 2 = Medicaid ; 3 = Private, incl. HMO ; 4 = Self-pay ; 5 = No charge ; 6 = Other
RACECAT	Race stratification category	Numeric	1 = White ; 2 = Black ; 3 = Hispanic ; 4 = Asian or Pacific Island ; 5 = Native American ; 6 = Other
TPPSnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric	
PPPSnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric	
OPPSnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric	
EPPSnn	Rate calculated by assuming an "average" performance for each patient group based on the reference population, but with the provider's actual case-mix	Numeric	
RPPSnn	The estimated rate calculated by adjusting to an "average" case-mix	Numeric	When stratifications other than hospital or area are selected, the RPPSnn variables and their confidence intervals are observed/expected ratios to avoid confounding with risk adjustment variables
LPPSnn	The lower confidence bound of the risk adjusted rate	Numeric	
UPPSnn	The upper confidence bound of the risk adjusted rate	Numeric	
SPPSnn	The smoothed rate calculated using multivariate signal extraction (MSX)	Numeric	

COLUMN HEADING	DESCRIPTION	FORMAT	COMMENTS
XPPSnn	Standard error of smoothed rate	Numeric	
VPPSnn	Variance for respective indicators	Numeric	

Table 36. SAS PSI Area Output

COLUMN HEADING	DESCRIPTION	FORMAT
Obs	Observation 1 (with MAREA = "") is the overall average for the entire dataset (TYPELVLP = 0). The remaining observations are individual providers, or hospitals (TYPELVLP = 16).	Numeric
MAREA	Identifier in the dataset for area	Text
TAPSnn	The number of discharge records included in the numerator (outcome of interest) as defined for the indicator	Numeric
PAPSnn	The number of discharge records included in the denominator (population at risk) as defined for the indicator	Numeric
OAPSnn	The rate (observed numerator/observed denominator) as defined for the indicator	Numeric

Appendix E: Provider-Level and Area-Level Indicators

Table 37. List of Provider-Level Indicators

INDICATOR NAME
IQI #1 Esophageal Resection Volume
IQI #2 Pancreatic Resection Volume
IQI #4 Abdominal Aortic Aneurysm (AAA) Repair Volume
IQI #5 Coronary Artery Bypass Graft (CABG) Volume
IQI #6 Percutaneous Coronary Intervention (PCI) Volume
IQI #7 Carotid Endarterectomy Volume
IQI #8 Esophageal Resection Mortality Rate
IQI #9 Pancreatic Resection Mortality Rate
IQI #11 Abdominal Aortic Aneurysm (AAA) Repair Mortality Rate
IQI #12 Coronary Artery Bypass Graft (CABG) Mortality Rate
IQI #13 Craniotomy Mortality Rate
IQI #14 Hip Replacement Mortality Rate
IQI #15 Acute Myocardial Infarction (AMI) Mortality Rate
IQI #16 Heart Failure Mortality Rate
IQI #17 Acute Stroke Mortality Rate
IQI #18 Gastrointestinal Hemorrhage Mortality Rate
IQI #19 Hip Fracture Mortality Rate
IQI #20 Pneumonia Mortality Rate
IQI #21 Cesarean Delivery Rate, Uncomplicated
IQI #22 Vaginal Birth After Cesarean (VBAC) Delivery Rate, Uncomplicated
IQI #23 Laparoscopic Cholecystectomy Rate
IQI #24 Incidental Appendectomy in the Elderly Rate
IQI #25 Bilateral Cardiac Catheterization Rate
IQI #30 Percutaneous Coronary Intervention (PCI) Mortality Rate
IQI #31 Carotid Endarterectomy Mortality Rate
IQI #32 Acute Myocardial Infarction (AMI) Mortality Rate, Without Transfer Cases
IQI #33 Primary Cesarean Delivery Rate, Uncomplicated
IQI #34 Vaginal Birth After Cesarean (VBAC) Rate, All
IQI #90 Mortality for Selected Procedures
IQI #91 Mortality for Selected Conditions
NQI #1 Neonatal Iatrogenic Pneumothorax Rate
NQI #2 Neonatal Mortality Rate
NQI #3 Neonatal Blood Stream Infection Rate
PDI #1 Accidental Puncture or Laceration Rate
PDI #2 Pressure Ulcer Rate
PDI #3 Retained Surgical Item or Unretrieved Device Fragment Count
PDI #5 Iatrogenic Pneumothorax Rate
PDI #6 RACHS-1 Pediatric Heart Surgery Mortality Rate
PDI #7 RACHS-1 Pediatric Heart Surgery Volume
PDI #8 Perioperative Hemorrhage or Hematoma Rate
PDI #9 Postoperative Respiratory Failure Rate
PDI #10 Postoperative Sepsis Rate
PDI #11 Postoperative Wound Dehiscence Rate
PDI #12 Central Venous Catheter-Related Blood Stream Infection Rate
PDI #13 Transfusion Reaction Count
PDI #19 Pediatric Patient Safety for Selected Indicators
PSI #2 Death Rate in Low-Mortality Diagnosis Related Groups (DRGs)
PSI #3 Pressure Ulcer Rate

INDICATOR NAME
PSI #4 Death Rate among Surgical Inpatients with Serious Treatable Complications
PSI #5 Retained Surgical Item or Unretrieved Device Fragment Count
PSI #6 Iatrogenic Pneumothorax Rate
PSI #7 Central Venous Catheter-Related Blood Stream Infection Rate
PSI #8 Postoperative Hip Fracture Rate
PSI #9 Perioperative Hemorrhage or Hematoma Rate
PSI #10 Postoperative Physiologic and Metabolic Derangement Rate
PSI #11 Postoperative Respiratory Failure Rate
PSI #12 Perioperative Pulmonary Embolism or Deep Vein Thrombosis Rate
PSI #13 Postoperative Sepsis Rate
PSI #14 Postoperative Wound Dehiscence Rate
PSI #15 Accidental Puncture or Laceration Rate
PSI #16 Transfusion Reaction Count
PSI #17 Birth Trauma Rate – Injury to Neonate
PSI #18 Obstetric Trauma Rate – Vaginal Delivery With Instrument
PSI #19 Obstetric Trauma Rate – Vaginal Delivery Without Instrument
PSI #90 Patient Safety for Selected Indicators

Table 38. List of Area-Level Indicators

INDICATOR NAME
IQI #26 Coronary Artery Bypass Graft (CABG) Rate
IQI #27 Percutaneous Coronary Intervention (PCI) Rate
IQI #28 Hysterectomy Rate
IQI #29 Laminectomy or Spinal Fusion Rate
PDI #14 Asthma Admission Rate
PDI #15 Diabetes Short-Term Complications Admission Rate
PDI #16 Gastroenteritis Admission Rate
PDI #17 Perforated Appendix Admission Rate
PDI #18 Urinary Tract Infection Admission Rate
PDI #90 Pediatric Quality Overall Composite
PDI #91 Pediatric Quality Acute Composite
PDI #92 Pediatric Quality Chronic Composite
PQI #1 Diabetes Short-Term Complications Admission Rate
PQI #2 Perforated Appendix Admission Rate[1]
PQI #3 Diabetes Long-Term Complications Admission Rate
PQI #5 Chronic Obstructive Pulmonary Disease (COPD) or Asthma in Older Adults Admission Rate
PQI #7 Hypertension Admission Rate
PQI #8 Heart Failure Admission Rate
PQI #9 Low Birth Weight Rate
PQI #10 Dehydration Admission Rate
PQI #11 Bacterial Pneumonia Admission Rate
PQI #12 Urinary Tract Infection Admission Rate
PQI #13 Angina Without Procedure Admission Rate
PQI #14 Uncontrolled Diabetes Admission Rate
PQI #15 Asthma in Younger Adults Admission Rate
PQI #16 Lower-Extremity Amputation among Patients with Diabetes Rate
PQI #90 Prevention Quality Overall Composite
PQI #91 Prevention Quality Acute Composite
PQI #92 Prevention Quality Chronic Composite
PSI #21 Retained Surgical Item or Unretrieved Device Fragment Rate
PSI #22 Iatrogenic Pneumothorax Rate
PSI #23 Central Venous Catheter-Related Blood Stream Infection Rate
PSI #24 Postoperative Wound Dehiscence Rate
PSI #25 Accidental Puncture or Laceration Rate
PSI #26 Transfusion Reaction Rate
PSI #27 Perioperative Hemorrhage or Hematoma Rate