The Johns Hopkins ACG® System

Technical User Guide

Version 8.2

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JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

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This document is provided as an information resource on measuring population morbidity for those with expertise in risk-adjustment models. The documentation should be used for informational purposes only. Information contained herein does not constitute recommendation for or advice about medical treatment or business practices.

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If users have questions regarding the software and its application, they are advised to contact the organization from which they obtained the ACG software. Questions about grants of rights or comments, criticisms, or corrections related to this document should be directed to the Johns Hopkins ACG team (see below). Such communication is encouraged.

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Third Party Library Acknowledgements

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Table of Contents

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1 Getting Started

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Introduction to The Johns Hopkins ACG® System

The ACG (Adjusted Clinical Groups) System was developed by faculty at the Johns Hopkins Bloomberg School of Public Health to help make health care delivery more efficient and more equitable. Because the ACG System can be used for numerous management, finance, and analytical applications related to health and health care, they have become the most widely used, population-based, case-mix/risk adjustment methodology. Precisely because of the diversity of ACG applications, one size does not fit all in terms of methodology. Like health management and analysis itself, using case-mix or risk adjustment methods involves art as well as science, and these applications are particularly context and objective driven. We hope this documentation will provide you with much of the guidance you will need in order to apply the ACG System to most effectively meet the risk adjustment and case-mix needs of your organization.

Objective of the Technical User Guide

The technical user guide was designed to assist analysts, programmers, or other personnel who are responsible for applying ACG functionality to data. The objective of this manual is to provide basic instructions on how to create and use data from which conclusions and decisions can be made.

Technical User Guide Navigation

Locating information in the technical user guide is facilitated by the following search methods:

- **Master Table of Contents**. The master table of contents contains the chapter names and principal headings for each chapter.
- **Chapter Table of Contents**. Each chapter has a table of contents, which lists the principal headings and subheadings and figures and tables.
- **Index**. Each chapter is indexed and organized alphabetically.

Technical User Guide Topics

The *Technical User Guide* contains chapters on the following subjects:

- **Chapter 1: Getting Started**. Provides a general overview of the physical organization of the manual as well as content.
- **Chapter 2: Release Notes**. Intended for all users, this chapter quickly summarizes the major enhancements included in Version 8.2.
- **Chapter 3: Selecting the Right Tool**. Intended for all users, this chapter provides a brief overview of the ACG toolkit and illustrates how the components might be combined for comparing population health or morbidity, used to demonstrate variability of cost within disease category, and for profiling, disease, case-management, predictive modeling and/or payment application.
- **Chapter 4: Basic Data Requirements**. Intended more for the programmer/analyst, this chapter discusses at a high level the minimum data input requirements and other necessary data requirements for performing ACG-based risk adjusted analyses. Included are discussions of augmenting or supplementing diagnosis information with optional user supplied flags as well as consideration of the use of pharmacy information.
- **Chapter 5: Installing and Using ACG Software**. Intended for the programmer/analyst, this chapter discusses the technical how-to of installing, using, importing and exporting data and reports.
- **Chapter 6: Assessing the ACG Grouper's Output**. Intended for those running the software, this chapter is intended to provide rudimentary advice on assessing ACG output.
- **Chapter 7: Making Effective Use of Risk Scores**. Intended for the programmer/analyst, the purpose of this chapter is to provide an overview of the risk scores or "weights" produced by the software and to provide assistance to the user as to how results might be improved or refined via customizing and the use of local cost data.
- **Chapter 8: Final Considerations**. A prelude to the *Reference Manual*, this final chapter of the *Technical User Guide*, highlights some of the key analytical and technical issues that affect both the framing and interpretation of analyses associated with the application of diagnosis-based risk adjustment in populations. Much of this discussion relates to forming a population for risk adjustment, determining which members to include and to exclude, and circumstances where sampling is appropriate.
- **Index**

Reference Manual Topics

For your convenience, a list of the *Reference Manual* chapters is provided.

- **Chapter 1: Getting Started**. Provides a general overview of the physical organization of the manual as well as content.
- **Chapter 2: Adjusted Clinical Groups (ACGs)**. This chapter provides a brief overview of the history of the clinical origin of the ACG System and describes the minutiae of the ACG assignment algorithm. .
- **Chapter 3: Clinical Aspects of ACGs**. Designed to provide more clinical contextual detail, this chapter also explains the ACG algorithm but does so using several clinical vignettes to help elucidate how ACGs work.
- **Chapter 4: Expanded Diagnosis Clusters (EDCs)**. The first section of this chapter explains the development and evolution of the EDC methodology while the second is dedicated to demonstrating how they might be used or combined with ACGs for disease or case-management applications.
- **Chapter 5: Predicting Future Resource Use with Diagnostic Data**. This chapter provides background information on the conceptual and clinical basis underlying predictive modeling and provides the history of the development of the ACG diagnostic-based predictive model (Dx-PM).
- **Chapter 6: Predicting Future Resource Use with Pharmacy Data**. This chapter describes the pharmacy based predictive model, Rx-PM, Also included is a discussion of how therapeutic classes are assigned to morbidity groups as well as how these groupings get incorporated into the model. Additionally, the combination model, the DxRx-PM, is presented. An appendix is provided for those wishing to locally calibrate.
- **Chapter 7: Predictive Modeling Statistical Performance**. This chapter demonstrates the ACG predictive models statistical performance while describing the various ways in which they can be applied in health care applications.
- **Chapter 8: Provider Performance Assessment**. This chapter outlines the basic steps to taking a population-based approach to practitioner profiling.
- **Appendix A: ACG Publication List**
- **Appendix B: Sample Listing of Common ICD-9-CM Diagnosis Codes Assigned to ADG Cluster**

- **Appendix C : Variables Necessary to Locally Calibrate the ACG Predictive Models**
- **Index**

Customer Commitment and Contact Information

As part of our ongoing commitment to furthering the international state-of-the-art of risk-adjustment methodology and supporting users of the ACG System worldwide, we will continue to perform evaluation, research, and development. We will look forward to sharing the results of this work with our user-base via white papers, our web site, peer-reviewed articles, and in-person presentations. After you have carefully reviewed the documentation supplied with this software release, we would welcome your inquiries on any topic of relevance to your use of the ACG System within your organization. (Technical support is available during standard business hours by contacting your designated account representative directly. If you do not know how to contact your account representative, please call 866-287-9243 or e-mail acg@dsthealthsolutions.com. We thank you for using the ACG System and for helping us to work toward meeting the Johns Hopkins University's ultimate goal of improving the quality, efficiency, and equity of health care across the United States and around the globe.

2 Release Notes

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Overview

This chapter discusses the enhancements incorporated into Version 8.2 of the Johns Hopkins ACG Software. To briefly summarize, Version 8.2 of the Johns Hopkins ACG Software includes a number of new enhancements which can be organized into a few broad categories: a) localization enhancements, b) technical enhancements, and c) documentation enhancements. Details on each change to the software are presented in the following sections.

Files created under Version 8.1 of the software may be opened in Version 8.2. When opening a file created with Version 8.1, the user will be prompted to upgrade the file. A copy of the original file will be saved with the file extension "acgd-saved-old-version." **Note:** If files created in Version 8.1 are upgraded to Version 8.2, then some summary statistics calculated at the time of file creation and new to Version 8.2 will be left blank.

Localization Enhancements

Version 8.2 of the Johns Hopkins ACG Software supports diagnoses based on ICD-9-CM and ICD-10-WHO coding standards. For pharmacy data, the software supports National Drug Codes (NDC) and Anatomical Therapeutic Chemical (ATC) classification systems for prescription drugs. Other references in the system are based on either a U.S. Elderly population or U.S. Non-elderly population as sourced from a national cross-section of managed care plans provided by PharMetrics, Inc., a unit of IMS, Watertown, MA.

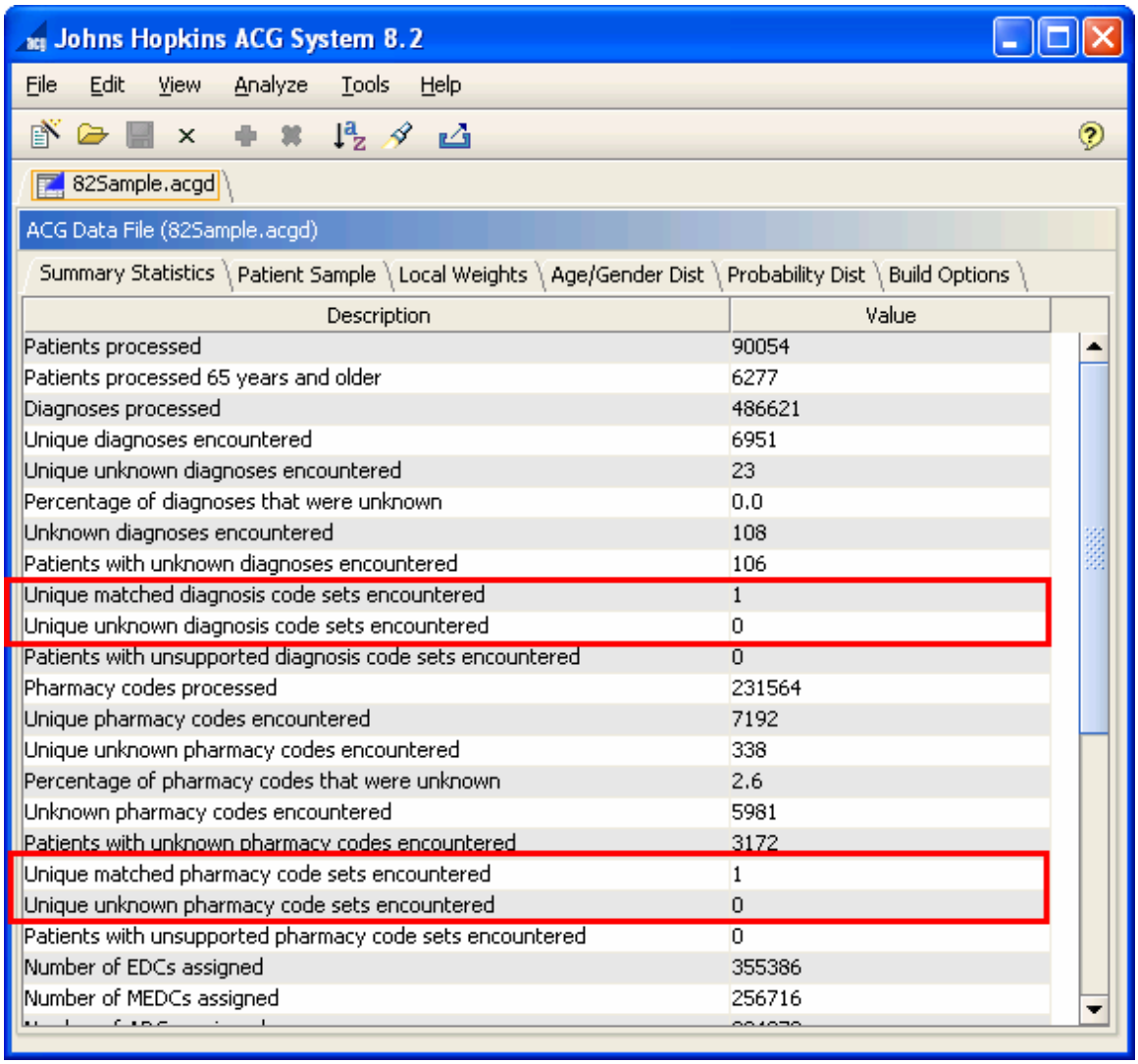
As the diversity of ACG users continues to grow globally and across new and unique product types, we have received many requests to calibrate the system to unique coding systems and data sources. The following enhancements represent technical changes that will provide for future flexibility in delivering new content. If you have a need to customize the ACG model to your environment, Version 8.2 will allow you to operationalize new models within the ACG Software. Please contact your distributor if you would like to discuss model customizations.

Code Sets

The ICD-9-CM, ICD-10-WHO and NDC coding standards that are currently supported by the ACG Software are updated via the web through a mapping file. This allows for code maintenance to occur without a reinstallation of the software. Beginning with Version 8.2, the ACG Software will not be constrained to diagnoses based on ICD-9-CM and ICD-10-WHO or pharmacy coding based on NDC classification. If you use local coding variants, e.g., Read codes in the United Kingdom or ICD-10-SGVB in Germany, please contact your distributor to determine if a country-specific or regional adaptation is available. Access to additional code sets is controlled via the mapping file and your license file.

Several additional fields were added to the Summary Statistics (reference **Figure 1**) to identify how many unique code sets were present in the data and used by the ACG Software.

Figure 1: Summary Statistics Tab



Description	Value
Patients processed	90054
Patients processed 65 years and older	6277
Diagnoses processed	486621
Unique diagnoses encountered	6951
Unique unknown diagnoses encountered	23
Percentage of diagnoses that were unknown	0.0
Unknown diagnoses encountered	108
Patients with unknown diagnoses encountered	106
Unique matched diagnosis code sets encountered	1
Unique unknown diagnosis code sets encountered	0
Patients with unsupported diagnosis code sets encountered	0
Pharmacy codes processed	231564
Unique pharmacy codes encountered	7192
Unique unknown pharmacy codes encountered	338
Percentage of pharmacy codes that were unknown	2.6
Unknown pharmacy codes encountered	5981
Patients with unknown pharmacy codes encountered	3172
Unique matched pharmacy code sets encountered	1
Unique unknown pharmacy code sets encountered	0
Patients with unsupported pharmacy code sets encountered	0
Number of EDCs assigned	355386
Number of MEDCs assigned	256716

Anatomical Therapeutic Chemical (ATC) Classification

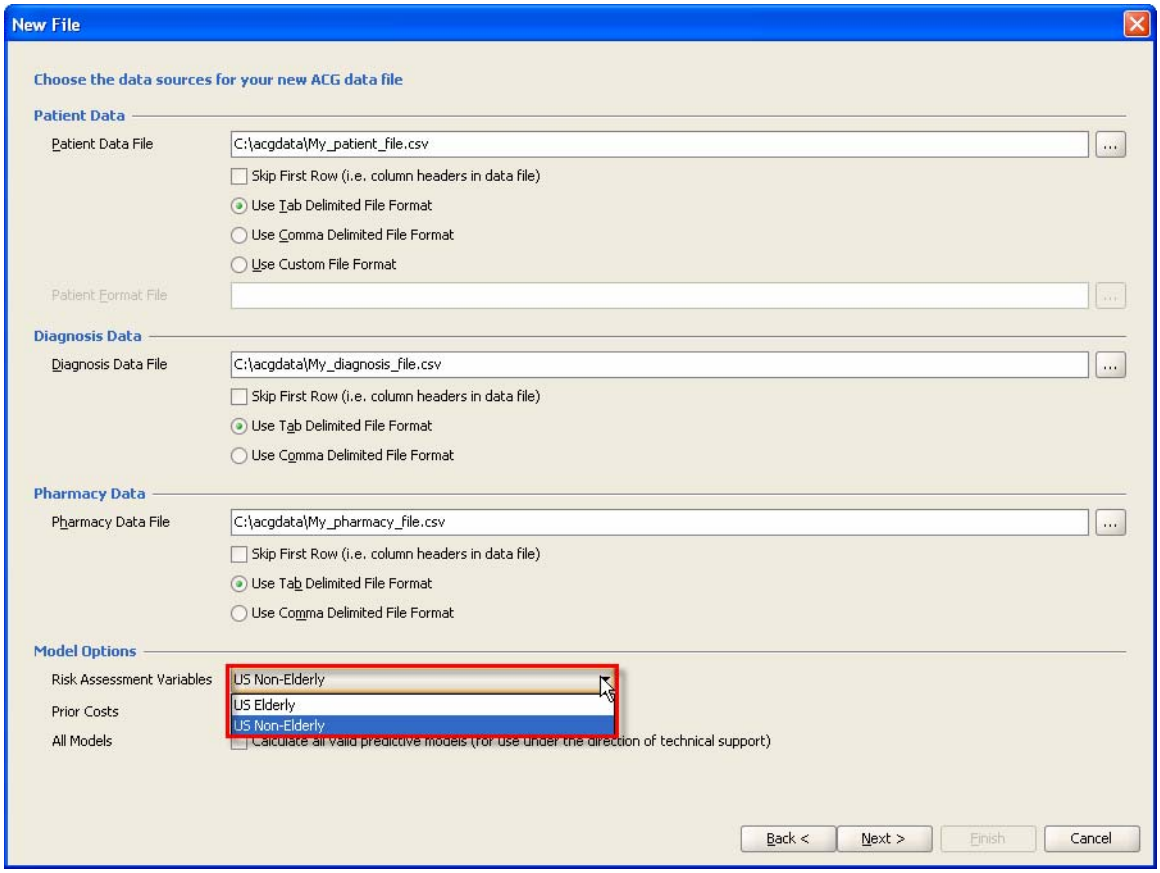
The use of ATC codes as a data source for the pharmacy predictive models (Rx-MGs and Rx-PM) has been tested with our international partners and is now available for licensing. Please contact your distributor.

Risk Assessment Variables

The ACG Software provides reference data through a number of output variables. Specifically, concurrent weights, predictive model coefficients and reference prevalence rates are based on external data aggregated from multiple U.S. health plans. The software currently provides two separate references, one for a U.S. elderly population and one for a U.S. non-elderly population. In Version 8.2, these external references have been renamed Risk Assessment Variables (RAVs) and are now delivered with the mapping files for ease of update. This change will also provide the capability to license additional references, or Risk Assessment Variables, in the future. Please contact your distributor if you would like to discuss the creation of Risk Assessment Variables based on your population.

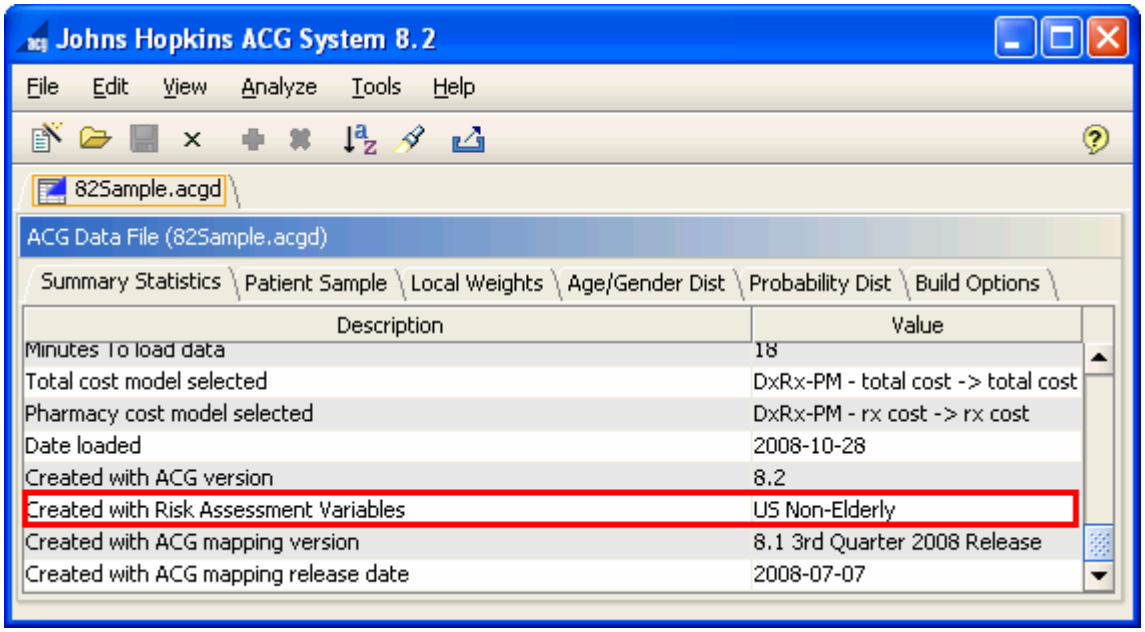
For all users, the selection of reference data for model calibration has changed to a drop-down box on the New File screen (reference **Figure 2**).

Figure 2: New File Screen



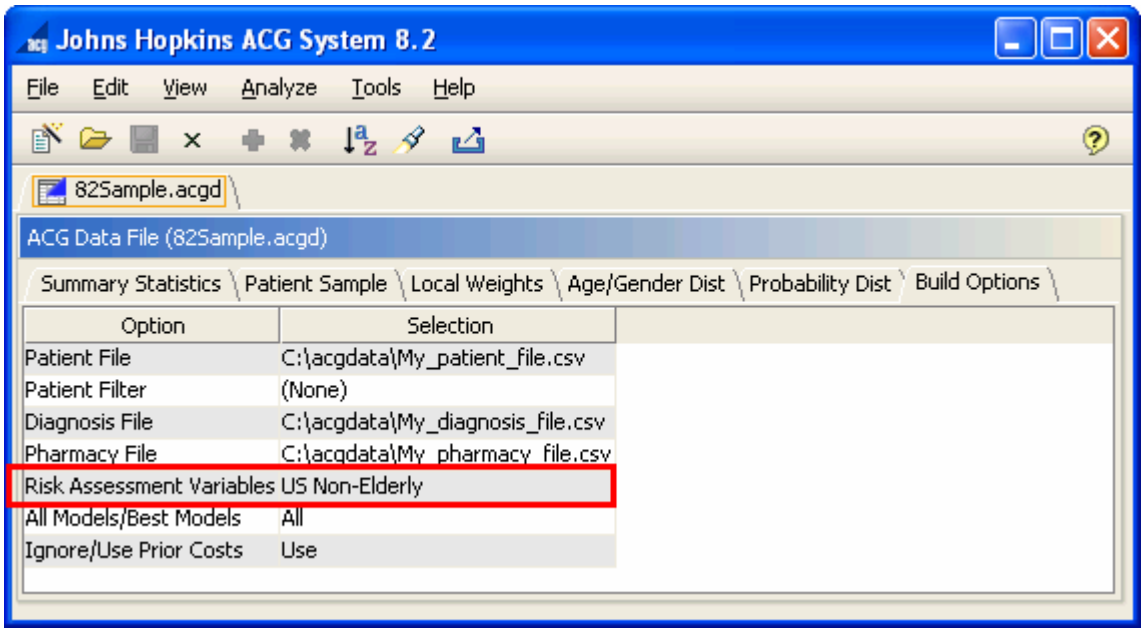
This Risk Assessment Variables used to process the data through the ACG System is stored with the ACG data file and recorded in the Summary Statistics tab (reference **Figure 3**).

Figure 3: Summary Statistics Tab



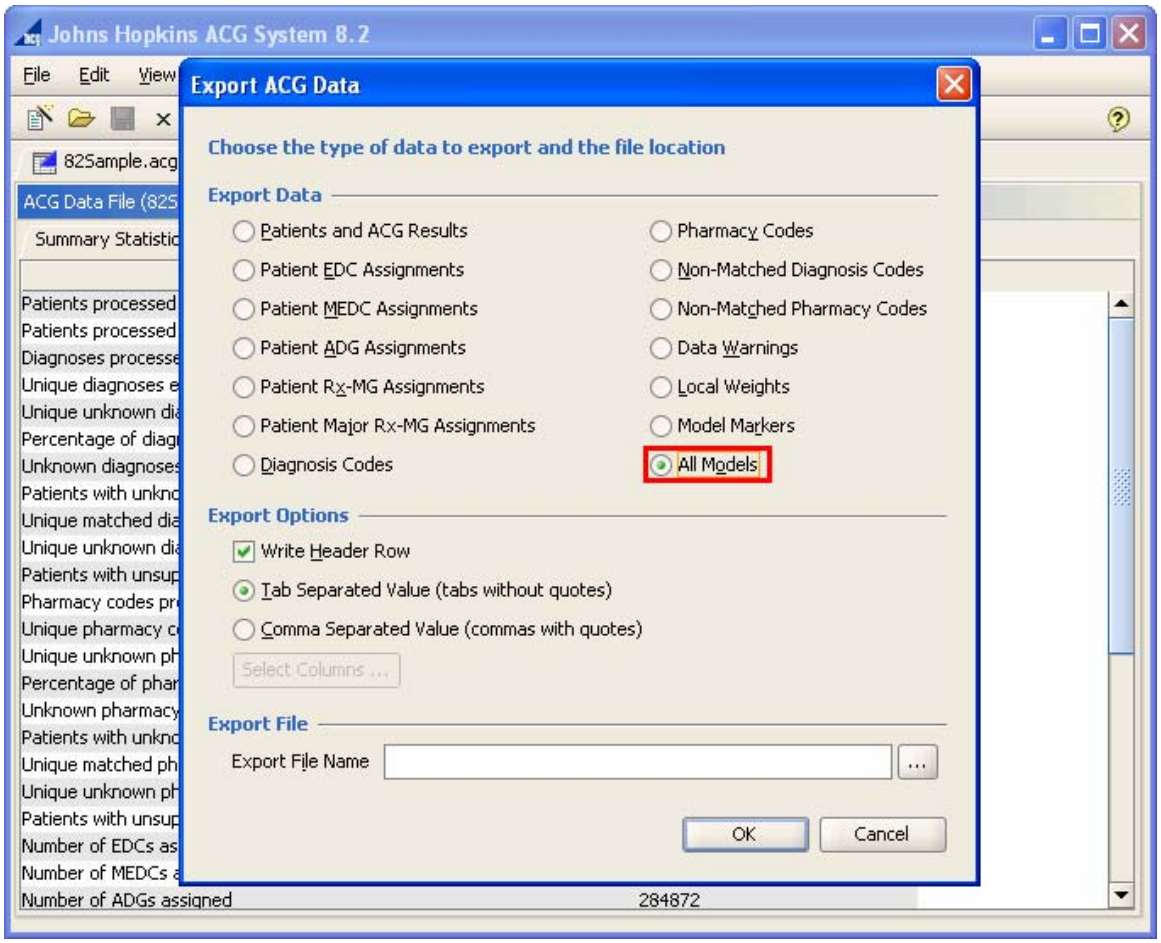
The Risk Assessment Variables are also stored with the Build Options for the ACG data file (reference **Figure 4**).

Figure 4: Build Options Tab



The change in model selection also prompted a change to the output of the All Models" file export option (reference **Figure 5**).

Figure 5: All Models File Export Option



This data file contains all possible predictive model scores for each patient. The previous format was 109 columns with 55 columns populated at one time based on the model selected. The columns presented in this file now represent the columns associated with the selected Risk Assessment Variables.

Enhanced License Management

The license file that is required for the operation of the software now considers the Code Sets and Risk Assessment Variables available to individual users in addition to the Predictive Models (Dx-PM, Rx-PM, DxRx-PM) that are licensed. Existing license files will provide continued access to currently licensed components in Version 8.2.

Label Changes

The new Risk Assessment Variables controlling concurrent ACG weights, predictive modeling scores, and prevalence rates are now customer-driven and may not always be based upon national data sets. Therefore, the Report Options and Report Columns have been changed to reflect Reference to describe the selected Risk Assessment Variables (reference **Figure 6** (below) and **Figure 7** on the next page).

Figure 6: Report Options Tab

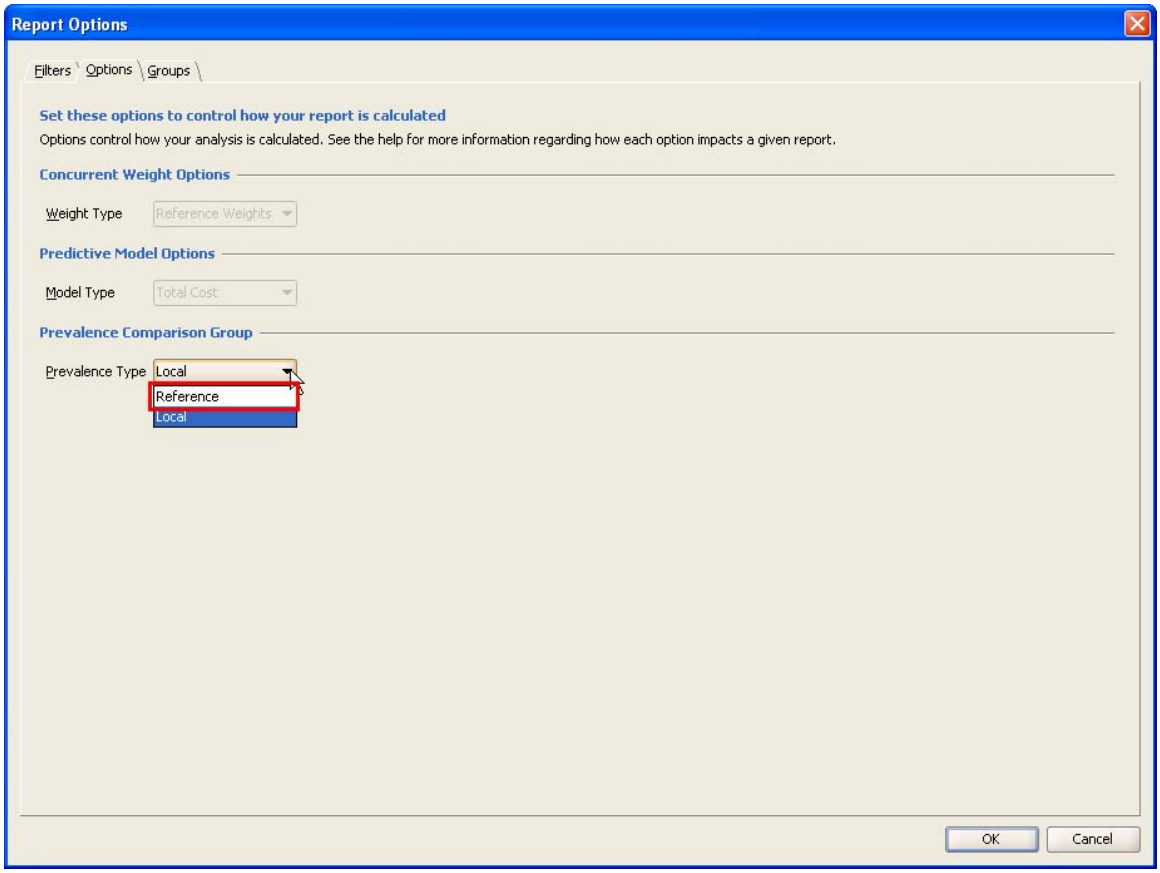
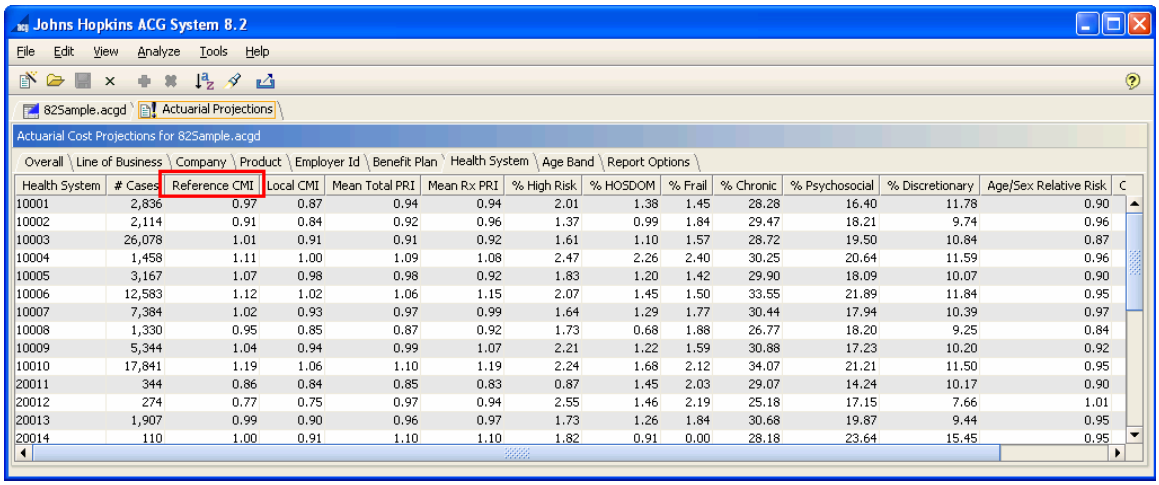


Figure 7: Reference Option Selection



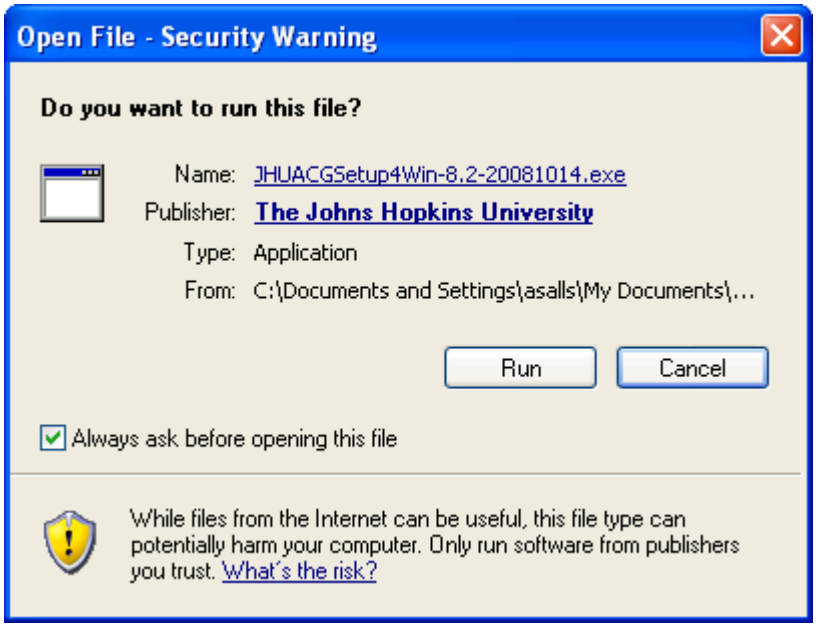
Health System	# Cases	Reference CMI	Local CMI	Mean Total PRI	Mean Rx PRI	% High Risk	% HOSDOM	% Frail	% Chronic	% Psychosocial	% Discretionary	Age/Sex Relative Risk
10001	2,836	0.97	0.87	0.94	0.94	2.01	1.38	1.45	28.28	16.40	11.78	0.90
10002	2,114	0.91	0.84	0.92	0.96	1.37	0.99	1.84	29.47	18.21	9.74	0.96
10003	26,078	1.01	0.91	0.91	0.92	1.61	1.10	1.57	28.72	19.50	10.84	0.87
10004	1,458	1.11	1.00	1.09	1.08	2.47	2.26	2.40	30.25	20.64	11.59	0.96
10005	3,167	1.07	0.98	0.98	0.92	1.83	1.20	1.42	29.90	18.09	10.07	0.90
10006	12,583	1.12	1.02	1.06	1.15	2.07	1.45	1.50	33.55	21.89	11.84	0.95
10007	7,384	1.02	0.93	0.97	0.99	1.64	1.29	1.77	30.44	17.94	10.39	0.97
10008	1,330	0.95	0.85	0.87	0.92	1.73	0.68	1.88	26.77	18.20	9.25	0.84
10009	5,344	1.04	0.94	0.99	1.07	2.21	1.22	1.59	30.88	17.23	10.20	0.92
10010	17,841	1.19	1.06	1.10	1.19	2.24	1.68	2.12	34.07	21.21	11.50	0.95
20011	344	0.86	0.84	0.85	0.83	0.87	1.45	2.03	29.07	14.24	10.17	0.90
20012	274	0.77	0.75	0.97	0.94	2.55	1.46	2.19	25.18	17.15	7.66	1.01
20013	1,907	0.99	0.90	0.96	0.97	1.73	1.26	1.84	30.68	19.87	9.44	0.95
20014	110	1.00	0.91	1.10	1.10	1.82	0.91	0.00	28.18	23.64	15.45	0.95

Technical Enhancements

Changes to Installation

The installation package was changed. In Windows environments, the installation now affirms The Johns Hopkins University as the publisher using a digital signature. If your installation does not indicate The Johns Hopkins University as the publisher, please contact your distributor (reference **Figure 8**).

Figure 8: The Johns Hopkins University Digital Signature



For Unix users, the installation no longer includes the Java Runtime. Your Unix administrator will need to install Java Runtime 1.6 or greater and have it accessible in the path for the ACG System to run correctly. The benefit of separating Java from the installation allows the Unix system administrator greater control over the Java runtime environment and allows the ACG software greater compatibility with regard to operating system patch levels.

Support for Vista

The new installation package now makes the ACG System compatible with Vista. Vista is now a supported platform.

Support for Larger ACGD Files

The data files created by the ACG System (.acgd files) are stored in a compressed format. Previous versions of the ACG System used a 32-bit compression tool and were limited to patient files that did not exceed 2 GB after compression, approximately 16 million members. The 32-bit compression tool has been replaced with a 64-bit compression tool allowing individual patient files of up to 2 TB, or approximately 16 billion members. This capacity is cut in half when the All Models selection is applied.

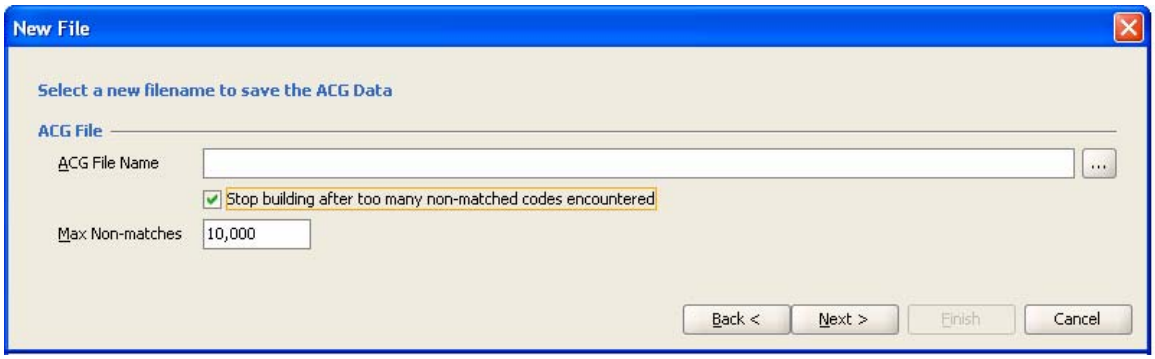
Application of Regional Settings

The ACG System will now use Windows regional settings to determine the format of numbers for importing. Previously, the ACG System would format numbers using the regional settings, but would fail to import numbers using a format other than a comma thousands separator or period decimal separator. The regional settings are accessible from the Windows control panel.

Mismatch Break

With Version 8.2, there are many variants of Models, Code Sets and Risk Assessment Variables all of which are licensed components. The New File screen (reference **Figure 9** on the following page) allows you to optionally set an error threshold so that processing is stopped in the event that the data does not match your license or an available code set.

Figure 9: New File Screen



Changes to the Output Format

The use of scientific notation in the export of very small values (e.g., local weights) was reported as an issue. All numeric outputs from the system will display all decimal values without the use of scientific notation.

Documentation Enhancements

A variety of improvements have been made to facilitate implementation of the ACG System.

- Technical User Guide, Chapter 4: Basic Data Requirements, has been expanded to describe the contents of Risk Assessment Variables and to describe the implementation of pharmacy-based predictive modeling using ATC Codes.
- Technical User Guide, Chapter 5: Installing and Using ACG Software, has been revised to reflect the latest application usage.
- Reference Manual, Chapter 6: Predicting Future Resource Use with Pharmacy Data, has been expanded to discuss how ATC codes have been applied within the system.

3 Selecting the Right Tool

Introduction

Targeted for both new and current users, this chapter offers a quick overview of the myriad ACG System applications and suggests how the various components of the System's toolkit can be combined to maximize their usefulness to you. This section also attempts to summarize some material that is presented elsewhere in our documentation. Where possible, links to more detailed discussion are noted.

One System, Many Tools, Many Solutions

The ACG System's suite of tools has been used to support basic and complex applications in finance, administration, care delivery, and evaluative research for over a decade. These applications have been both real-time (concurrent) and forward-looking (prospective). They may involve simple spreadsheet calculations or complex multi-variable statistical models. No other risk adjustment methodology has been used for so many purposes in so many places, while at the same time showing such high levels of quantitative and qualitative success. The flexibility offered by the ACG System demonstrates that we recognize that one size does not fit all. This also means that a bit of custom tailoring may be needed to get the best fit within your organization.

The following list provides potential uses and applications of The Johns Hopkins ACG System:

- Performance profiling of providers and assessing provider efficiency
- Rate setting, capitation payment and actuarial risk assessment
- Resource planning and program budgeting
- Clinical analysis, evaluation and research
- Quality improvement and outcome monitoring
- High-risk case identification (also known as predictive modeling)

Introduction to the Components of the ACG Toolkit

The Johns Hopkins ACG System is a suite of tools. Each tool is designed to assist organizations with understanding the health care needs of their population. Whether through simple categorical approaches, complex disease classification or sophisticated predictive modeling, the ACG System provides you with multiple solutions for addressing the many aspects of their business.

These are the components of the ACG System's toolkit:

Aggregated Diagnostic Groups (ADGs)

The first step in the ACG assignment process is to categorize every ICD-[1](9,9-CM,and 10) diagnosis code given to a patient into a unique morbidity grouping known as an "ADG." ADGs are the building blocks of the ACG System. Each ADG is a group of ICD diagnosis codes that are homogenous with respect to specific clinical criteria and their demand on healthcare services. The ADG categories reflect the entire spectrum of care, with certain ADGs indicating preventive care, while others assigned when specialty care is more likely. Patients with only one diagnosis over a time period are assigned only one ADG, while a patient with multiple diagnoses can be assigned to one or more ADGs:

- ***Example*:** A patient with both Obstructive Chronic Bronchitis (ICD-9-CM code 491.2) and Congestive Heart Failure (ICD-9-CM code 428.0) will fall into only one ADG, Chronic Medical: Unstable (ADG-11),

- ***Example*:** A patient with Candidiasis of Unspecified Site (ICD-9-CM code 112.9) and Acute Upper Respiratory Infections of Unspecified Site (ICD-9-CM code 465.9) will have two ADGs, Likely to Recur: Discrete Infections (ADG-8) and Time Limited: Minor-Primary Infections (ADG-2), respectively.

For more information on ADGs, please refer to the chapter in the *Reference Manual* entitled, "Clinical Aspects of ACGs."

[1] "ICD" stands for the World Health Organization "International Classification of Disease" coding system. The number reflects the version number. "CM" stands for "Clinical Modification", the version used in the United States.

Adjusted Clinical Groups[2] (ACGs)

ACGs are a series of mutually exclusive, health status categories that are defined by morbidity, age and sex. They are based on the premise that the level of resources necessary for delivering appropriate health care to a population is correlated with the illness burden of that population. This means that populations using the most health care resources reflect the interplay of co-morbidities and cannot be accurately characterized by a single disease assignment. These populations consist of individuals with multiple possibly unrelated conditions. The Johns Hopkins ACG Research Team arrived at the conclusion that the clustering of morbidity is a better predictor of health services resource use than the presence of specific diseases. This conclusion is the fundamental concept that differentiates ACGs from other case-mix adjustment methodologies.

For more information on ACGs, please refer to the chapter in the *Reference Manual* entitled, "Clinical Aspects of ACGs."

Expanded Diagnosis Clusters (EDCs)

Each assigned ICD code maps to a single EDC. ICD codes within an EDC share similar clinical characteristics and are expected to evoke similar types of diagnostic and therapeutic responses. The main criterion used for the ICD-to-EDC assignment is diagnostic similarity. Codes that refer to the same disease or condition are grouped together. As broad groupings of diagnosis codes, EDCs help to remove differences in coding behavior between practitioners. Each EDC is classified into one of 27 broad clinical categories, termed a Major EDC (MEDC). MEDCs may further aggregated into five MEDC types (Administrative, Medical, Surgical, Obstetric/Gynecologic, Psychosocial) providing a concise way of summarizing all diagnosis codes.

- ***Example*:** There are 56 ICD-9-CM codes that practitioners can record as a diagnosis for otitis media. The EDC for otitis media combines these codes into a single rubric. EDCs identify patients with specific diseases and are applicable to both pediatric and adult populations.

For more information on EDCs, please refer to the chapter in the *Reference Manual* entitled, "Expanded Diagnosis Clusters (EDCs)."

[2] Formerly, "Ambulatory Care Groups."

Rx-Defined Morbidity Groups (Rx-MGs)

Rx-defined Morbidity Groups (Rx-MGs) classify NDC codes into unique clinical groupings that are the building blocks of the Rx Predictive Model. In addition to the generic drug (active ingredient), the route of administration is a key variable in determining the Rx-MG. Rx-MGs group drugs that are similar in terms of morbidity, duration, stability and therapeutic goal. For example, drugs in the class of corticosteroids may be delivered orally, topically, by injection or inhaled to reduce inflammation. The route of administration is a key consideration in determining whether the drug is being used to treat joint conditions such as arthritis, respiratory conditions such as asthma, or to treat allergic reactions.

There are 60 Rx-MGs organized within 19 broad clinical categories. Of the 60 categories, approximately half represent highly differentiated groupings that indicate a clinical condition. For example, proton pump inhibitors are classified into the Rx-MG GASx060 - Gastrointestinal/Hepatic / Peptic Disease. These condition-specific designations were used only when there was a very strong correlation between drug and disease and when there were no substantive off-label uses of the drug. The remaining categories are more generalized groupings and indicate the general action of the drug in addition to the duration, stability and/or therapeutic goal. For example, anti-diarrheals, laxatives and antacids are classified within Rx-MG GASx010 – Gastrointestinal/Hepatic / Acute Minor.

For more information on Rx-MGs, please refer to the chapter in the *Reference Manual* entitled, “Predicting Future Resource Use with Pharmacy Data.”

Adjusted Clinical Group – Predictive Modeling (ACG PM)

Predictive modeling, also known as high-risk case identification, allows healthcare organizations to target patients who would benefit from case management, a personalized, interactive process to manage disease preventively before it results in costly care. With the cost of healthcare rising each year, predictive modeling can help align premium levels with the risk of the employer group. Because the ACG System can stratify members within a disease category, health plans can adjust care and resources to match the degree of care needed. If, for instance, a health plan has a concentration of women over a certain age with diabetes, the ACG system stratifies the women by risk, allowing the health plan to assess higher-risk women. Once identified, the plan may direct healthcare personnel and administrators to proactively monitor diet and other indicators that can prevent major complications, a version of case management.

The ACG System has a suite of predictive modeling tools: the Dx-PM (formerly called ACG-PM), based on diagnosis codes, the Rx-PM, based on drug codes, and the combined DxRx-PM, which uses both diagnostic and medication information to provide the most comprehensive idea of a patient's future health care use. The *Reference Manual* chapters five through seven provide an overview of predictive modeling and its application in the healthcare arena, as well as detailed information about the development and use of the ACG System's predictive modeling tools. Chapter 5, "Predicting Future Resource Use with Diagnostic Data" focuses on clinical and conceptual challenges facing predictive modeling and introduces the diagnosis-bases Dx-PM while Chapter 6, "Predicting Future Resource Use with Pharmacy Data" provides an overview of the pharmacy based Rx-PM and discusses the benefits of combining both ICD and Rx information sources in the DxRx-PM. The series closes with Chapter 7, "Predictive Modeling Statistical Performance," which discusses some key considerations in evaluating model performance and provides some simple validation statistics of the various ACG predictive models.

The ACG System allows you to better understand and explain the health of populations. The System's various diagnosis-based risk assessment markers provide a useful means for comparing the morbidity of different subpopulations of interest to you. Additional pharmacy-based markers can also identify morbidity characteristics of a population. Pharmacy data is typically available much sooner than diagnosis information. Simple descriptive analyses like those shown in the following sample tables compare the distribution of morbidity across selected population groupings. These are offered as models for how you may wish to apply our System to describe the morbidity characteristics of those cared for by your organization.

Table 1: Comparison of ADG Distribution across Two Enrollee Groups

ADG	Description	Total	Group 1	Group 2
1	Time Limited: Minor	14.7%	14.8%	14.4%
2	Time Limited: Minor -Primary Infections	32.2%	33.2%	27.4%
3	Time Limited: Major	5.5%	4.0%	12.3%
4	Time Limited: Major-Primary Infections	6.1%	5.1%	10.6%
5	Allergies	3.6%	3.6%	3.3%
6	Asthma	4.4%	4.2%	5.0%
7	Likely to Recur: Discrete	8.6%	6.6%	17.2%
8	Likely to Recur: Discrete-Infections	20.7%	22.0%	14.9%
9	Likely to Recur: Progressive	2.0%	0.8%	7.7%
10	Chronic Medical: Stable	12.9%	7.4%	37.1%
11	Chronic Medical: Unstable	8.6%	4.0%	28.8%
12	Chronic Specialty: Stable-Ortho	0.9%	0.5%	2.8%
13	Chronic Specialty: Stable-ENT	0.7%	0.6%	1.4%
14	Chronic Specialty: Stable-Eye	2.6%	2.0%	5.3%
15	No Longer in Use	0.0%	0.0%	0.0%
16	Chronic Specialty: Unstable-Ortho	0.8%	0.4%	2.4%
17	Chronic Specialty: Unstable-ENT	0.0%	0.0%	0.1%
18	Chronic Specialty: Unstable-Eye	1.6%	0.8%	5.2%
19	No Longer in Use	0.0%	0.0%	0.0%
20	Dermatologic	4.5%	4.4%	5.0%
21	Injuries/Adverse Effects: Minor	10.8%	10.2%	13.7%
22	Injuries/Adverse Effects: Major	9.3%	8.1%	14.3%
23	Psychosocial: Time Limited, Minor	3.5%	3.0%	5.5%
24	Psychosocial: Recur or Persist: Stable	9.8%	7.4%	20.3%
25	Psychosocial: Recur or Persist: Unstable	5.8%	2.5%	20.1%
26	Signs/Symptoms: Minor	16.9%	15.3%	24.4%
27	Signs/Symptoms: Uncertain	17.5%	14.1%	32.3%
28	Signs/Symptoms: Major	14.8%	11.6%	28.9%
29	Discretionary	5.8%	4.8%	10.4%
30	See and Reassure	1.8%	1.3%	3.8%
31	Prevention/Administrative	43.5%	46.7%	29.5%
32	Malignancy	1.0%	0.3%	4.0%
33	Pregnancy	2.2%	2.6%	0.3%
34	Dental	1.4%	1.4%	1.7%

Table 1 illustrates how ADGs, the building blocks of the ACG System, can quickly demonstrate differences in types of morbidity categories across sub-groupings within your organization. In this example, the case-mix profile of Group 2 tends to be more complex than that of Group 1, with the prevalence of the chronic medical and psychosocial ADGs being especially high.

An advantage of ADGs is that they can quickly identify clinically meaningful morbidity trends that may be obscured at the disease-specific or relative morbidity index levels.

Another approach to describing a population's health or contrasting morbidity between population sub-groupings would be to compare ACG categorical cell distributions. Here one is typically looking for different prevalence rates or frequencies within certain ACG cells (e.g., pregnancy categories, non-user categories, infant). While useful as a drilldown approach for understanding the "why" of differences between groups, the number of ACGs (93+ groups depending on user specified options), may be slightly too cumbersome for comparing/contrasting morbidity between population sub-groupings.

To simplify things, the ACG System Software will automatically assign a six-level (Low to High) simplified morbidity category termed a Resource Utilization Bands, or RUB. The six RUBs are formed by combining the ACG mutually exclusive cells that measure overall morbidity burden.

Utilizing the RUB categories, **Table 2** demonstrates how a simple RUB-based analysis highlights differences in the distribution of morbidity of the Group 1 and Group 2 exemplary subpopulations. Confirming the impression drawn from Table 1, the Group 2 population clusters in the bands associated with higher overall morbidity burdens.

Table 2: Percentage Distribution of Two Subgroups by Resource Utilization Band (RUB) Categories

RUB Category	Total	Group 1	Group 2
1 - Non-users	25.8%	35.6%	22.5%
2 - Healthy Users	13.9%	17.5%	11.1%
3 - Low Morbidity	28.3%	30.1%	25.0%
4 - Moderate	27.6%	13.8%	33.5%
5 - High	3.7%	2.5%	7.4%
6 - Very High	0.7%	0.5%	1.5%

Through use of disease-specific EDCs a standardized morbidity ratio analysis is now available (See the chapter entitled, "Expanded Diagnosis Clusters (EDCs)" in the *Reference Manual* for additional details on interpreting this table.) Table 3 shows an example of this analysis based on the major subheadings of Expanded Diagnosis Clusters. This report presents MEDC level disease prevalence of a subpopulation of interest after taking into account the age and sex mix of the group relative to either the underlying population or a national comparison group. The user can determine the population to be used for comparison by using the report options when the analysis is run. The analysis is also available by individual EDC; thus, the morbidity ratio report will assist you in isolating statistically significant (demographically adjusted) disease category differences within a subpopulation of interest.

The diagnostic/morbidity distribution reports outlined here should be useful for many clinically oriented applications within your organization. These could include population clinical needs assessments and targeting where disease management or outreach programs might be developed.

Table 3: Observed to Expected Standardized Morbidity Ratio (SMR) by Major EDC (MEDC)

Major EDC Description	Observed Prevalence Per 1,000 Population	Age-Sex Expected Prevalence per 1,000	Standard Morbidity Ratio (SMR)	Approximate 95% confidence interval Low	High
Administrative	269.87	280.93	0.961	0.952	0.969
Allergy	75.56	63.50	1.190	1.169	1.211
Cardiovascular	86.29	79.18	1.090	1.072	1.108
Dental	6.65	7.60	0.876	0.824	0.927
Ears, Nose, Throat	172.29	211.01	0.817	0.807	0.826
Endocrine	40.65	31.44	1.293	1.262	1.324
Eye	54.53	121.67	0.448	0.439	0.457
Female reproductive	88.28	81.09	1.089	1.071	1.106
Gastrointestinal/Hepatic	67.47	57.13	1.181	1.159	1.203
General Signs and Symptoms	80.15	70.37	1.139	1.120	1.158
General Surgery	108.65	100.40	1.082	1.066	1.098
Genetic	0.25	0.24	1.045	0.729	1.360
Genito-urinary	50.53	48.01	1.053	1.030	1.075
Hematologic	11.49	10.53	1.091	1.042	1.139
Infections	28.20	36.80	0.766	0.744	0.788
Malignancies	14.01	11.10	1.263	1.212	1.314
Musculoskeletal	164.24	184.12	0.892	0.881	0.903
Neurologic	66.96	58.69	1.141	1.120	1.162
Nutrition	10.04	10.86	0.924	0.880	0.969
Psychosocial	51.25	40.68	1.260	1.233	1.287
Reconstructive	24.36	27.22	0.895	0.867	0.922
Renal	8.87	5.27	1.684	1.598	1.770
Respiratory	126.73	140.04	0.905	0.893	0.917
Rheumatologic	14.72	12.44	1.183	1.136	1.230
Skin	144.07	149.81	0.962	0.950	0.974
Toxic Effects	4.49	5.51	0.815	0.756	1.309
Unassigned	128.37	99.34	1.292	1.275	1.309

A similar prevalence analysis is available based upon the Rx-Morbidity Groups. This analysis presents prevalence of treated conditions within a subpopulation of interest after taking into account the age and sex mix of the group relative to either the underlying population or a national comparison group. The user can determine the population to be used for comparison by using the report options when the analysis is run. This analysis identifies prevalence of very specific patient populations, such as insulin-dependent diabetics, medicated hypertension patients or patients on anti-depressants. The benefit in using prescriptions to define conditions is that certain conditions are under-coded by diagnosis. This is particularly true for depression, for example, where Rx-MGs possibly provide a truer prevalence identified by the use of anti-depressants.

Table 4: Observed to Expected Standardized Morbidity Ratio (SMR) by Rx-Morbidity Group (Rx-MG)

Rx-MG Description	Observed Prevalence Per 1,000 Population	Age-Sex Expected Prevalence per 1,000	Standard Morbidity Ratio (SMR)	Approximate 95% confidence interval Low	High
Allergy / Immunology / Acute Minor	83.21	68.96	1.207	1.159	1.254
Allergy / Immunology / Chronic Inflammatory	54.06	46.13	1.172	1.115	1.229
Cardiovascular / Chronic Medical	26.78	24.61	1.088	1.013	1.164
Cardiovascular / Congestive Heart Failure	9.29	8.50	1.093	0.965	1.222
Cardiovascular / High Blood Pressure	112.07	108.48	1.033	0.998	1.068
Cardiovascular / Hyperlipidemia	79.17	74.01	1.070	1.027	1.113
Cardiovascular / Vascular Disorders	14.04	13.18	1.065	0.963	1.167
Ears, Nose, Throat / Acute Minor	18.89	15.71	1.202	1.103	1.301
Endocrine / Bone Disorders	15.61	13.57	1.151	1.046	1.255
Endocrine / Chronic Medical	30.26	26.85	1.127	1.053	1.200
Endocrine / Diabetes With Insulin	9.09	9.86	0.922	0.812	1.031
Endocrine / Diabetes Without Insulin	22.40	21.97	1.020	0.943	1.097
Endocrine / Thyroid Disorders	36.41	34.79	1.046	0.984	1.109
Eye / Acute Minor: Curative	44.93	37.00	1.215	1.150	1.279
Eye / Acute Minor: Palliative	15.78	12.46	1.267	1.152	1.381
Female Reproductive / Hormone Regulation	90.97	83.16	1.094	1.053	1.135
Gastrointestinal/Hepatic / Acute Minor	22.23	19.04	1.168	1.079	1.256
Gastrointestinal/Hepatic / Peptic Disease	58.77	50.25	1.170	1.115	1.224
General Signs and Symptoms / Nausea and Vomiting	21.90	15.90	1.377	1.271	1.482
General Signs and Symptoms / Pain	168.43	143.55	1.173	1.141	1.206
General Signs and Symptoms / Pain and Inflammation	99.60	85.12	1.170	1.128	1.212
Genito-Urinary / Acute Minor	21.76	17.33	1.256	1.160	1.353

Rx-MG Description	Observed Prevalence Per 1,000 Population	Age-Sex Expected Prevalence per 1,000	Standard Morbidity Ratio (SMR)	Approximate 95% confidence interval Low	High
Infections / Acute Minor	366.25	320.47	1.143	1.121	1.164
Neurologic / Migraine Headache	23.17	18.89	1.226	1.135	1.318
Neurologic / Seizure Disorder	24.84	21.03	1.181	1.096	1.266
Psychosocial / Attention Deficit Hyperactivity Disorder	23.40	21.24	1.102	1.020	1.183
Psychosocial / Anxiety	37.95	31.57	1.202	1.132	1.272
Psychosocial / Depression	130.69	113.13	1.155	1.119	1.191
Psychosocial / Acute Minor	15.41	12.04	1.280	1.163	1.397
Psychosocial / Chronic Unstable	8.12	7.36	1.104	0.966	1.243
Respiratory / Acute Minor	66.93	58.99	1.135	1.085	1.184
Respiratory / Chronic Medical	5.12	4.98	1.027	0.864	1.189
Respiratory / Airway Hyperactivity	84.35	71.80	1.175	1.129	1.221
Skin / Acne	29.69	25.29	1.174	1.097	1.251
Skin / Acute and Recurrent	92.47	78.99	1.171	1.127	1.214

Health Status Monitoring

Monitoring the health status of a population may be desirable for purposes of setting health policy or demonstrating value to health purchasers. As a population ages, health may be expected to decline, but interventions to improve population health may improve or reverse that trend. The ACG System describes population health in a unique, aggregate way that can be trended over time.

In the example below, the case-mix for the population demonstrates a sharp increase in case-mix from 1.02 to 1.17. Using a "movers analysis," Resource Utilization Bands which stratify the population into low, moderate and high morbidity categories, can be used to show changing morbidity patterns within a population (see Table 5). For example, in the prior period there were 758 patients assigned to the low morbidity category – 405 of these individuals stayed in the low morbidity category, 329 moved to the moderate morbidity bucket and 24 moved to the high morbidity bucket. For those who went from low to high, their average cost went from $2,333 to $14,183. Similarly, there were 2271 moderate morbidity patients in the prior period. Roughly half stayed the same and slightly less then half moved to low morbidity categories, but 10% moved to high morbidity categories and tripled their resource use.

Table 5: Movers Analysis—Tracking Morbidity Burden Over Time

		Current Period (Case Mix = 1.17)		
		Low Morbidity	**Moderate Morbidity**	**High Morbidity**
Prior Period (Case-Mix =1.02)	**Low Morbidity**	405 12.0% P: $618 C: $1,382	329 9.7% P: $705 C: $1,512	24 0.7% P: $2,383 C: $14,183
	Moderate Morbidity	986 37.6% P: $2,116 C: $2,549	1074 41.0% P: $2,123 C: $1,844	211 8.1% P: $3,599 C: $9,507
	High Morbidity	130 5.0% P: $11,060 C: $6,539	94 3.6% P: $10,035 C: $2,554	124 4.7% P: $11,577 C: $9,947

Provider Performance Assessment

Profiles such as those summarized below are a useful tool for evaluating performance and allocating resources for a wide range of ACG users. The most common profiling activities include:

- Financial exchange between organizations and providers
- Provider efficiency assessment
- Resource planning
- Access to care evaluation
- Fraud, waste, and abuse detection
- Quality of care assessment

Profiling Resource Use

One of the most popular uses of the ACG System Software is to set risk-adjusted resource consumption norms for subgroups of patients/members within an organization. These norms are compared to actual resource use in order to profile provider efficiency and to develop performance reports to help suggest where over-use and under-use may be a problem.

Profiling applications are very amenable to simple actuarial cell strategies for risk adjustment. Most users apply the ACG mutually exclusive cells for this purpose while others have chosen to combine ACGs and use RUBs for these applications. The simpler RUB method is sometimes selected when the population's numbers are small or when the need to communicate the inner-workings of the methods to a wide audience of providers is critical.

If you have historical claims data (or other similar data sources), it is generally preferable to calculate "local" expected resource use values for each ACG (or RUB) for each resource measure of interest (e.g., total cost, hospital use, specialist referrals, pharmacy) based on actual patterns of practice within your organization. If such data are unavailable or inadequate, then the relative weights supplied as part of the ACG Software can be used as a proxy. See the chapter entitled, "Making Effective Use of Risk Scores," in the *Technical User Guide* for a detailed discussion of relevant methodological issues related to weight calculation.

Table 6 presents a summary of the most common profiling statistics:

1. The actual to group average resource use (unadjusted efficiency ratio). This is a measure of how the profiling group compares to the average population.

2. The expected to plan average (the case-mix index or morbidity factor). This provides an indication of how sick the profiling population is compared to the average population.

3. The actual to expected average resource use (efficiency ratios). The observed-to-expected ratio (O/E Ratio) provides an indication of how many health care resources were consumed by this group compared to how many resources they would have consumed had they utilized the average resource use of the population based on their case-mix characteristics.

All three of these statistics are expressed as relative values with the average or normative value centered at 1.0. Scores greater than 1.0 indicate higher than average whereas those less than 1.0 indicate lower than average. Tests of statistical significance can be developed to assess outlier status. Clearly the use of risk adjustment provides a dramatically different basis for assessing the performance of the three profiled sites. For additional information, see the chapter entitled, "Provider Performance Assessment," in the *Reference Manual*.

Table 6: Comparison of Observed to Expected Visits and Calculation of Three Profiling Ratios

	Visits	Site A	Site B	Site C
1	Actual Visits per person **(Observed)**	5.35	6.10	6.90
2	Plan Average	5.50	5.50	5.50
3	Actual to Group Average* **(Unadjusted Efficiency Ratio)**	0.97	1.11	1.26
4	Number of Expected Visits**	4.30	6.25	5.54
5	Expected to Plan Average*** **(Morbidity Factor)**	.78	1.14	1.01
6	Observed to Expected Ratio**** **(Adjusted Efficiency Ratio)**	1.24	0.98	1.25
*	Row 1 divided by Row 2			
**	Expected based on ACG characteristics at each site			
***	Row 4 divided by Row 2			
****	Row 1 divided by Row 4			

Evaluating Productivity and Distributing Workload

In addition to efficiency assessment, case-mix adjustment is vital to the evaluation of physician productivity. Physicians may be under pressure to reduce the duration of visits in order to increase the number of daily visits performed. This can be counter-productive when the physician's panel is more complex. Communication with the patient about primary and secondary prevention, medication adherence and treatment decisions are key to the successful management of a patient with multiple co-morbid conditions. Time and discussion with the patient is needed to identify a patient's psychosocial problems or a lack of support at home. Additional time with a patient can also improve patient satisfaction and may even reduce utilization of laboratory tests, consultations and medications. Case-mix adjustment is key to understanding the differences in physician productivity.

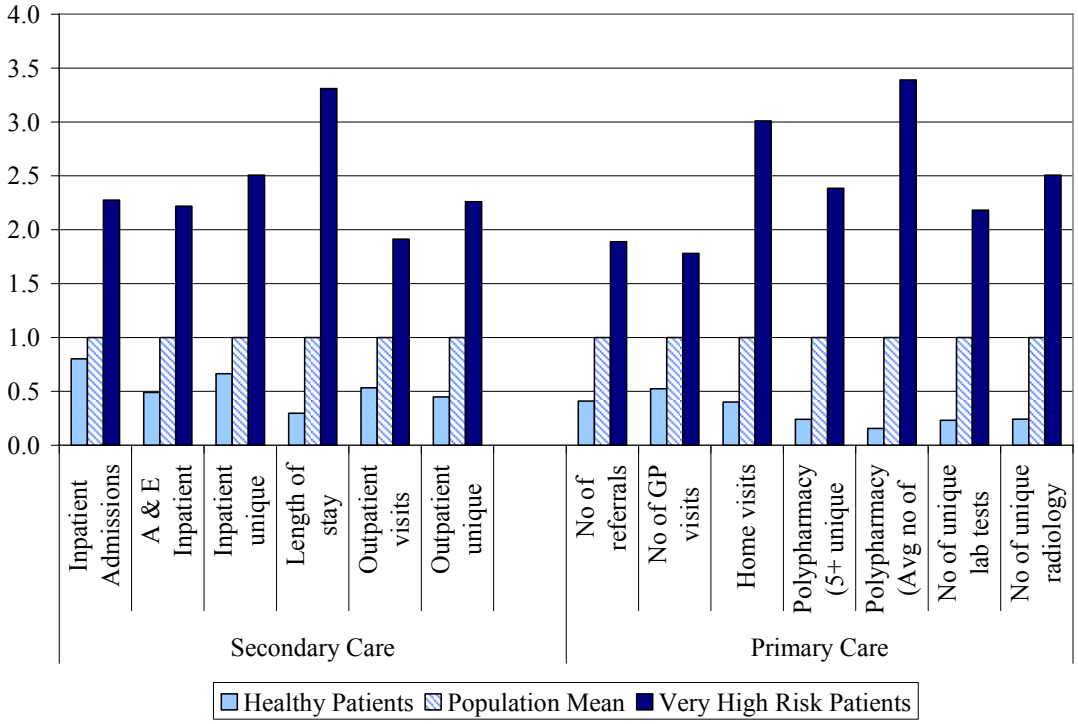
Table 7: Comparison of Characteristics Affecting Physician Productivity

	Panel 1	Panel 2
Average Patient Age	36	36
% Female	39.6%	77.0%
Average Case-Mix	0.86	1.23
% patients with ≥1 hospital dominant condition	1.0%	1.9%
% patients with ≥3 chronic conditions	7.3%	30.7%
% patients with frailty condition	1.3%	2.5%
% patients with >2 major ADGs	1.6%	2.3%
% patients with psycho-social condition	11.5%	21.7%
Average # EDCs	5.3	6.5
Average # Rx-MGs	2.5	3.3
Average visit length	13.6 min	20.4 min

Quality of Care Assessment

Case-mix adjustment is relevant in population-based assessments of provider clinical performance where there is a plausible basis for results to vary among patients with different levels of morbidity burden. Many long-standing performance assessment programs, such as those promulgated by the National Committee on Quality Assurance and the Joint Commission on the Accreditation of Healthcare Organizations, have long focused on process metrics only because there is little basis to believe that the provision of specific services should differ in populations that differ by case-mix. The steady rise in pay-for-performance initiatives and balanced scorecards for health care providers has been accompanied by the steady expansion of performance assessments to include outcome metrics. There is a strong basis of evidence that health outcomes do vary by case-mix and that these metrics need some form of case-mix adjustment to ensure appropriate comparisons between health care providers. When performance assessment is focused on specific diseases there is a tendency to look for case-mix or severity adjustment that is tailored to the specific disease. There are numerous risks to such a disease-oriented performance assessment strategy, not the least of which is that there are often insufficient numbers of cases for an accurate assessment and that such a disease orientation will encourage care practices that are not holistic. Some pay for performance programs have chosen to roll up disease-specific metrics into an overall summary measure that is less prone to the problem of small numbers and also broadens the quality focus. In such cases, ACGs used as RUBs or Dx-PM risk scores will work quite effectively as case-mix adjusters. Indeed, prior work has shown that ACGs do an excellent job of adjusting for differences in case-mix for commonly used outcome indicators such as re-hospitalizations and even mortality. **Table 8** shows how outcomes can vary dramatically between groups characterized as low or high risk based upon Dx-PM risk score.

Table 8: Percentage of Patients with Selected Outcomes by ACG PM Risk Group



FROM PILOTING AND EVALUATING CASE-MIX AND PREDICTIVE MODELLING MEASURES WITHIN THE BRITISH PRIMARY CARE SECTOR, FEB 2007

Care Management and "Predictive Modeling:" Providing Information for Disease and Care Managers

As discussed previously, concurrent ACG/RUB morbidity information can be combined with EDCs to control for morbidity differences across a given disease-specific group of interest (e.g., diabetics enrolled in a disease management program). EDCs are useful in portraying the disease characteristics of a population of interest. Within disease management programs, if significant differences in expected resource consumption exist across the morbidity subclasses, this analytic approach is useful for better targeting interventions towards subgroups at higher risk.

The ACG Software produces tables in which each row represents persons falling into EDC (or MEDC) disease-specific categories; the columns array these individuals into RUB co-morbidity categories according to their ACG assignment. **Table 9** presents the percentage distribution for a series of selected EDCs across the five RUB categories. **Table 10** presents the expected relative resource use within each RUB and illustrates co-morbidity's profound influence on resource use within individual disease groups. The ACG-based RUBs do a very good job of explaining variations in resource use within specific diseases. For additional detail on interpreting or building similar tables please refer to the chapter entitled "Expanded Diagnosis Clusters (EDCs)" in the *Reference Manual*.

Table 9: Percentage Distribution of Each Co-Morbidity Level Within an EDC (Samples)

EDC	Description	RUB-1 Very Low	RUB-2 Low	RUB-3 Average	RUB-4 High	RUB-5 Very High
ADM02	Surgical aftercare	4.7	19.3	46.6	18.9	10.4
ADM03	Transplant status	3.8	7.7	32.9	26.6	29.1
ALL01	Allergic reactions	0.0	36.2	53.6	8.5	1.6
ALL03	Allergic rhinitis	0.0	34.5	56.0	8.2	1.3
ALL04	Asthma, w/o status asthmaticus	0.0	23.6	63.2	10.7	2.5
ALL05	Asthma, with status asthmaticus	0.0	20.9	58.0	15.6	5.4
ALL06	Disorders of the immune system	0.0	6.5	47.6	25.5	20.4
CAR04	Congenital heart disease	0.0	17.4	45.9	23.9	12.4
CAR05	Congestive heart failure	0.0	0.4	36.6	31.1	31.9
CAR06	Cardiac valve disorders	0.0	7.6	59.1	22.2	11.1
CAR07	Cardiomyopathy	0.0	2.2	43.8	30.1	23.9
CAR08	Heart murmur	12.3	25.8	44.5	11.9	5.4

EDC	Description	RUB-1 Very Low	RUB-2 Low	RUB-3 Average	RUB-4 High	RUB-5 Very High
CAR09	Cardiac arrhythmia	0.0	3.7	58.4	24.5	13.3
CAR10	Generalized atherosclerosis	0.0	7.0	43.7	25.4	23.9
CAR11	Disorders of lipoid metabolism	0.0	17.3	68.0	10.4	4.2
CAR12	Acute myocardial infarction	0.0	0.2	21.3	39.3	39.2
CAR13	Cardiac arrest, shock	0.0	5.4	19.2	31.2	44.2

You can develop your own reports, and the EDCs that define the rows in Tables 5 and 6 could be replaced by episodes of illness categories that an organization may obtain from other sources. ACG-based RUBs are equally effective in explaining variations in resource use within episodes of care.

Table 10: Estimated Concurrent Resource Use by RUB by MEDC (Samples)

EDC	Description	RUB-1 Very Low	RUB-2 Low	RUB-3 Average	RUB-4 High	RUB-5 Very High
ADM02	Surgical aftercare	0.20	0.63	2.31	7.94	27.30
ADM03	Transplant status	0.20	0.65	2.39	8.23	29.89
ALL01	Allergic reactions	0.00	0.54	2.07	7.49	25.41
ALL03	Allergic rhinitis	0.00	0.54	2.13	7.43	25.40
ALL04	Asthma, w/o status asthmaticus	0.00	0.62	2.03	7.43	26.10
ALL05	Asthma, with status asthmaticus	0.00	0.62	2.13	7.50	28.23
ALL06	Disorders of the immune system	0.00	0.74	2.39	7.71	29.63
CAR04	Congenital heart disease	0.00	0.73	2.20	7.11	25.56
CAR05	Congestive heart failure	0.00	0.81	2.62	8.30	28.83
CAR06	Cardiac valve disorders	0.00	0.56	2.42	7.86	27.10
CAR07	Cardiomyopathy	0.00	0.73	2.37	8.23	28.69
CAR08	Heart murmur	0.21	0.64	2.22	7.20	23.05
CAR09	Cardiac arrhythmia	0.17	0.61	2.37	8.07	25.82
CAR10	Generalized atherosclerosis	0.00	0.46	2.47	8.23	27.06
CAR11	Disorders of lipoid metabolism	0.00	0.49	2.29	8.17	25.14
CAR12	Acute myocardial infarction	0.00	0.82	1.85	7.87	26.28
CAR13	Cardiac arrest, shock	0.00	0.62	2.12	7.74	27.84

High-Risk Case Identification for Case Management

The suite of ACG Predictive Models, includes the Dx-PM, based on diagnosis codes, the Rx-PM, based on drug codes, and the combined DxRx-PM, which uses both diagnostic and medication information. These represent a real advance if you want to establish or augment care management programs within your organization. Existing ACG measures have many applications in this domain as well.

There are a great number of variants within the ACG predictive models. You can select a model based on data source (diagnosis, pharmacy or both), calibration data (elderly or non-elderly) and prior cost (total cost, pharmacy cost or no prior cost). In general, the accuracy of the predictive model will increase as more information is made available. Therefore, a model that uses diagnosis, pharmacy and prior cost will be more predictive than a model based only on pharmacy claims without prior cost. There is still good reason to implement the pharmacy only model. Pharmacy data is fairly complete after 90 days and there is generally minimal lag. As new enrollees are brought on to the plan, rapid risk assessment can be performed on these members using Rx-PM. The minor differences in predictive accuracy are compensated for by the gains in time for intervention. The ACG predictive modeling suite provide choices that allow you to select the model that best fits your application.

Using just a single month of claim's data, **Table 11** demonstrates the benefit of the ACG Rx-PM model.

Table 11: Amount of Data and Its Impact on Model Performance

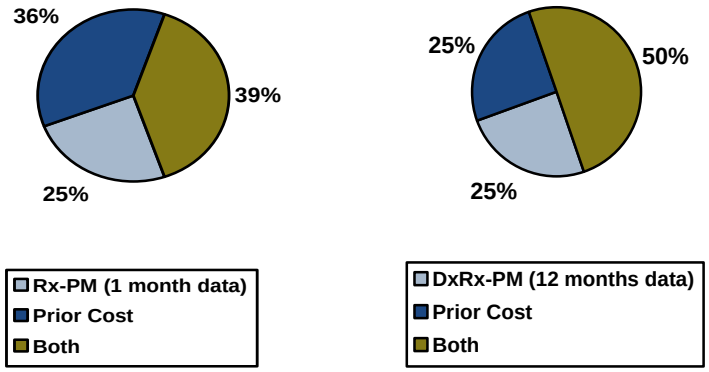
Data and Model	C-Statistic
1 Month Rx	0.774
3 Months Rx	0.784
6 Months Rx	0.784
12 Months Rx	0.782
12 Months Rx+Dx+Prior Cost	0.831

There are many ways to adapt the ACG predictive models in the pursuit of improved patient care. This section provides a summary and overview of some of the recommended approaches that an organization may wish to consider in the care-management and quality improvement (QI) domains.

ACG predictive modeling provides information at the individual patient level to help identify persons who potentially would be well served by special attention from the organization's care management infrastructure. This high-risk case identification process could be used to target a person for interventions such as a referral to a case-manager, special communication with the patient's physician, structured disease management programs, or educational outreach. There are several benefits to this approach to case selection:

- The various clinical categories and markers from the system provide a comprehensive patient profile that can improve the productivity of the screener
- A rapid assessment can be performed on the whole population, not just those being referred through other programs
- Predictive modeling helps to identify a unique population of members at risk
  - By identifying members that are complex and co-morbid, but not necessarily currently high cost, you identify a population that is more open to care management services and therefore, higher case open rates are seen using ACG predictive models as a referral tool. This is a productivity improvement for the care management staff as well.
  - Approximately 25% of the members correctly identified as high risk by an ACG predictive model were not previously high cost. This percentage seems to hold regardless of the model – Dx-PM, Rx-PM or DxRx-PM. When using Rx-PM, this percentage holds true with as little as 1 month of data.
  - **Figure 1** illustrates two pie charts providing a comparison by percentage of high cost members correctly identified using prior cost,Dx-PM and DxRx-PM models. The two charts contrast the difference between making predictions using just one month of pharmacy data versus making predictions using twelve months of diagnosis+pharmacy data. While the Rx-PM model works well on as little as one month of data, the accuracy of predictive modeling improves as the quality of the underlying data (as measured by diagnoses and pharmacy data) improves. Using Dx-PM and Rx-PM as independent assessments of risk can yield even more information for a care manager.

Figure 1: Percent Correctly Identified as High Cost; Comparing One-Month of Rx to 12-Months of Dx+Rx



- The Rx-MGs can supplement the EDCs in describing the clinical conditions of the patient. Depression and hypertension, in particular, may not be part of the diagnoses, but will be captured in the prescriptions. If these patients are tracked over time and there is a pattern of prescriptions without visits, communication with the member and provider may be helpful.

◢ Pharmacy identifies additional members with specific conditions as compared to diagnosis alone as demonstrated in **Figure 2**.

Figure 2: Percent of Patients Identified by ICD or NDC or Both

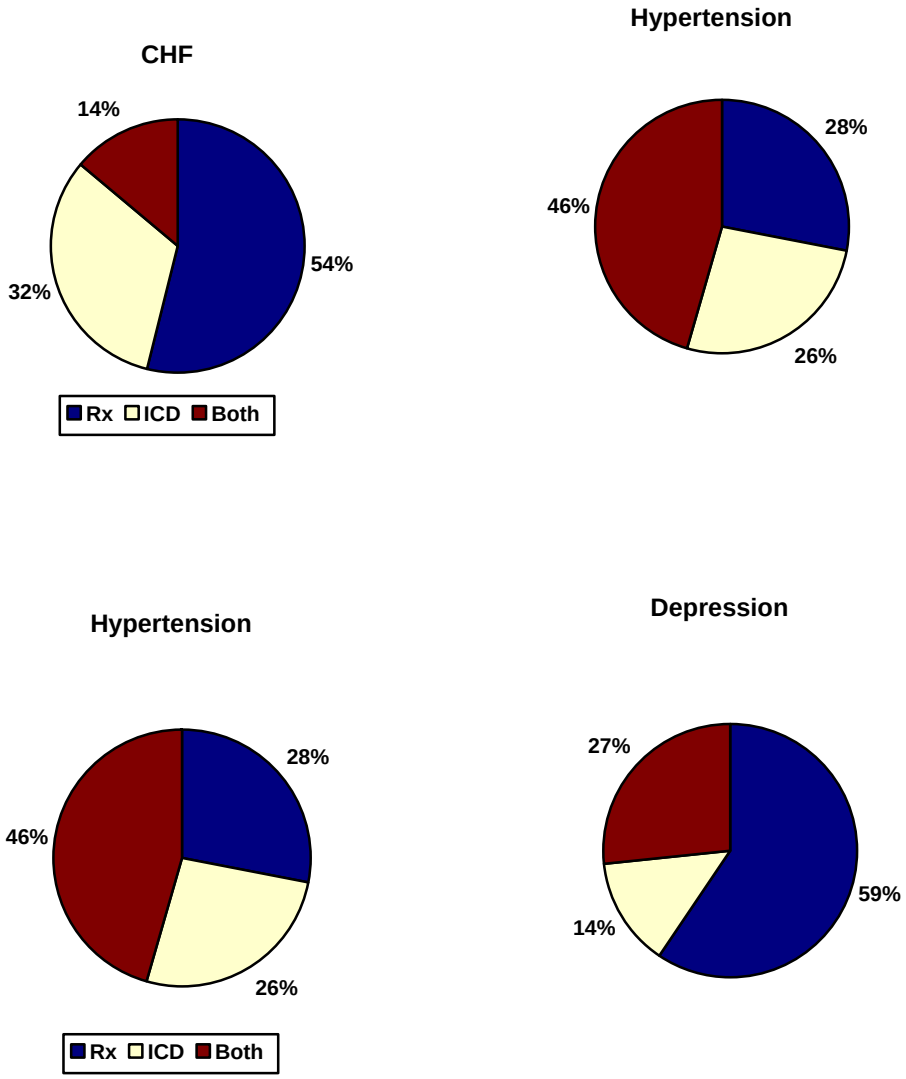
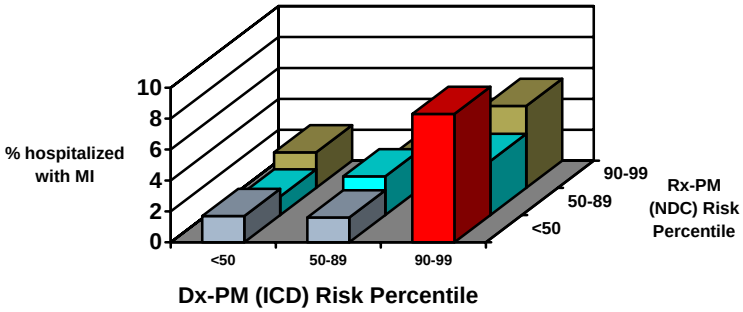


Figure 3 shows the value of evaluating members with discordant scores based on diagnosis and pharmacy. Both the Dx-PM and Rx-PM scores were grouped into percentiles to indicate high, medium and low risk. Those members with high risk as defined by Dx-PM were more likely to be hospitalized, especially when they were low risk as defined by Rx-PM. The combination of scores may provide insight into the under-treatment or non-compliance of particular populations.

Figure 3: Combining Rx and Dx Predictive Modeling Scores for Targeted Intervention



The ACG predictive models include reports providing disease-specific (based on selected individual and aggregated EDCs and/or pharmacy based morbidity categories (Rx-MGs)) distributions of risk probability scores and average expected resource use for different risk cohorts. An example of such a report for The Johns Hopkins ACG Dx-PM model, shown as **Table 12**, will be useful in helping to frame a strategy for targeting various risk cohorts within disease management programs.

Table 12: Number of Cases and The Johns Hopkins ACG Dx-PM Predicted Relative Resource Use by Risk Probability Thresholds for Selected Chronic Conditions

	Number of Cases				Predicted Relative Resource Use			
		Probability Score Category			Probability Score Category			
Disease Category (EDC)	Total	≥0.4	≥0.6	≥0.8	<0.4	≥0.4	≥0.6	≥0.8
Arthritis	17,679	940	463	172	2.18	6.82	9.31	15.71
Asthma	27,863	764	386	136	1.43	6.75	9.29	14.85
Diabetes	16,991	1,307	716	345	2.67	7.59	10.62	17.36
Hypertension	50,122	2,064	1,011	457	2.06	7.25	10.27	17.57
Ischemic Heart Disease	9,330	971	514	242	3.27	7.40	10.35	17.33
Congestive Heart Failure	1,634	460	292	184	5.17	8.81	12.26	19.61
Hyperlipidemia	31,240	1,170	529	186	1.97	7.13	9.49	15.46
Low Back Pain	61,980	1,493	723	279	1.76	6.53	8.77	14.27
Depression	10,190	599	298	113	2.09	6.63	9.03	14.30
Chronic Renal Failure	742	308	253	183	13.11	16.48	19.40	25.21
COPD	6,204	545	301	147	2.58	7.71	10.24	16.68

The ACG Predictive Model's Probability Score

The ACG predictive model probability score (used in **Table 12**) identifies persons in your organization who would be likely to benefit from special attention. To capitalize on this method, you will want to develop periodic reports of members with high PM scores who also meet other organizational criteria such as:

- Enrolling with certain providers
- Falling into certain eligibility categories
- Residing in certain geographic areas
- Meeting previous patterns of utilization

After these other stratifiers are taken into consideration as appropriate, a case finding report should list all in-scope individuals arrayed from highest to lowest, based upon the overall PM high-risk probability score within your organization. **Table 13** provides an example of a case finding report.

In addition to running the report automatically generated by the software, you are encouraged to develop your own individual risk summary reports on each potential case over a certain threshold (for instance the top 1% of individuals). This target group can be separated further by case managers on the basis of various sources of information available from the ACG Software and elsewhere. These additional data might include primary care provider information, service history, history of prior inclusion in care management programs, and results from any ongoing surveys (such as health-risk appraisals). Reference chapters five through seven focused on the ACG Predictive Models and managing care for persons at risk for high future cost for a comprehensive discussion of the ACG predictive models and their applications.

Table 13: Care Management Listing

Patient Id	Age	Sex	Total Cost	Rescaled Total Cost Resource Index	Probability High Total Cost	Hospital Dominant Count	Chronic Condition Count	Frailty Flag	Arthritis	Asthma	Congestive Heart Failure	Chronic Renal Failure	Depression	Diabetes	Hyper-lipidemia	Hyper-tension
6221564*16 19331125	71	M	$ 7,127	29.15	0.95	3	6	N	NP	NP	NP	NP	NP	NP	NP	Rx
6244137*14 195396	51	M	$ 7,304	23.39	0.95	2	6	Y	NP	NP	NP	NP	NP	NP	NP	NP
6422322*14 195861	47	M	$ 8,082	21.12	0.88	2	3	N	NP	NP	NP	NP	Rx	NP	Rx	Rx
6221471*14 19551215	49	F	$ 7,861	18.33	0.88	0	7	N	BTH	Rx	NP	NP	NP	NP	NP	BTH
6427141*16 1955217	50	M	$ 5,375	18.44	0.88	1	7	N	NP	NP	NP	BTH	NP	ICD	BTH	BTH
444412*141 9411026	63	M	$ 8,306	20.58	0.88	1	7	N	NP	NP	NP	ICD	NP	BTH	BTH	BTH
6442443*16 19621114	42	F	$ 4,757	17.07	0.88	1	6	N	NP	NP	NP	ICD	Rx	NP	NP	NP
6533734*14 1928824	76	F	$ 6,276	20.16	0.88	1	3	N	NP	NP	NP	NP	Rx	BTH	NP	Rx
6646141*14 1939117	65	M	$ 8,004	19.16	0.88	2	8	N	NP	Rx	BTH	ICD	NP	NP	NP	BTH

Patient Id	Age	Sex	Total Cost	Rescaled Total Cost Resource Index	Probability High Total Cost	Hospital Dominant Count	Chronic Condition Count	Frailty Flag	Arthritis	Asthma	Congestive Heart Failure	Chronic Renal Failure	Depression	Diabetes	Hyper-lipidemia	Hyper-tension
6547141*14 1920314	85	M	$ 7,466	17.36	0.88	3	10	Y	ICD	NP	ICD	NP	NP	BTH	ICD	BTH
6775544*16 1950530	55	F	$ 7,357	18.44	0.88	0	5	N	NP	NP	NP	BTH	NP	NP	BTH	BTH
6777442*16 19551215	49	F	$ 3,701	17.94	0.88	0	6	N	BTH	Rx	NP	NP	NP	NP	NP	BTH
6351677*16 1940629	65	M	$ 6,174	14.15	0.82	2	8	N	NP	NP	NP	ICD	NP	BTH	BTH	BTH
7111144*14 1946716	58	M	$ 8,147	15.21	0.82	2	5	N	NP	NP	Rx	NP	NP	NP	NP	NP
6541544*14 1946824	58	M	$ 1,041	16.94	0.82	0	6	N	NP	NP	ICD	NP	NP	NP	NP	NP
7113531*14 1927222	78	F	$ 5,791	15.37	0.82	2	8	N	NP	NP	BTH	ICD	NP	BTH	BTH	BTH
7416121*14 19621114	42	F	$ 8,037	16.21	0.82	1	5	N	NP	NP	NP	NP	Rx	NP	NP	NP
7142172*14 1949105	55	F	$ 4,596	14.71	0.82	2	5	N	NP	NP	NP	NP	Rx	BTH	NP	BTH
6141214*14 1946722	58	M	$ 5,518	14.19	0.82	0	8	N	NP	NP	BTH	ICD	NP	BTH	ICD	BTH

Patient Id	Age	Sex	Total Cost	Rescaled Total Cost Resource Index	Probability High Total Cost	Hospital Dominant Count	Chronic Condition Count	Frailty Flag	Arthritis	Asthma	Congestive Heart Failure	Chronic Renal Failure	Depression	Diabetes	Hyper-lipidemia	Hyper-tension
7144164*16 19611211	43	F	$ 5,274	16.04	0.82	0	1	N	NP	NP	NP	BTH	NP	NP	NP	Rx
6146255*16 195461	51	F	$ 2,998	15.46	0.82	1	4	N	NP	NP	NP	ICD	NP	ICD	NP	NP

Managing Pharmacy Risk

Prescription Drug Plans (PDPs) have unique challenges. The organizations are at financial risk yet have access to very limited data to manage that risk. The ACG Rx-PM and the pharmacy based morbidity groups Rx-MGs provide a unique opportunity to leverage this information for comparing population health (SMR reports – reference **Table 4**), predicting resource needs (**Table 12**) and providing useful and relevant information to care managers (**Table 13**).

Medication Therapy Management Program (MTMP) Candidate Selection

Medicare PDPs have unique challenges in that one of the regulatory requirements of PDPs is that they implement Medication Therapy Management Programs (MTMPs). MTMPs are designed to improve medication adherence, patient safety and quality. The programs typically focus on promoting beneficiary education and counseling, increasing enrollee adherence to prescription medication regimens and of detecting adverse drug events and patterns of over-use and under- use of prescription drugs. These outreach programs should reach individuals with multiple chronic diseases, such as, but not limited to, diabetes, asthma, hypertension, hyperlipidemia, and congestive heart failure who are taking multiple covered Part D Drugs and who are identified as likely to incur annual costs for covered Part D drugs that exceed the level specified by the Secretary of Health and Human Services. Since PDPs have access only to prescription history under their program, meeting this criteria can be a challenge. Rx-PM and the Rx-Morbidity groups provide an excellent means of finding the population of individuals defined in the regulations. The Rx-MGs identify members being treated for particular conditions while the Rx-PM predicted resource index, calibrated for an elderly population, can be used to calculate an individual cost forecast. Using these tools for the identification of candidates for MTMPs allows a PDP to screen the whole population with an objective and reproducible method.

Capitation and Rate Setting

The ACG System has made it possible to accomplish risk adjustment with fairly simple and straightforward analytic strategies and the ACG actuarial cells have long been the primary actuarial method for capitation and rate setting. Actuarial cells represent a fixed number of discrete categories into which individuals are placed based on their expected use of resources.

There are a number of advantages associated with using an actuarial cell-based approach to risk adjustment for capitation and underwriting, which include:

Simplicity. Once the population has been classified into around 100 ACG cells, it is possible to risk-adjust the population by using a spreadsheet. Some users have chosen to simplify this approach even further by collapsing the ACGs into smaller homogeneous groupings called resource utilization bands (RUBs). Even when grouped into RUBs, studies indicate that ACGs retain much of their explanatory power.

Less prone to manipulation. Particularly in applications involving rate setting, there could be incentives to manipulate risk-adjustment strategies to increase payment. Unlike some other disease-specific risk adjusters, aggressive efforts to capture additional diagnostic codes on the part of providers will have a more limited impact on ACG assignments. Where "code creep" associated with general increases in completeness and accuracy of coding exists, the simplicity of the ACG System makes it very easy to identify this trend and to implement appropriate action, such as recalibration of the underlying cost weights.

Stability. The conceptual elegance and underlying simplicity of ACGs have made the system very stable over long periods. The underlying clinical truth captured by ACGs does not change dramatically with each new data set and each new application.

Ease of making local calibrations. It is very easy to recalibrate ACG-based actuarial cells to reflect local differences in patterns of practice, benefit structure, and provider fees. Especially for capitation and rate-setting tasks, we encourage you to calibrate the ACG output to reflect the unique nature of the local cost structure. The same simplicity that makes it possible to risk-adjust using a spreadsheet makes it equally possible to accomplish recalibration using the same types of simple tools.

The ultimate testimony to the value of ACGs used as the basis of actuarial cells is the fact that for almost a decade they have been used to facilitate the exchange of many billions of dollars within numerous private and public health plans in both the United States and Canada.

◢ ***Example*:** For a simple case study illustrating the use of ACG actuarial cells for prospective payment see "*The Development of Risk-Adjusted Capitation Payment System For Medicaid MCOs: The Maryland Model", Weiner et al, Journal of Ambulatory Care Management, January, 1998.*

ACGs in Multivariate Models

Multivariate regression for risk adjustment has been used for many years by some of the more sophisticated users of the ACG System. If additional risk descriptors are available beyond diagnosis, age, and sex, this approach has the potential for improved predictive models that have both actuarial and payment applications.

The strength of regression-based strategies is the ease with which additional risk factor information can be incorporated and thereby introduce better control for the effects of case-mix. If you have access to additional well-validated risk factor data and if you have previous experience using regression models within your organization, then you should consider using regression. In regression strategies, ACGs, ADGs, and EDCs remain valuable as distinct risk factors to be supplemented by additional data. NOTE: Although EDCs are useful for identifying individuals with specific high impact diseases, it is important to note that they do not account for burden of co-morbidity as do ACGs. Therefore, we do not generally recommend that EDCs be used as the only means of controlling for case-mix in regression analysis.

However, there is also a potential drawback since regression may introduce some assumptions and statistical pitfalls that can be troublesome without seasoned analytical support. Their inherent complexity makes them difficult to calibrate to local cost patterns, and regression models are also potentially easier to game because more factors can be manipulated. Finally, while it is possible to introduce a wide range of variables that improve the model's explanatory power, this explanatory power is often confined to the data set and time period on which the model is based. The model's results may end up differing significantly from year to year depending on the inter-relations of the myriad risk factors that have been included, a phenomenon referred to as over-fitting.

Predictive Model Predicted Resource Index (the PM PRI Score)

To address some of the analytic challenges inherent in regression-based approaches, the ACG Predictive Model provides a ready-made solution and assigns a relative value that can be readily converted to dollars. Termed the Predicted Resource Index (or PRI for short), this output is most relevant for prospective financial applications. **Table 14** presents Predictive Ratios by Quintile for the diagnosis based, Dx-PM, applied to commercial and Medicare populations.

Table 14: Predictive Ratios by Quintile for The Johns Hopkins ACG Dx-PM Applied to Commercial and Medicare Populations

Predictive Ratio	Commercial	Medicare
Lowest Quintile Total Spending Year 1	1.29	1.08
2nd Quintile Total Spending Year 1	1.10	1.13
3rd Quintile Total Spending Year 1	1.13	1.07
4th Quintile Total Spending Year 1	1.04	0.98
Highest Quintile Total Spending Year 1	**0.88**	**0.93**

Ratios reflect actual year-2 costs for each year-1 "quintile" cohort divided by their predicted costs.

One important caveat is worth noting here. Though not included in the results presented in **Table 14**, prior pharmacy cost is available as an optional risk factor in Dx-PM. Although inclusion of pharmacy cost information improves model performance, we do NOT recommend that models using the optional pharmacy cost predictor be applied to capitation rate setting. Instead, we suggest that the Dx-PM model, relying only on ICD input variables, be used for such a purpose.

We take this position for the same reason we believe that episode groupers that rely on procedure codes (such as CPT) and Rx-groupers based on use of specific medications (as defined by NDC codes) should not be used for rate-setting purposes or efficiency profiles. Risk factor variables of this type, which are directly defined by the providers' clinical practices, are potentially intertwined with patterns of over use or under use. Risk-adjusted rates based on these factors may, in a circular manner, lead to setting rates that are inappropriate--either too high or too low. Moreover, when risk factors are determined by such drug use (or procedural) delivery patterns, providers who practice efficiently could potentially be penalized for their efficiency. This circularity issue is not a major concern when only diagnostic information (not linked to specific types or settings of service) is used as the main source of information on risk factors.

Underwriting

The ACG predictive models, calibrated for high-risk case-identification, provide underwriters with a suite of tools to estimate future resource use based on the case-mix of the enrolled population, which offers an improvement over more traditional prior utilization models. For example, in addition to just estimating future resource use, the models can also be used to help identify persons expected to convert from relatively low to relatively high resource use. This not only improves the quality and accuracy of

underwriting, but also provides opportunities for reducing costs for employers by getting at-risk employees enrolled in timely case management interventions to help reduce both future medical expenses and illness-associated absenteeism.

The ACG predictive models are especially useful for small group underwriting because the movement of one or two high- risk individuals into or out of a plan can have potentially dramatic effects on costs for a small group. Small employer groups are sensitive to price and have a tendency to shop for a new carrier at renewal time. The initial rate process uses more data than is feasible during a typical renewal; therefore, the initial rate process often produces the most competitive rates. Small groups exhibiting low risk can often find rates lower than with their current provider; however, small groups exhibiting a history of high expenditures may find going to a new insurer prohibitively expensive. This type of selection bias can lead to a very high risk pool and a future inability of a plan to offer attractive rates to retain the healthy groups. In order to retain the best business, insurers are faced with the difficult task of offering competitive pricing for these small groups by trying to accurately match premium revenue to expected expense while complying with existing rating regulations. The Johns Hopkins suite of Predictive Models provides, health plans the tools necessary to leverage existing medical and pharmacy claims in order to better estimate risk and better set premiums for small group renewal.

There are several benefits to using predictive modeling within the underwriting process:

- There is greater efficiency. Predictive modeling can provide an automated risk assessment on every member; thereby reducing the medical underwriting effort. This reduction in effort, in turn, reduces the elapsed time needed for analysis and consequently will reduce the lag between the experience period and the rating period. Rx-PM can reduce this lag further. This leads to greater accuracy.

- The ACG predictive models provide an objective, reproducible method which is favored by regulators. It offers greater consistency among underwriters and is more defensible to customers than manual approaches.

- The various clinical groupings and markers from the system provide supporting detail that can be used by sales and marketing. Discordant predictions based on Rx-PM and Dx-PM can be used as a data quality check and prompt more targeted investigation by medical underwriters.

- Predictive modeling better matches premium to future costs allowing for more competitive renewals and improved customer retention.

Table 15: Actuarial Cost Projections

Employer	# Cases	Age/Sex Relative Risk	Observed/ Expected	National CMI	Local CMI	Mean Total PRI	Mean Rx PRI	% High Risk	% HOSDOM	% Frail	% Chronic	% Psychosocial	% Discretionary
33472*08	10	0.78	0.57	0.66	0.59	0.57	0.39	0.0	0.0	0.0	20.0	20.0	10.0
1214*37	11	0.74	2.19	0.61	0.52	0.80	1.74	0.0	0.0	0.0	27.3	18.2	9.1
1317*37	11	0.72	1.73	0.44	0.43	0.40	0.20	0.0	0.0	0.0	27.3	18.2	0.0
65466*93	11	1.02	0.54	1.27	1.21	0.98	0.98	0.0	9.1	18.2	36.4	18.2	9.1
4114253*37	12	0.85	0.35	0.52	0.51	0.39	0.27	0.0	0.0	0.0	25.0	16.7	0.0
34565*08	16	1.21	0.88	0.97	0.94	1.23	0.59	6.3	6.3	0.0	25.0	12.5	0.0
65215*16	19	1.15	0.72	1.34	1.17	0.86	0.47	0.0	0.0	0.0	21.1	21.1	10.5
1322*37	21	0.97	0.55	0.40	0.41	0.59	0.39	4.8	4.8	0.0	14.3	9.5	0.0
32316*08	22	0.89	0.47	0.65	0.56	0.80	1.14	0.0	0.0	0.0	27.3	18.2	4.5
74134*06	22	1.04	0.95	1.63	1.68	2.69	2.98	4.5	0.0	0.0	63.6	27.3	18.2
4112725*11	24	1.01	0.95	0.73	0.63	0.98	1.39	0.0	0.0	0.0	29.2	8.3	4.2

The Actuarial Cost Report provided in Table 15 is a standard report produced by the software and represents a summary of information relevant for actuarial purposes and for differentiating groups as high medium and low risk. This analysis provides a number of aggregate measures for both current and future costs expressed as a relative index (scores equal to 1.0 indicate average morbidity or risk, greater than 1.0 indicate greater than average morbidity burden or risk and less than 1.0 less than average). The National CMI is a concurrent measure that compares the group case mix to a national benchmark based on the mix of ACGs assigned to the members of the group. The Local CMI is a similar measure but the comparison group is based on the population presented to the ACG System. Mean Total PRI is a measure of prospective risk using the ACG predictive model to forecast total cost relative to the plan average. Likewise, the Mean Rx PRI measures the prospective risk of pharmacy cost relative to the plan average. These resource indicators can be compared to the age-sex relative risk. When age-sex relative risk is equal to the local CMI, the risk is driven by the age and sex of the group. When age-sex relative risk is lower than the local CMI, the risk is driven by disease burden more than the age-sex mix of the group. There is an additional index of the observed cost to the expected cost (accounting for the local CMI) as a measure of how efficiently the group utilizes services as compared to the population mean.

There are additional rate-based measures provided to describe the factors contributing to group risk. Groups with higher disease burdens will also generally tend to have higher prevalence rates of high risk members who are more likely to have chronic conditions, higher rates of hospital dominant and frailty conditions, and higher rates of psychosocial conditions. Comparisons can be made between the group and the population mean by comparing the groups tab to the "overall" tab in the analysis window.

Concurrent versus Prospective Applications

The time frame used for most rate setting and other financial analyses is a prospective or predictive one. That is, this year's diagnostic information is used to determine risk factors and expected resource consumption in some future period. Thus the weights associated with each risk factor are calibrated to that future period. But this is not the only temporal approach that organizations can use for rate setting. Some ACG System users have implemented concurrent rating processes for financial exchanges. In such cases, this year's expected resource use among the benchmark population is attached to each ACG cell as a relative value rather than next year's resource use. While we do encourage experienced actuaries and financial analysts to learn more about the advantages and challenges of these innovative concurrent approaches, we do not recommend that organizations apply concurrent approaches to payment without first simulating the impact that these methods might have on the rate-setting process.

- ***Example*:** A real-world example of a concurrent approach to rate setting is one being implemented in Minnesota Medicaid where plan-level payments are based on concurrent ACG-adjusted profiles of the plan. Under this scenario, payment to a health plan is the same for each individual enrollee within a particular plan; however, the amount paid is case-mix adjusted by the plan's overall morbidity burden (relative to an average, across the population, of 1.0). This approach assumes that the morbidity burden of large groups (i.e., any individual health plan) is fairly stable and that the group's overall morbidity does not change much by the addition/exit of any one individual.

Additional Information

For additional discussion on this and other issues related to risk adjustment as applied to financial exchanges, we encourage readers to review our chapter titled "Health-Based Risk Adjustment: Application to Premium Development and Profiling" incorporated into Charles Wrightson's, *Financial Strategy for Managed Care Organizations: Rate Setting, Risk Adjustment, and Competitive Advantage*. See http://www.ache.org/pubs/wrightson.cfm for ordering details or search in the Resource Center at www.acg.jhsph.edu for a pdf of our chapter.

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4 Basic Data Requirements

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Overview

This chapter provides an overview of the general data requirements for the ACG System Software and its subsequent applications. The chapter is intended for the analysts and programmers who will be planning and performing ACG-based analyses.

The ACG System Software is designed to operate using data typically retained in machine-readable health insurance claims or encounter data files. In addition, member enrollment files detailing age, gender, and other demographics for each unique patient (not just the subscriber to the insurance policy) are generally required. Assignment of risk assessment variables can be accomplished by constructing a minimal data set composed of at least the minimum following data elements:

- A unique identifier for every member eligible to use services during the study period;
- The age or date of birth; and
- The gender of each member.

In addition, the user must provide either (or both) of the following:

- All relevant ICD diagnosis codes assigned by providers for all encounters during the risk assessment time period in question; and/or
- All codes from the pharmacy prescriptions filled for each patient during the risk assessment time period in question.

If ICD diagnosis information is available, the software will assign all of the following:

- Aggregated Diagnosis Groups (ADGs, the 32 morbidity markers);
- Adjusted Clinical Groups (ACGs, the actuarial cells);
- Expanded Diagnosis Clusters (EDCs, disease clusters);
- Concurrent weights for each ACG category based on national reference data;
- Resource Utilization Bands (ACGs collapsed into 6 categories from very low to very high resource use).

If pharmacy information is available, the software will assign the following:

- Rx-Morbidity Groups (Rx-MGs, 60 morbidity markers)

In addition, the software is a predictive modeling tool. Predictions for total healthcare expenditures, pharmacy expenditures and the probability of having high expenditures for each of these categories will be calculated. The software automatically selects the best

available model based on the available data, with the minimum data elements being age, gender, and either diagnosis, pharmacy or diagnosis + pharmacy codes. Optionally, and at your discretion, predictive model performance may be enhanced by the incorporation of the following:

- Total medical costs (including pharmacy costs), and/or
- Pharmacy costs.

Finally, and discussed in more detail subsequently, you may optionally augment the diagnosis stream in three key areas: pregnancy status, delivery, and low birth weight. Providing such additional, user-supplied flags will enhance the performance of the system and may affect the number of risk categories produced.

Once risk assessment variables have been assigned, the output of the software is typically linked to additional user-supplied, data inputs to prepare additional customized reports. In some cases, particularly where reporting systems are already in place, the software output can be exported and linked directly to existing patient-specific summary files. In addition to the basic data input (age, gender, and relevant diagnosis codes) and output (ADGs, ACGs, EDCs, concurrent weights, RUBS, and predictive modeling scores) produced by the software, there are several additional pieces of information that are required to produce many of the sample reports presented in the *Technical User Guide* in the chapter entitled, "Selecting the Right Tool," including:

- Data elements necessary to stratify the population into groups for analysis, such as primary care physician identifier, region, benefit plan, or employer group, and, ideally, the dates when the members entered/left these groups;
- Data elements necessary to construct resource consumption measures (typically dates of service, service/procedure codes, length of inpatient stay, the place of service code and the allowed charges from each claim line item) and summary measures of resource consumption (e.g., total charges, ambulatory charges, ambulatory encounters, lab/ x-ray use, pharmacy use rates, or specialty referrals);
- Information on enrollment status during the time period in question;
- Any other administrative information.

A layout of the standard patient summary file, which could be used to perform all of the available Windows™-based analyses, is presented in the *Technical User Guide* in **Table 1** of the chapter entitled "Installing and Using ACGs Software."

Data Items Usually Required for ACG Analysis in a Managed Care Context

- Unique member identifier
- Relation of person to subscriber
- Age
- Gender
- Benefit plan, product, or line-of-business identifier (e.g., copayment level, deductible levels, utilization review provisions, benefit flags such as member health or maternity)
- Sponsor, company and/or employer group identifier
- Geographic area of residence (e.g., ZIP code)
- Any other rating factors now used by actuaries
- ADG flags (yes/no for each of the 32 ADGs)
- ACG category
- EDC markers
- Predictive Modeling scores
- Rx-MGs
- Total paid/allowed claims for each patient
- Total paid/allowed ambulatory care claims for each patient
- Total paid/allowed in-patient care claims for each patient
- Total paid/allowed ancillary procedures (e.g., pharmacy, lab, x-ray) for each patient
- Utilization measures (e.g., visits, days in hospital, number of lab claims)
- Provider ID, primary care physician, panel, or site
- Continuous enrollment flag or start/stop months of eligibility
- Total paid/allowed pharmacy claims for each patient
- Optional markers for: Pregnancy, Delivery, Low Birth Weight

Coding Issues Using the International Classification of Diseases (ICD)

Diagnosis codes are the primary data requirement of the Johns Hopkins ACG System. The user must ensure, to the extent possible, the diagnosis codes recorded on the claims encounter records and the resulting machine-readable data records are comprehensive and consistent with the source medical records. For the purpose of assessing the quality of diagnosis code data, a rudimentary understanding of the structure and limitations of the International Classification of Diseases (ICD-9, ICD-9-CM, and/or ICD-10) is needed.

The two current editions of the International Classification of Diseases (ICD-9 and ICD-10) are developed and maintained by the World Health Organization. In the United States, a clinical modification of ICD-9 was prepared by the National Institutes of Health (NIH). Known as ICD-9-CM, this system has been in use since the early 1980s and is expected to be replaced by ICD-10-CM. ICD-10 was adopted by the WHO in 1993 and it and its various adaptations are in use by several other countries.

The ICD system was designed to serve primarily as an epidemiologic tool for tabulating causes of mortality throughout the world. As accountability and reporting requirements in the health care delivery and financing system have multiplied, so has the integration of ICD diagnosis coding into claims management, medical management, and managed care system oversight.

ICD-9-CM employs a five-digit coding scheme whereas ICD-9 uses only four digits. In both systems, codes with as few as three digits are sometimes valid. The system is almost entirely numeric with the exception of selected codes that begin with the letter V (Factors Influencing Health Status) or the letter E (External Causes of Injury and Poisoning). There are roughly 15,000 ICD-9-CM codes, but the lack of specification or agreement as to what constitutes an invalid code renders this number an estimate.

The most obvious difference between ICD-9 and ICD-10 is the format of the codes to include alphanumeric categories. Some chapters and conditions are organized differently and ICD-10 has almost twice as many categories as ICD-9.

Since the ICD was originally developed to code causes of death, its underlying assumptions lack an appreciation for the problem-oriented nature of differential diagnosis in clinical medicine, particularly for conditions seen in primary care and other ambulatory care settings. Many clinical problems have uncertain, or at best, tentative diagnoses in these settings. As a result, rule-out diagnoses may be coded as definitive diagnoses when claim forms are submitted (see the Rule-Out, Suspected, and Provisional Diagnosis section below).

Furthermore, the use of ICD diagnosis codes by providers is inconsistent and often confusing. Nonetheless, it is our belief (supported by evaluation of many health plan databases) that the overwhelming majority of providers strive to report codes that adequately characterize the condition of their members. The JHU team and other

researchers have repeatedly assessed the integrity of diagnosis codes assigned by care providers and have found that they convey a sufficiently accurate picture of patients' health status and resource requirements. The next sections describe some ICD coding issues of which ACG Software users should be aware.

Diagnosis Codes with Three and Four Digits

The ICD coding scheme is structured hierarchically, with the fourth or fifth digits used to further define or subdivide diseases or conditions that are described in general terms with the first three digits. With the majority serving as headers for the more specific four- and five-digit codes that follow, only a minority of three-digit ICD-9 or ICD-10 codes are clinically valid as separately defined conditions. Therefore, these three-digit codes often will not be accepted by payers on insurance claims.

The difficulty for the analyst is that there is no official list of valid three-digit codes. While the Center for Medicare and Medicaid Services' Diagnosis Related Groups (e.g., the CMS DRG) grouper does contain a list of valid ICD-9-CM codes, these are geared to the inpatient setting. For ambulatory care services, the only source of information lies with the various ICD-9-CM publications produced by the general publishing houses and software vendors, and these differ on the specific codes they consider valid. Many of these entities produce color-coded ICD-9 books that indicate whether a code is valid for billing or if it requires a fourth or fifth digit. JHU encourages you to obtain one of these books and use it to compare the results from the *Non-Matched ICD-9 List* produced by the ACG Software.

Given the common use of three-digit codes, the ACG system does accept many three-digit codes and other invalid codes when their meaning is clear and their categorization is precise enough for assignment into a single ADG.

Rule-Out, Suspected, and Provisional Diagnoses

One of the most frequent criticisms of the ICD system is the lack of codes that allow a provider to stipulate that a particular diagnosis be designated as rule-out (R/O), suspected, or provisional. Providers may record diagnoses as R/O on medical records even though they do not strongly suspect them because certain tests, procedures or trials of therapy are used to make a more definitive diagnosis. However, because ICD has no rule-out code or modifier, diagnoses such as coronary artery disease, subarachnoid hemorrhage, and hiatal hernia, just to name a few, may remain in the patient's claim database because they were recorded on one or more of the claim forms in the course of the patient's work-up.

With the exception of excluding diagnoses from lab and x-ray claims (which frequently are rule-out or provisional in nature), the Johns Hopkins ACG Development Team does not believe that R/O or suspected diagnoses have a dramatic effect on ACG assignment. One reason is that in a retrospective application, R/O diagnoses still affect the consumption of healthcare resources. For example, a patient who has R/O coronary artery

disease or R/O hiatal hernia still consumes the resources associated with the differential diagnosis of these disorders. Although the extent of their impact is not well understood in applications designed to predict resource consumption in the next time period, the presence of rule-out or suspected diagnosis codes may have an effect if they appear in large numbers or if certain providers or groups use these more than other providers or groups. This impact is especially relevant if the ruled-out diagnoses resolve to ADGs that the patient would not be otherwise assigned to based upon the array of his/her other confirmed diagnoses. For patients with multiple comorbidities, the probability of this is lower than for patients who are relatively healthy. While it is certainly possible for rule-out diagnoses to make healthy individuals appear sicker than they really are, this distortion should occur for only a small subgroup of patients. To some extent, the user can assess this by linking a count of ADGs assigned to a broad measure of resource consumption, such as total charges, and a narrow one, such as office visits, and then comparing the correlation between ADG counts and the two resource consumption measures. Persons with many ADGs, low total charges, and many visits, may suggest that rule-out diagnoses play a role in the assignment of the ADGs. When a particular health plan or physician consistently appears to have a high morbidity mix but relatively low resource use, it may be useful to ascertain, using medical records, if the use of R/O diagnoses is higher in these instances. For example, this situation could occur if certain experienced diagnosticians are referred a disproportionate share of difficult patients with unclear symptoms.

While the only way to validate the impact of R/O diagnoses is by undertaking a complex and expensive review of medical records, our experience suggests that ACG applications will not be adversely impacted by a random distribution of rule-out diagnosis codes.

Special Note for ICD-10 Users

The WHO version of the ICD-10 was first incorporated into the ACG grouper in August of 2003. Users of ICD-10 are encouraged to pay special attention to the discussion on augmenting their pregnancy, delivery, and low birth weight information as the usefulness of ICD-10 data for these purposes is not well established in the United States.

◢ ***Tip*: The ACG System supports the WHO version of ICD-10. If you have a need for a country-specific adaptation, please contact your ACG software distributor to discuss the potential for local customization.**

Using ICD-9 and ICD-10 Simultaneously

It is possible to simultaneously use both ICD-9 and ICD-10 data collected on the same population. These codes can be processed as one data stream; however, ICD-9 data must be stored in separate fields (or columns on the input data) from the ICD-10 data (see the "Installing and Using ACG Software" chapter in the Technical User Guide for more detail).

Selecting Relevant Diagnoses for Input to the ACG Software

In the United States and elsewhere, healthcare providers of all types record diagnostic codes on insurance claim forms and other types of administrative records. These diagnoses are generally reasonably accurate and have proven quite useful in understanding the case-mix of various populations. However, there is a series of coding-related issues and analytic approaches that is discussed here to help the user maximize the accuracy of the ACG assignment by preprocessing the ICD stream input into the ACG grouper.

Analysis Time Frame

The ACG System is calibrated to use one year of data with an appropriate run-out period. For example, the data required to perform a retrospective profiling analysis on calendar year 2004 should include all diagnosis and demographic information collected between 01-01-2004 and 12-31-2004 after allowing for run-out/claims lag.

Excluding Lab and X-Ray Claims

Most health plans collect claims information from clinical laboratory, diagnostic imaging, and durable medical equipment providers that include diagnosis information. These claims **should not** be used as input for the ACG Software. The diagnoses on these claims often, and perhaps even primarily, represent rule-out, suspected, or provisional codes. The inclusion of such diagnoses could result in many false positives. For example, all women receiving a blood test for pregnancy will likely be classified as pregnant if the assignment is based on this lab service claim. Therefore, when identifying ICD codes to input to the ACG grouper, selecting diagnoses from all service claims within a specified time frame, **excluding lab and x-ray**, is the recommended approach. **Table 1** provides a listing of the typical place of service codes and procedure code ranges to exclude.

Table 1: Typical Place of Service Codes to Exclude and Procedure Code Ranges to Exclude

Typical Place of Service Codes to Exclude	Procedure code ranges to exclude
'12' /* private residence/home */	'36415' - '36416' /* drawing blood */
'31' /* skilled nursing facility */	'70000' - '76999' /* x-ray and ultrasound */
'32' /* nursing home */	'78000' - '78999' /* imaging */
'33' /* custodial care */	'80000' - '87999' /* lab tests */
'34' /* hospice */	'88000' – '88099' /* autopsy */
'41' /* ambulance - land */	'88104' - '88299' /* cytopathology */
'42' /* ambulance - other */	'88300' - '88399' /* surgical pathology */
'65' /* renal dialysis */	'92551' - '92569' /* hearing tests */
'81' /* independent lab */	'93000' - '93350' /* ECG and ultrasound */
'99' /* unknown */	'99000' - '99001' /* specimen handling */
'00' /* non-CMS code for pharmacy */	'G0001' /* drawing blood (HCPCS) */
	'E0100'-'E9999' /* durable medical equipment */

A Sample R/O Implementation Method

1. Apply R/O claims line identification criteria to identify non-institutional claims that either have a POS or a CPT in one of the listed categories
2. Identify whole claims that contain only R/O lines. When a claim contains a mix of R/O and non-R/O lines then retain the entire claim.
3. Discard diagnoses from claims that contain 100% R/O lines.

Coding Issues Using National Drug Codes (NDC)

The National Drug Code (NDC) is a drug product classification system. First compiled and organized as part of a Medicare outpatient drug reimbursement plan, it has grown and spread to numerous sectors within the health care industry among which include managed care organizations, pharmaceutical manufacturers, wholesalers, hospitals, and Medicaid. Its usages span from clinical patient profile screening, to inventory control and drug claims processes. Recorded within a database headed by the Food and Drug Administration, it is used specifically by the government for product tracking, evaluations, research, and drug approval within the United States.

The code itself is comprised of three segments. Two forms exist – a ten and an eleven digit configuration. The ten digit code, referred to as a regulation NDC, is used mainly by the FDA. However, the majority of government agencies and health care organizations employ the 11 digit code format, including the Johns Hopkins ACG System. It follows the form 5-4-2 (referring to the digit lengths of each individual sub-code segment). The first segment, issued by the FDA, identifies the labeler/manufacturer code. The next four digits – called the product code - impart information regarding drug strength, dosage form, and formulation. The last two digits, the package code, refer to package size and type. Together, these three number sequences form the NDC number. With these pieces of information one can ascertain: generic name/active ingredient; manufacturer; strength; route of administration; package size; and, trade name, for any medication. We suggest users process all NDC codes over the period of interest.

The World Health Organization's (WHO) Anatomical Therapeutic Chemical (ATC) codes may also be processed with the ACG System. In the ATC classification system, the drugs are divided into different groups according to the organ or system on which they act and their chemical, pharmacological and therapeutic properties. Drugs are classified in groups at five different levels. The drugs are divided into fourteen main groups (1st level), with one pharmacological/therapeutic subgroup (2nd level). The 3rd and 4th levels are chemical/pharmacological/therapeutic subgroups and the 5th level is the chemical substance. The 2nd, 3rd and 4th levels are often used to identify pharmacological subgroups when that is considered more appropriate than therapeutic or chemical subgroups. On the following page, Reference **Table 2** for the complete classification of metformin and code structure.

Table 2: Classification of Metformin

The complete classification of metformin illustrates the structure of the code:

Code	Description
A	Alimentary tract and metabolism (1st level, anatomical main group)
A10	Drugs used in diabetes (2nd level, therapeutic subgroup)
A10B	Blood glucose lowering drugs, excl. insulins (3rd level, pharmacological subgroup)
A10BA	Biguanides (4th level, chemical subgroup)
A10BA02	Metformin (5th level, chemical substance)

The ATC system was created to serve as a tool for drug utilization research. Because the ATC system has been specifically designed to capture the therapeutic use of the main active ingredient, there is much more relevant information imbedded in an ATC code for making Rx-MG assignments (See Reference Manual Chapter 6 for a more detailed description of the Rx-MG assignment methodology.)

Identifying Special Populations with Augmented Data Inputs

As noted previously, the ACG System is designed to operate on the data typically retained in machine-readable health insurance claims or encounter files. Recognizing the limitations of ICD diagnosis information in common usage, users may augment diagnosis information by inputting further relevant information about their patient populations.

Through the use of optional flags you may supply additional information about pregnancy status, whether or not a pregnant woman has delivered, and information about an infant's birth weight.

Pregnancy Status

It is possible for analysts to provide the software with a flag indicating that a woman is pregnant. The rationale for including this option is that it is not uncommon in some plans for the charges associated with a woman's pregnancy and subsequent delivery to be reimbursed as a global or fixed payment at the time of delivery. In this reimbursement scenario, a woman's claims history may not include a pregnancy diagnosis until she actually delivers. However, given the importance of this information, the plan often does know that the woman is pregnant, despite this lack of related ICD codes during the prenatal care period. In cases where the plan wishes to supplement the standard claims data (e.g., if a pregnancy registry is believed to be more accurate than standard claims

data), the user may submit a special delivery flag that can supplement the standard ICD stream. Refer to the "Installing and Using ACGs Software" chapter in the *Technical User Guide* for a discussion of how to implement this approach.

◢ ***Tip*: ICD-9-CM codes used to identify pregnancy:**
640xx-677xx, V22xx, V23xx, V24xx, V27xx, and V28xx

Delivery Status

Each ACG from 1710 through 1770 is split into two categories (1711, 1712 through 1771, 1772) based on whether or not the women within these categories have delivered during the period of analysis. After extensive testing, the ACG System development team at Johns Hopkins is confident the standard ICD-9-CM codes used by the software for identifying deliveries are effective with positive predictive accuracy (that is, the women did actually deliver) averaging greater than 96% among all plans tested. However, for a variety of reasons diagnosis codes for delivery may not appear in a woman's claim history even though she did in fact deliver.

For example, the delivery may have occurred in an outpatient birthing center or other non-traditional venue, and claims were never submitted containing any delivery codes. Also, if an analyst is using only ambulatory data (not generally recommended) the ICD-9-CM delivery codes are not available, or the analyst is processing ICD-10 or ICD-9 data to assign ACGs, then it is suggested that the user provide a delivered flag in the input data stream.

Low Birth Weight (less than 2500 grams)

In a manner similar to the way pregnant women are subdivided by delivery status, infants can, at the user's discretion, be subdivided into subcategories based on their birth weight. However, utilization of this feature is somewhat more difficult. Although ICD codes allow for identification of low or normal birth weights among neonates, due to inconsistencies in how ICD codes are commonly used, the software cannot readily identify most low birth weight infants using only ICD codes from the input claims file. Validation analysis across a variety of indemnity and HMOs indicated that within most plans 2% to 5% of infants were identified as low birth weight. Based on vital records and other sources, the actual percentage should be somewhere between 6% and 9%. Because diagnoses did not seem a reliable source of the recording of birth weight, analysts wishing to take advantage of this feature to appropriately categorize low birth weight infants must flag such infants before passing the data to the ACG Software and provide the software with the flag's location.

◢ ***Tip*: ICD-9-CM codes used to identify low birth weight:**
764.0*; 764.1*; 764.2*; 764.9*; 765.0*; 765.1 (where * = 1-8 [48 codes total]).

Constructing Resource Consumption Measures

Key to any ACG-based application for either physician profiling or capitation is consideration of how the resource use measure is defined. Most analyses developed to date have focused on visit rates, ambulatory charges, or total charges. However, more recent work is being conducted to assess the ACG System as a means of evaluating pharmacy use, understanding specialist use, and assessing quality of care.

Summarizing Total or Ambulatory Charges

Most plans retain the submitted charge, allowed or eligible amount, and paid amount for healthcare services in their machine-readable claims files. The submitted charge refers to the charge submitted on the provider's claim. The allowed or eligible amount refers to the amount the plan has determined it will pay for the covered service, after applying reasonable and customary charge screens or a fee schedule. The paid charge is the allowed amount reduced by any applicable copayments and deductibles required by the subscriber.

◢ ***Tip*****:** Providing summarized total charges (including pharmacy cost) and/or a separate summary pharmacy cost field on the patient input file will improve predictive model performance.

Typically, it is recommended that users aggregate either the paid charge or the allowed amount for each patient as the most appropriate measure of total and/or ambulatory charges. Since the ACG System can be used to compare the consumption of resources across groups, different copayment and deductible amounts, as well as different paid charge amounts, may prevent accurate comparison of different subscriber groups. Therefore, the allowed amount is typically used as the best measure of resource consumption when comparing groups or profiling providers. In the case of capitation, where the focus is in plan liability, paid amounts may be appropriate.

Ambulatory Encounters

Some users, particularly those interested in ambulatory provider productivity, use the ACG System to case-mix adjust profiles of provider-patient contacts. Users should realize the potential difficulties associated with trying to define ambulatory encounters. Physician visits are relatively straightforward mechanisms for estimating face-to-face encounters; however, tabulating ancillary and surgical services into encounters is problematic. This issue is a focus of much ongoing research and few workable solutions currently exist. However, in the context of provider profiling, it is probably sufficient for analysts to estimate ambulatory encounters in **exactly the same way** for each group to be compared. Using this approach, even if the estimate of an ambulatory encounter is biased, valid ACG-adjusted comparisons can still be performed. The notion of using compatible techniques for estimating ambulatory encounters is especially important when the comparison involves two different types of service delivery environments, such as

comparing a fully-capitated, at-risk independent practice association (IPA) and a staff model HMO operating under a negotiated global budget.

Risk Assessment Variables

One way that the user can affect the output from the ACG System is with the selection of Risk Assessment Variables. Risk Assessment Variables are inputs to the system provided by Johns Hopkins which control the calculation of member-specific output variables. The user is asked to select the Risk Assessment Variables to be used at the time that the input files are specified. The Risk Assessment variables include:

- **Reference Concurrent Weights**: An estimate of concurrent resource use associated with a given ACG based on a reference database and expressed as a relative value. In addition to member output, these weights are used in observed to expected ratios and in reference case-mix index values.

- **Predictive Modeling Coefficients**: An estimate of prospective resource use associated with a given risk factor based on a reference database and expressed as a relative value. These coefficients are added for each member based on the risk factors present to produce a Predicted Resource Index.

- **Reference Prevalence Rates**: MEDC, EDC, Major Rx-MG and Rx-MG prevalence rates for each age-sex cohort within a reference population. These rates are aggregated to form the "expected" prevalence in the corresponding Standardized Morbidity Ratio analysis.

- **Resource Utilization Bands**: Aggregations of ACGs based upon estimates of concurrent resource use providing a way of separating the population into broad co-morbidity groupings. Several standard analyses use the distribution across RUBs.

- **Frailty Marker**: A dichotomous (on/off) variable that indicates whether an enrollee has a diagnosis falling within any 1 of 11 clusters that represent medical problems associated with frailty. This marker is one of the risk factors considered by the Dx-PM and DxRx-PM models.

- **Hospital dominant condition marker:** Diagnoses that, when present, are associated with a greater than 50 percent probability among affected patients of hospitalization in the next year. This marker is one of the risk factors considered by the Dx-PM and DxRx-PM models.

The standard sets of Risk Assessment Variables delivered with the software are US-Non-elderly and US-Elderly. In these sets of Risk Assessment Variables, the reference concurrent weights, the predictive modeling coefficients and reference prevalence rates are calculated based upon a representative population of either US-Non-elderly members or US-Elderly members. The mappings of ACGs to RUBs and the mappings of diagnosis codes to Frailty and Hospital Dominant Conditions are standard across all models at this

time. If your population is large and may vary from the US-Non-elderly or US-Elderly references, please contact your distributor about additional Risk Assessment Variables for your population.

Summary Review

To recap, this chapter lays out the general data requirements of the ACG System Software and outlines the key considerations for data analysts as they begin the process of gathering the necessary elements for running the software. The main data elements for running the software include a unique member identifier, age, gender and string of diagnoses codes for the period of interest, typically a year. To perform ACG-based analyses, the output produced by the software (the risk assessment variables) must be linked to data files containing additional data elements necessary to stratify the population into groups for analysis linked to resource consumption measures. The next chapter will walk you through the process of installing and using the software. Subsequent chapters are intended to aid in validating and using the output produced by the software.

5 Installing and Using ACG Software

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Introduction

The central element of the Johns Hopkins University ACG System Release 8.2 is a Windows-based reporting application intended to facilitate implementation of the ACG System within health care settings. The Windows-based software is not only a flexible reporting application, but also provides the ability to run the software in batch mode from the command line, allowing individuals to automate or to queue up multiple jobs. Additionally, the software is available as a stand-alone assignment module for several non-Windows-based, UNIX® platforms including: Solaris SPARC, AIX and HP-UX RISC. This chapter discusses using and installing all versions of the software.

◢ ***Tip*:** Input and output file requirements as well as batch mode processing are identical across all supported Windows and non-Windows-based UNIX platforms. This simplifies the use of all ACG-based applications within your organization (see the Appendix B of this chapter for details on batch mode processing).

System Requirements

The Johns Hopkins ACG System is built to handle relatively large data volumes and processing requirements. The performance of the software is very much based upon the speed and memory of your computer.

Operating System

The following versions of Windows are supported:

- Windows XP Professional, with Service Pack 1 or greater
- Windows XP Home
- Windows Vista

Central Processing Unit (CPU)

Any Intel® 32-bit compatible CPU is supported. A Pentium® 4 at 2.0 GHz or faster is recommended.

Memory (RAM)

512 megabytes (MB) RAM is recommended. The application will immediately utilize 64 MB upon startup and expand up to 512 MB RAM as necessary.

The size and complexity of the analyses (spreadsheet-like reports) are limited by the amount of RAM on your computer. If you experience "Out of Memory" errors while running an analysis, you should close any other open applications or otherwise expand the amount of available RAM, and try re-running the analyses.

Disk Space

The application itself consumes approximately 165 MB of hard drive space. The temporary space required to build an ACG data file is approximately four to five times the size of the import data files. An ACG data file can consume anywhere from five to 40 megabytes per 100,000 patients (depending on the length of member ID, number of diagnoses, etc.). One to five gigabytes of free disk space is typically sufficient to handle one million patients.

If you receive an out of space message and you have adequate space for the ACG data file, review the following related to the use of temporary space. The ACG application will use temporary space that is approximately five times greater than the input data files to sort and merge the data files. This can lead to out of space messages because the ACG application is taking advantage of the Windows TMP variable for these activities. This is typically on the client's primary (C:\) drive. It may be moved using the following actions in a Windows XP operating system:

1. Start
2. Control Panel
3. System
4. Advanced
5. Environment variables

Edit the TMP variable to a location with more available space. This will change default Windows behavior (e.g., logging statistics will be moved as well).

This TMP variable is machine and user-specific.

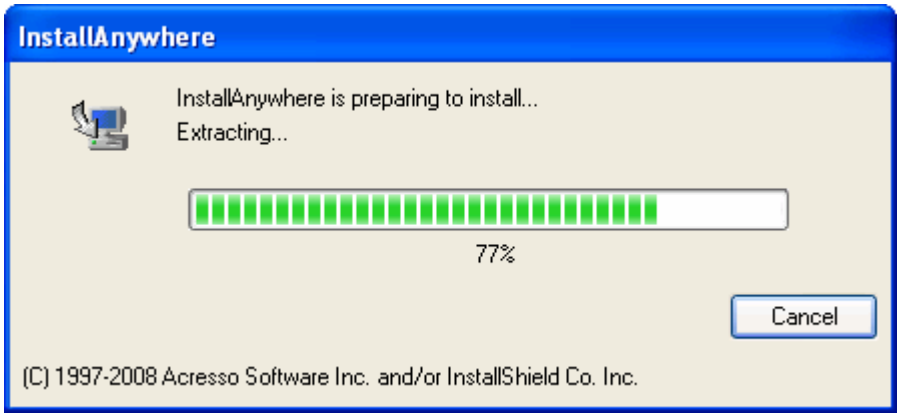
Installing the Software

The ACG application is most commonly delivered via FTP. Once the application is downloaded, use Windows Explorer to navigate to the **JHUACGSetup** executable file and double-click to begin installation. If you received an installation CD, insert the CD into your CD-ROM drive. If the installation screen does not automatically appear, choose **Start, Run** from the Windows taskbar, browse to the CD-ROM drive and select the **JHUACGSetup** executable file. The software uses a standard Windows Setup Wizard to install the software into the default or user-defined destination location and will optionally add program shortcuts to the Start Menu Folder. The software installation uses a digital signature to identify The Johns Hopkins University as the publisher of the software. If your software does not identify The Johns Hopkins University, contact your distributor to verify the application's authenticity. Once you verify the publisher, select **Run** to continue with the installation

Figure 1: First Setup Screen

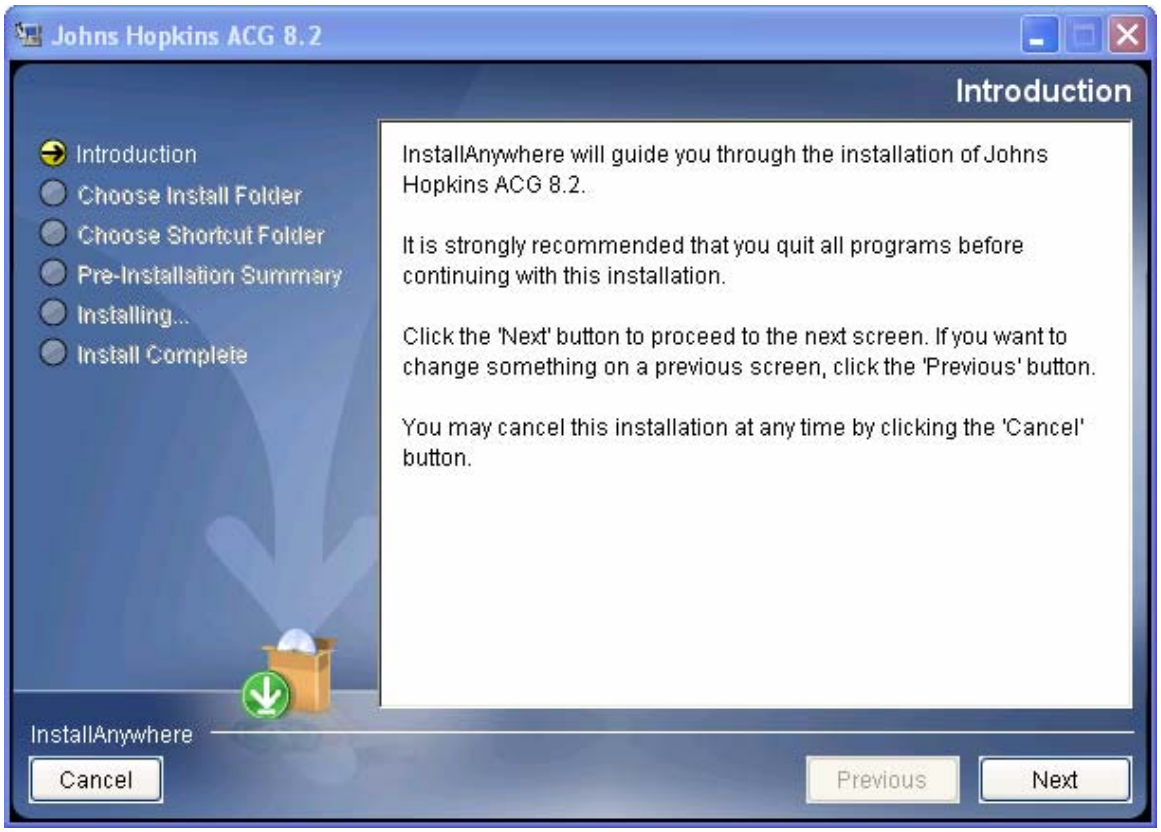
The software will begin extracting files for installation and will present a status screen during this step.

Figure 2: Extraction Status



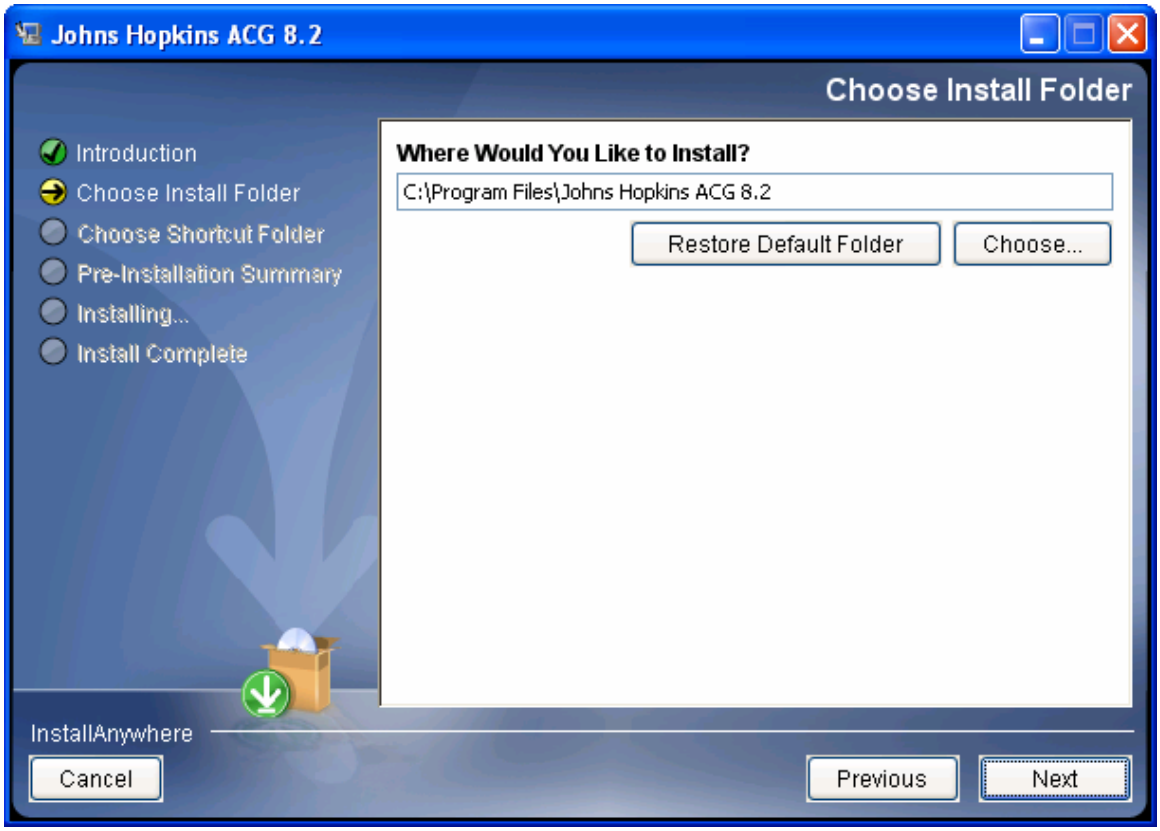
The installation wizard will then begin a guided setup for installing the software. Select next to pick your installation options.

Figure 3: Guided Setup



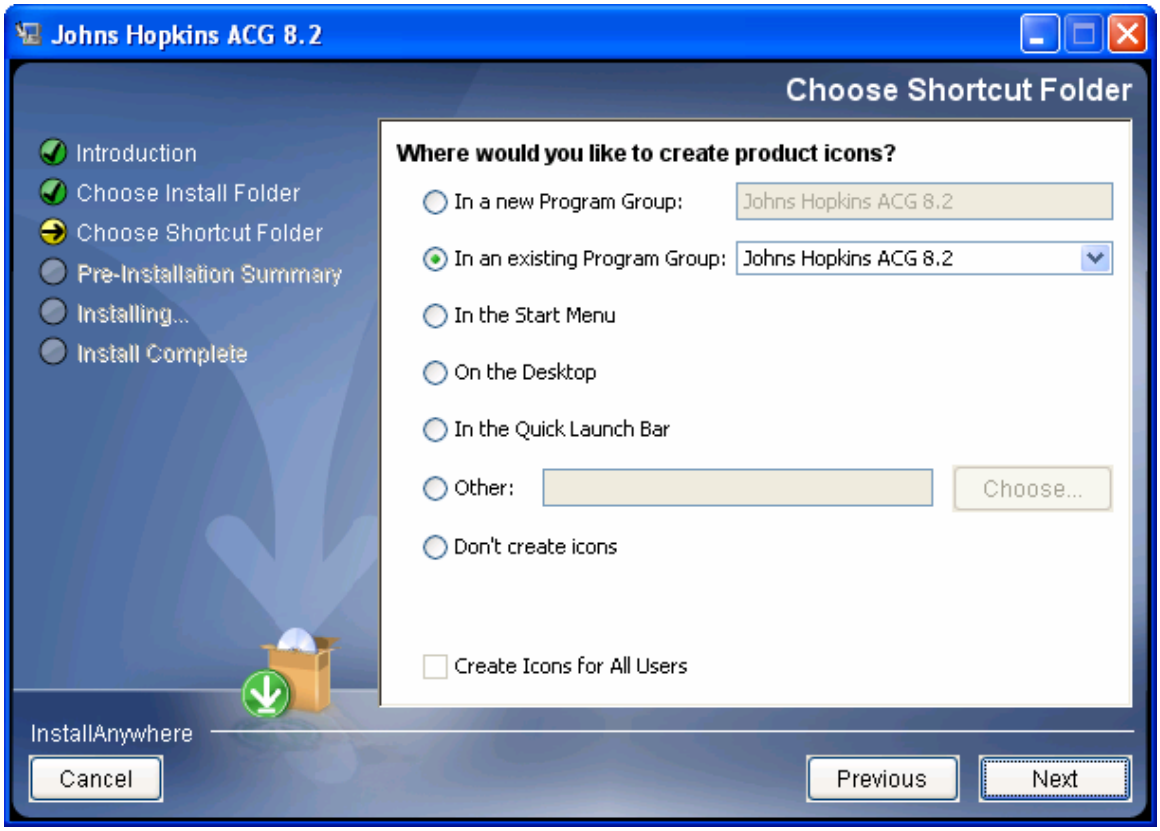
The installation will present a default folder for installation. You may accept the default by selecting **Next**, or you may choose an alternate location for the installation.

Figure 4: Select Destination Location



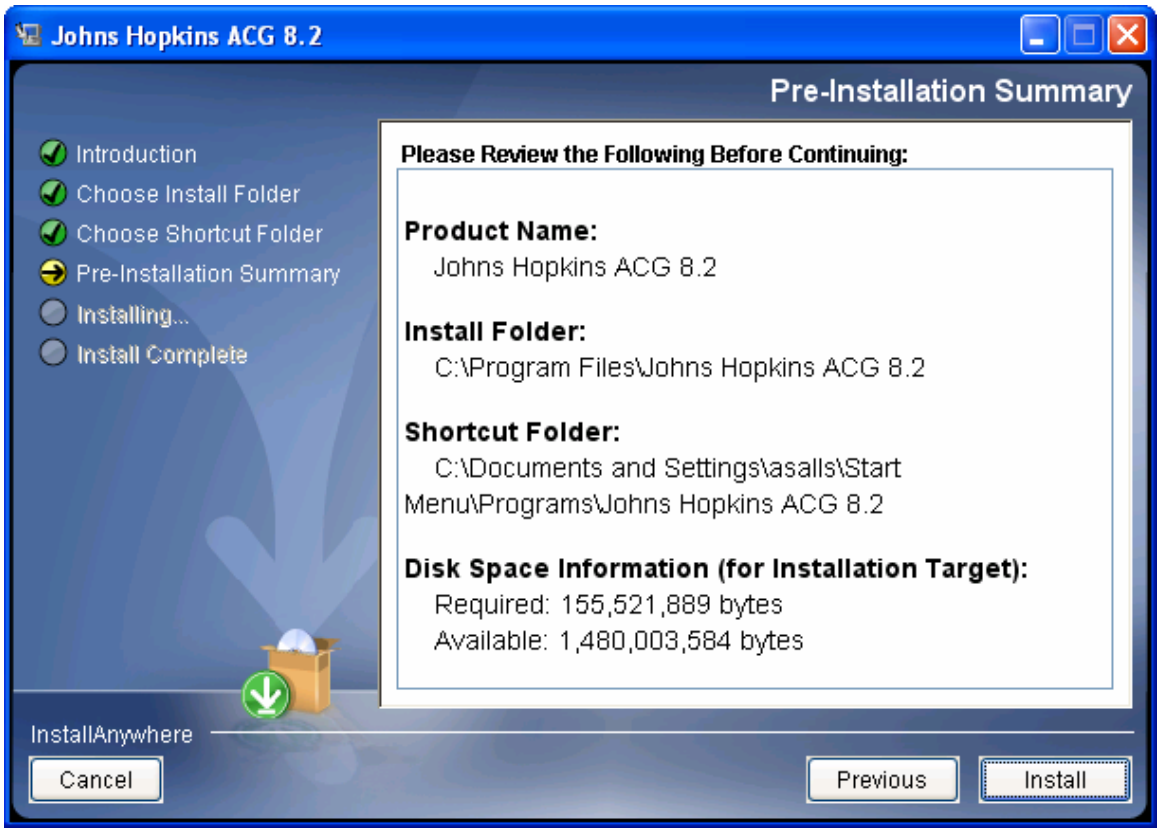
The application will create a shortcut folder with the icons for the application, documentation and reference data in the location of your choice. To accept the program default, select **Next**.

Figure 5: Choose Shortcut Folder



The installation wizard will confirm that there is sufficient free disk space and then present a pre-installation summary for review prior to installing the application. Click **Install** to begin the process of copying files and installing the application.

Figure 6: Pre-Installation Summary



◢ ***Tip*:** If you have a previous version of the ACG System installed and you wish to retain it, be sure to install the new version of the software into a separate folder/directory.

The application will present installation status and the current step.

Figure 7: Installation Status

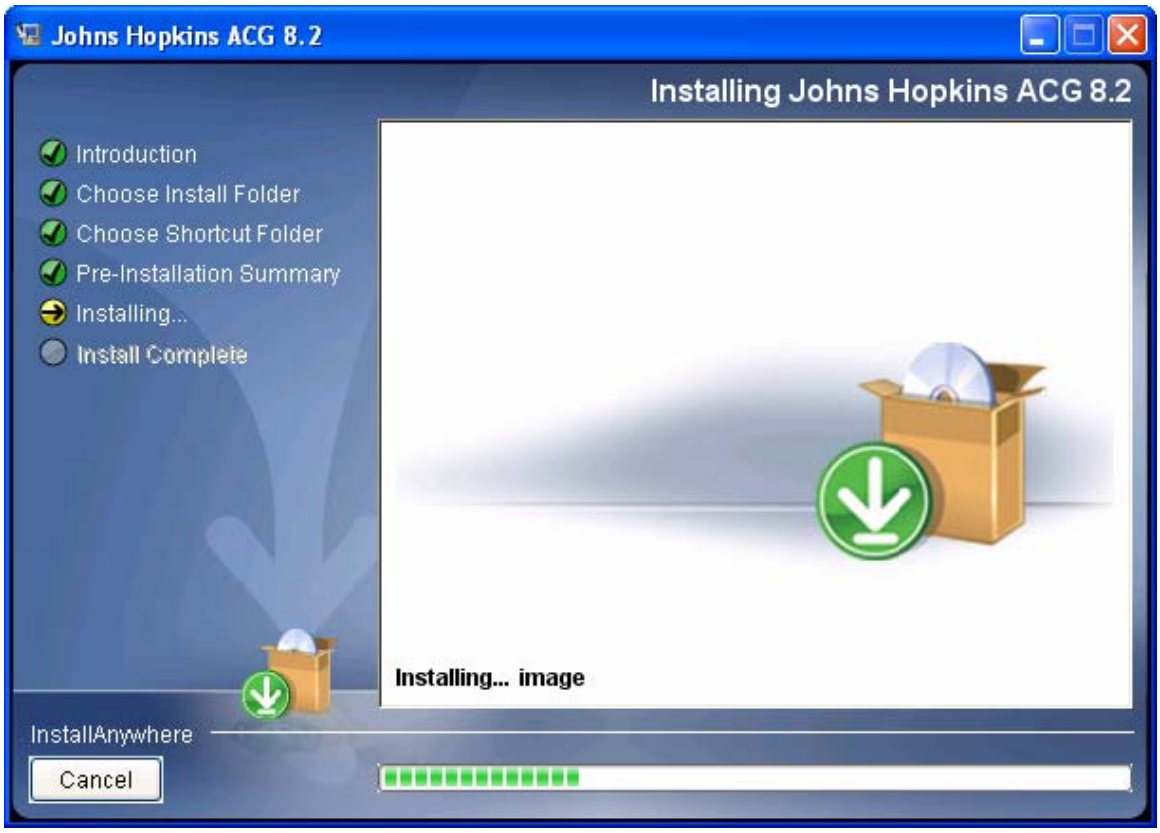
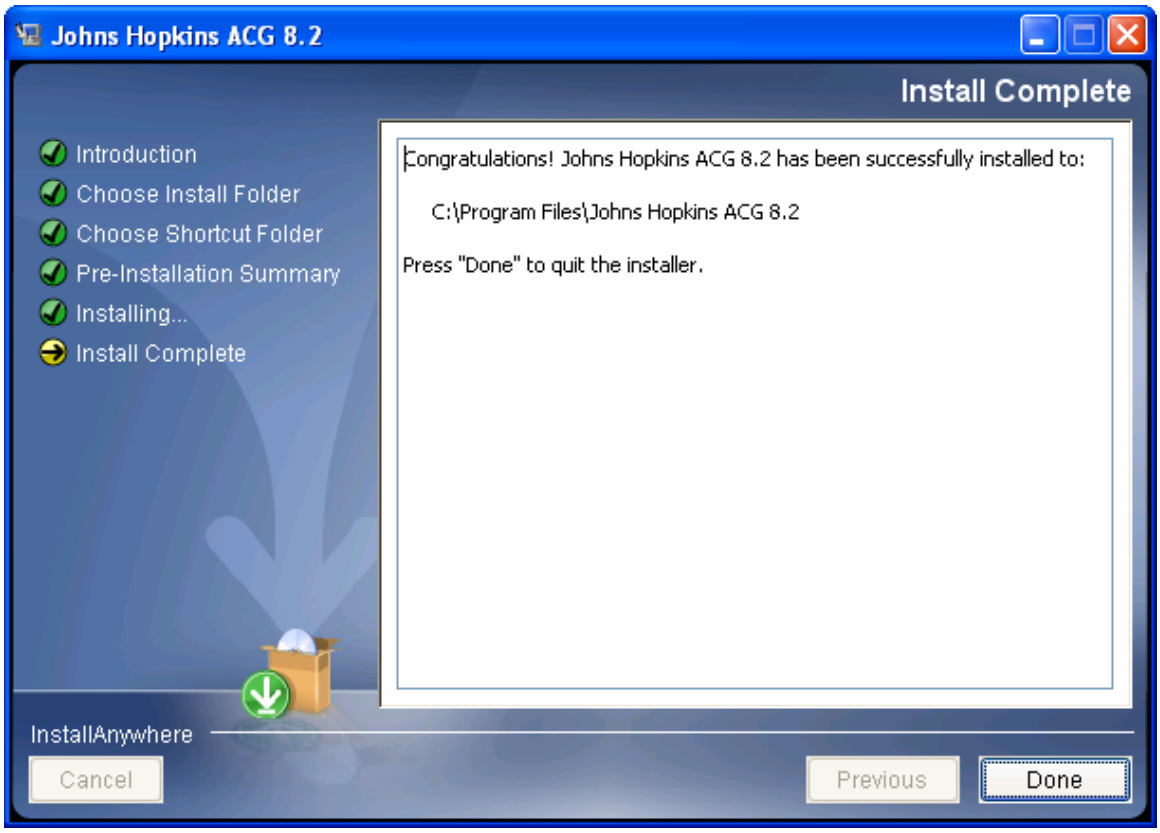


Figure 8: Install Complete



ACG License File

Upon the first initiation of the software, you must accept a standard licensing agreement and then you are asked to install a license file. Each license file is specific to your contract period/licensing terms. Licenses control access to the model types (Diagnosis or Pharmacy), regional code sets (i.e., ATC), and risk assessment variables (i.e., reference and calibration data). If your license expires prior to receiving an update, please contact your software vendor. A standard Windows Wizard guides you through the installation of the new license file.

Figure 9: Welcome to the Johns Hopkins ACG System Setup

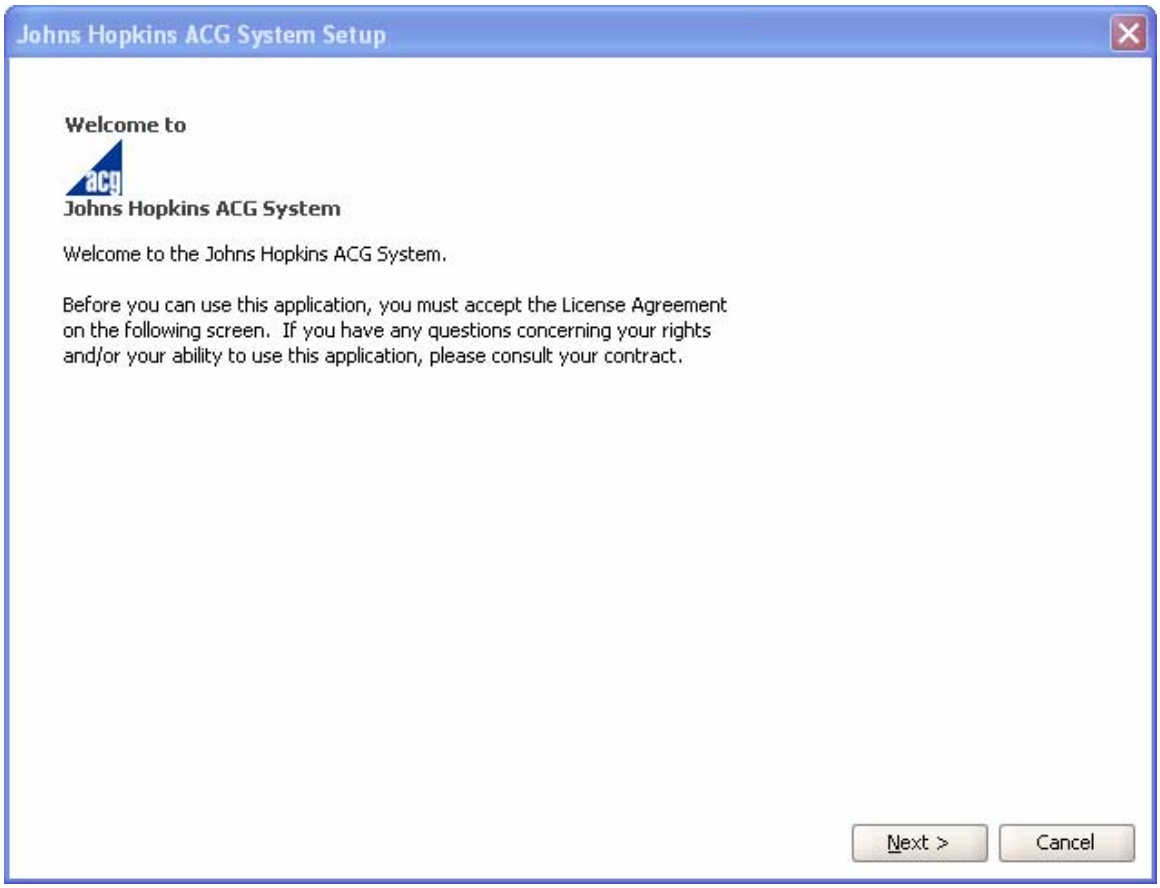


Figure 10: License Agreement

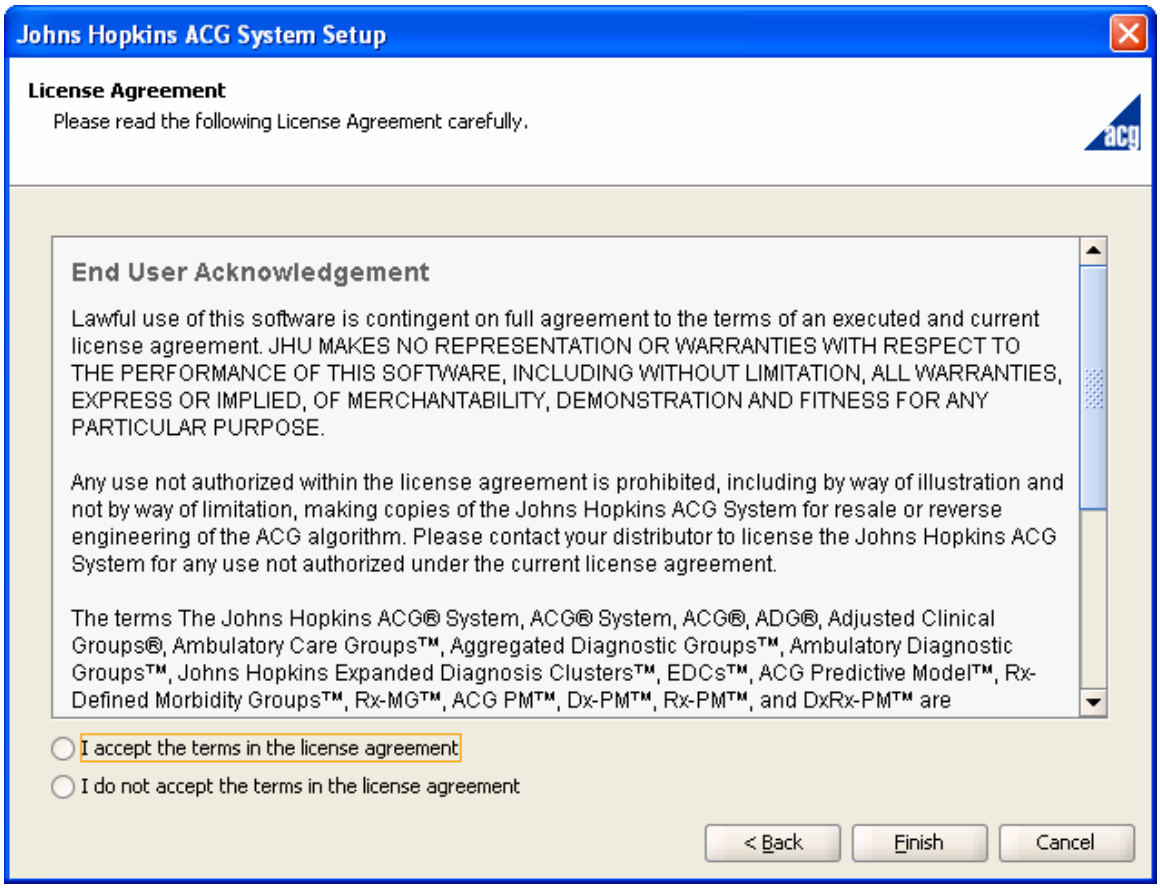
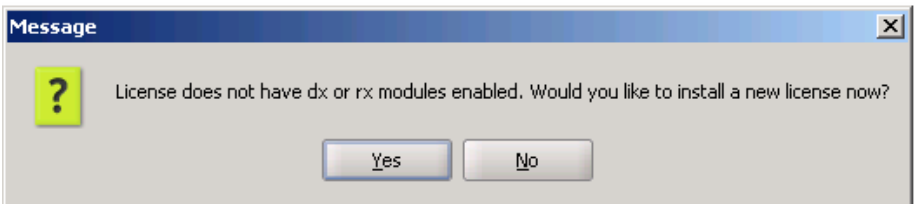


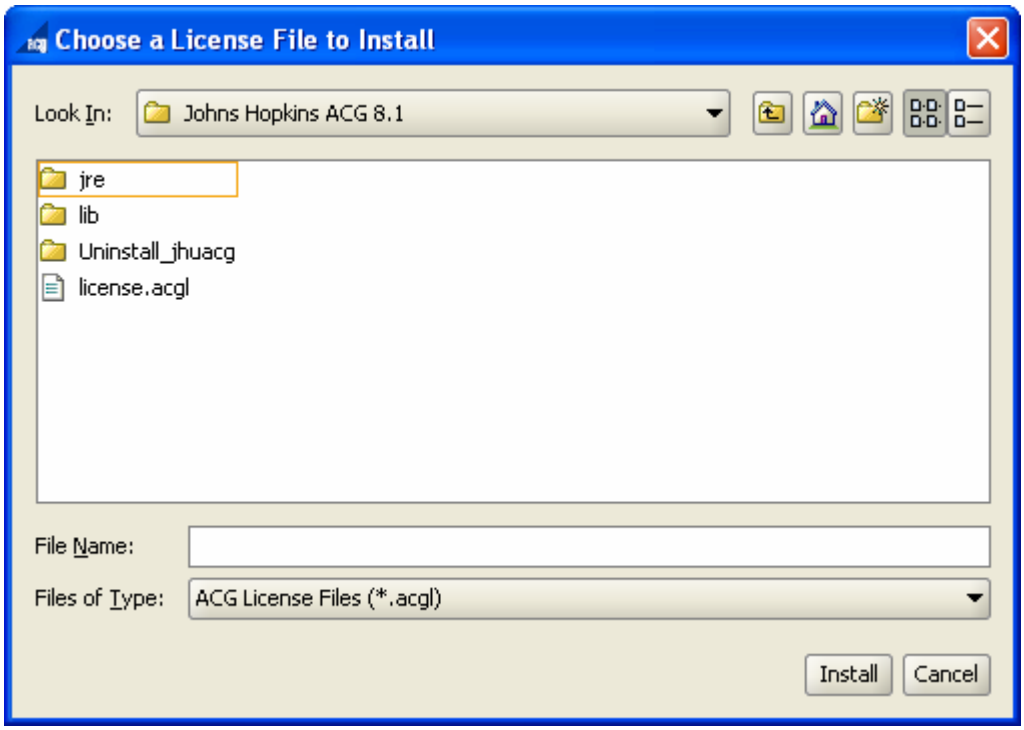
Figure 11: Install the License File

Upon completion of the install process, the user will be prompted to load a license file. License files are client specific. Access to the diagnosis and/or pharmacy components of the system is dependent on the licensing agreement acquired from your software vendor. For information on which license file is required, please contact your primary support person.



Click **Yes** to go to the next window (**Figure 12**).

Figure 12: Choose the License File

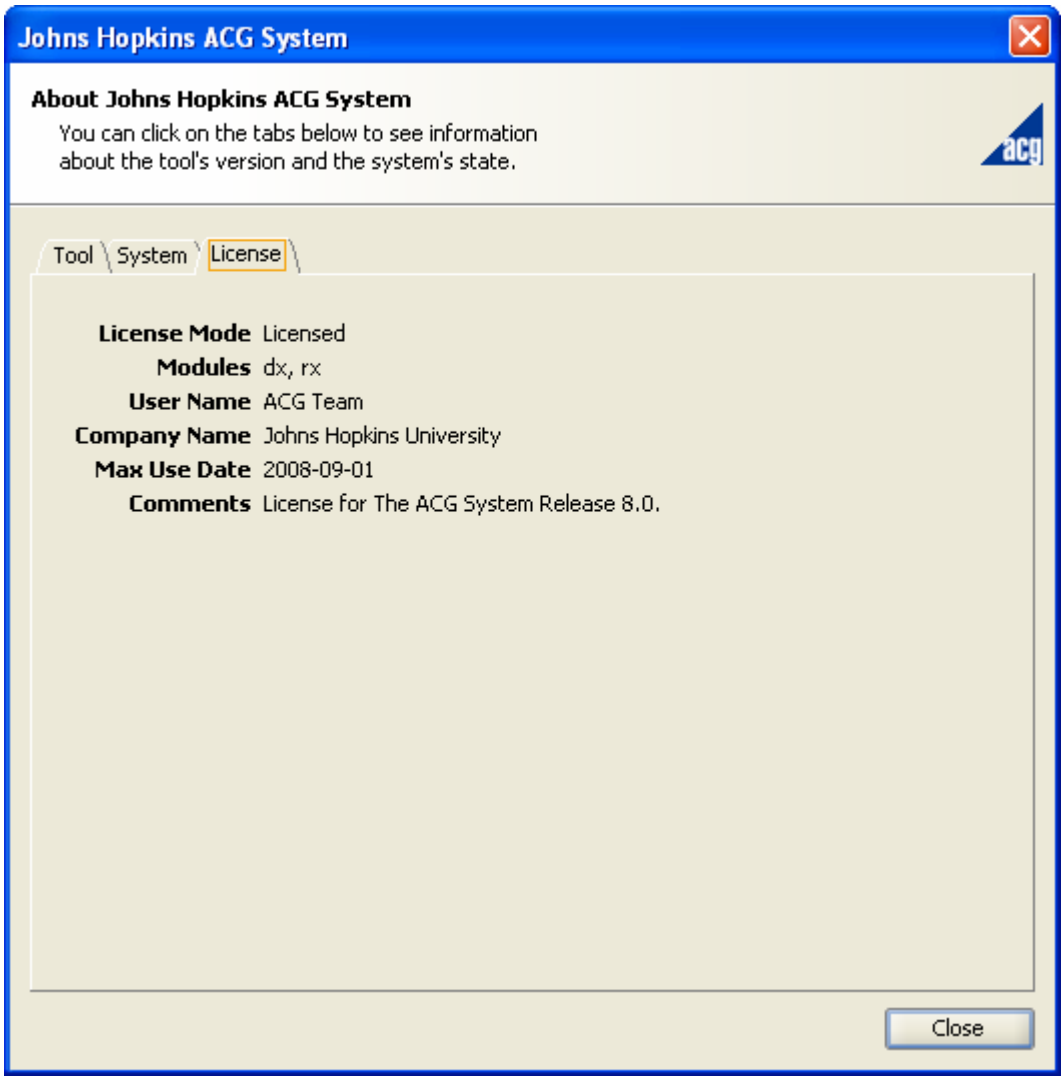


Click the **My Documents** button to search the desktop for the appropriate file, which is provided with the software installation CD.

◢ ***Tip*:** ACG license files have the .acgl extension. If you are having difficulty finding this file, you can use the search function of Internet Explorer ™ to search your desktop for files with this extension, or call your software vendor for additional support. Occasionally this file may be e-mailed to you, so it may be necessary to first save the file from your e-mail program to the desktop before beginning the search using the **My Documents** button.

◢ ***Tip*:** Each license file is specific to the modules licensed from your software vendor. The modules available are diagnosis only, pharmacy only, or both diagnosis and pharmacy. To determine which components of the system you have access to, please select **About** under the **Help** section within the tool bar.

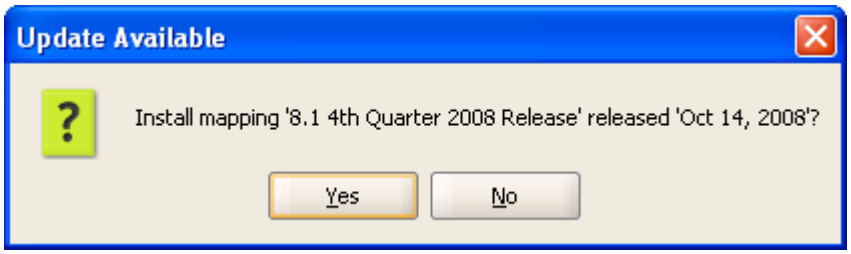
Figure 13: View the Installed License



Updating the Diagnoses and Pharmacy Mapping Files

The ACG application uses a mapping file to determine the use of diagnosis codes and pharmacy codes within the system. The ACG System installation includes a current mapping file. The mapping file will be updated from time-to-time to reflect new codes or groupings and reference data values. When the application is first opened, there will be a prompt asking if you would like to look for an updated mapping file. If you confirm with a yes, the software will attempt to connect to the ACG website to look for an updated mapping file. If a more recent file is available, you will be provided with the date of update and asked if you want to install the updated mapping file.

Figure 14: Install Updated Mapping File



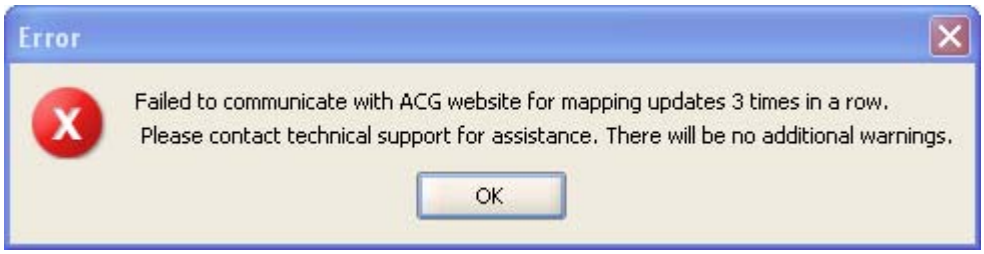
The ACG System will attempt to connect to the internet to look for updates periodically and you will be prompted to install the update. You can deny any particular update and return at a later time to manually initiate the update process. This process is started by selecting **Manage** mappings from the **Tools** menu. Click **Check for Updates** to connect to the ACG website.

Figure 15: Mapping File Manager

If the ACG System fails to connect to the ACG website on three consecutive tries, you will receive a message letting you know that it was unable to connect. If you are unable to connect to the internet for updates, you can receive a mapping file directly from your software vendor. Mapping files will be recognized by the ACG System when they are installed. This process is initiated by selecting Manage mappings from the Tools menu. Then click **Install File** and select your ACG mapping file using the file chooser. ACG mapping files will have a .acgm extension

◢ ***Tip*:** You may not be able to connect to the ACG Website if your internet connection uses a proxy server. Contact your designated support person to receive updated mapping files.

Figure 16: Mapping File Communication Error



Using the Software

The ACGs for Windows software is a standard Windows application initiated from the Start menu. Follow these steps to access the software:

1. Click the **Start Menu**.
2. Select **All Programs**.
3. Select **Johns Hopkins ACG 8.2**.

◢ ***Tip*:** To create a shortcut to the ACG Software on your desktop, simply right-click and drag a copy of the ACG icon to make a shortcut to the software on your desktop.

The Johns Hopkins ACGs subfolder in the Start Menu also contains links to the *Technical User Guide* and *Reference Manual*, two important pieces of reference material intended to assist you in your implementation of Release 8.2.

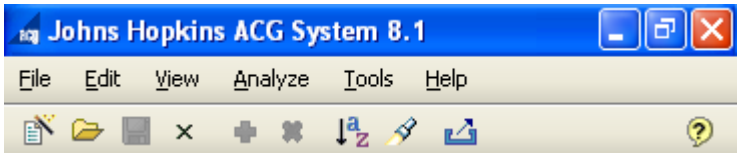
For almost all reports available in the software, results for a Commercial and Medicare reference data set for the under age 65 working age population as well as the over age 65 Medicare eligible population are available electronically as an Excel template which may be accessed via the pull down menu of the Johns Hopkins ACG 8.2 start menu. Users are encouraged to produce their own reports and use this reference comparison data as a benchmark.

The ACGs for Windows application includes an uninstall utility. It is recommended that this uninstall utility be used to remove the ACGs for Windows application to ensure that all aspects of the installation are removed. This can be accessed by using Windows Control Panel, Add/Remove Programs.

ACG for Windows Desktop

ACGs for Windows provides a range of functions available through its desktop, as shown in **Figure 17**.

Figure 17: AGGs for Windows Taskbar



ACGs for Windows has a standard taskbar with traditional Windows-like, pull-down menus. A brief overview of the functionality of the Windows taskbar follows.

File Menu

The File menu is for opening/saving ACG data files. These are files created by the ACG for Windows software and are appended with the .acgd extension. These files are working databases containing summary information on each member processed through the software. **Note:** It is not necessary to re-run your claims data each time you open the software; rather, ACG assignments can be stored in the *.acgd file for later use. The software can utilize multiple *.acgd files simultaneously and/or filters can be applied to the core database to create multiple *.acgd files to facilitate multi-level analyses. For your convenience, the last five files opened will be shown from the File menu.

Edit Menu

The Edit menu contains useful functions such as Sort and Find.

◢ ***Tip*:** Sorting can be accomplished in three ways: (1) use the sort item under the edit menu, (2) use the  button on the menu bar, or (3) click the column heading on the ACG desktop (click once for ascending and twice for descending order).

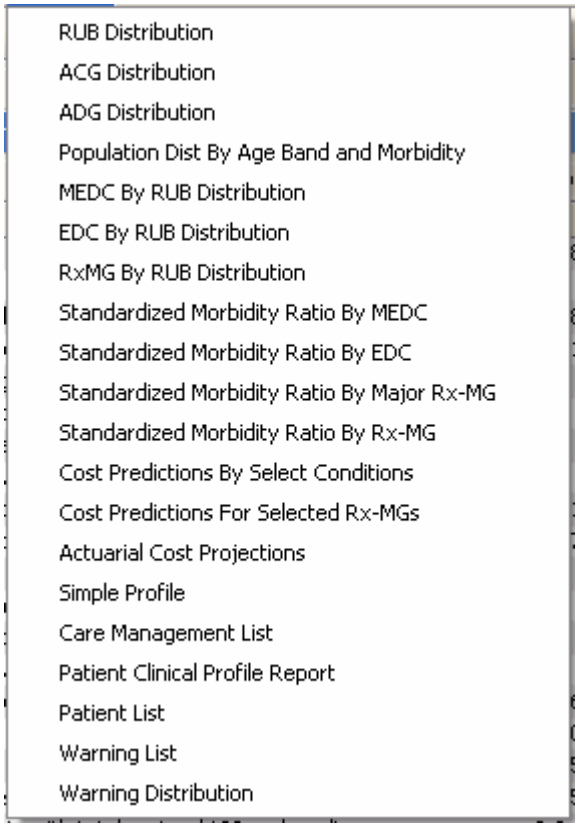
View Menu

The View menu allows switching between ACG data files (more than one data file can be open at a time) as well as switching between reports within one particular data file of interest.

Analyze Menu

The Analyze menu provides access to and allows for customization of the ACG-based reports. The columns and descriptions for each available analysis follow.

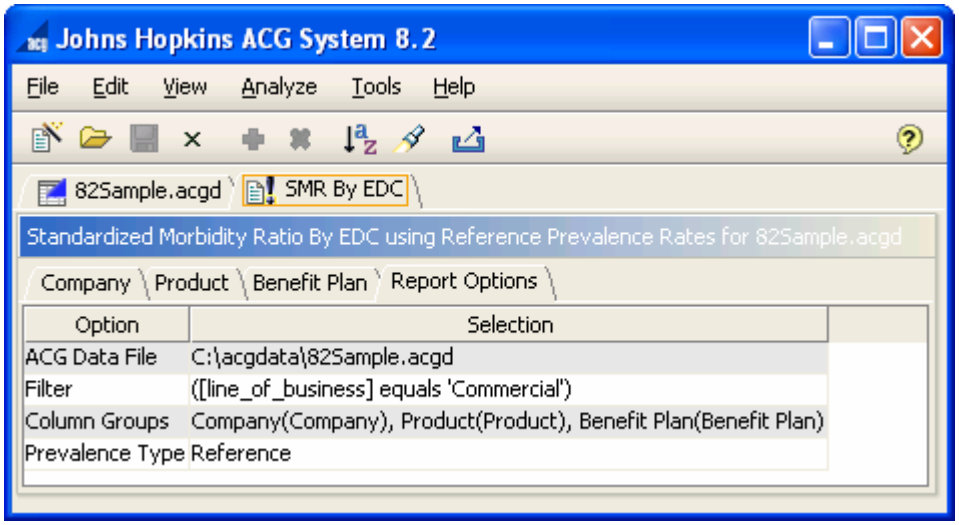
Figure 18: ACG Reports Available for Analysis



◢ ***Tip***: The following sections explain each of these analyses in more detail and this symbol will be used to highlight useful features and/or customizable aspects of the analysis. The reader is encouraged to review these tips along with Analyze Report Options (discussed under Loading the Sample Data Set) on how to take full advantage of the report customization capability of the software using the Filters, Groups and Options capabilities. ’

Note: For each analysis generated, a tab displays any filtering options, analysis groupings or options applied to the analysis (see **Figure 19**).

Figure 19: Report Options



Resource Utilization Band (RUB) Distribution Analysis

ACGs were designed to represent clinically logical categories for persons expected to require similar levels of healthcare resources. However, enrollees with similar predicted (or expected) overall utilization may be assigned different ACGs because they have different epidemiological patterns of morbidity. For example, a pregnant woman with significant morbidity, an individual with a serious psychological condition, or someone with two chronic medical conditions may all be expected to use approximately the same level of resources even though they each fall into different ACG categories. In many instances users may find it useful to collapse the full set of ACGs into fewer categories, particularly where resource use similarity and not clinical cogency is a desired objective. Often a fewer number of combined categories will be easier to handle from an administrative perspective. ACGs can be combined into what we term Resources Utilization Bands (RUBs).

The software automatically assigns 6 RUB classes:

- 0 - No or Only Invalid Dx
- 1 - Healthy Users
- 2 - Low
- 3 - Moderate
- 4 - High
- 5 - Very High

The RUB Distribution Analysis produces a frequency distribution by Resource Utilization Band. The report layout is as follows:

Table 1: RUB Distribution Analysis Report Layout

Column Name	Definition
Resource Utilization Band	Each RUB that was assigned to a patient within the current stratification.
RUB Description	The description for the resource utilization band.
Frequency	The number of patients with this RUB and in this stratification that meet the optional filter criteria.
Freq %	The percentage of patients within this stratification and meeting the optional filter criteria that were assigned this RUB.

The report is useful for providing a quick snapshot of population health and when populations sub-groupings are compared by RUB distribution, it is easy to identify which groups are serving patient populations with more (or less) severe morbidity merely by looking at the percentage with high or very high morbidity (or those with very low morbidity).

◢ ***Tip:*** If generating analyses for similar sub-groups regularly, filters can be saved and recalled for later analyses. This feature is discussed more thoroughly under the "Analyze Report Options" heading.

ACG Distribution Analysis

The foundation of the system is the original Adjusted Clinical Group algorithm. ACGs assign persons to unique, mutually exclusive morbidity categories based on patterns of disease and expected resource requirements. ACGs can be used in place of traditional age/sex categories when attempting to account for variations in morbidity burden across two or more patient populations. A person falls into one of 93 mutually-exclusive ACG health status categories based on a combination of ADGs, age, gender and, if available, birth weight for newborns and delivery status for pregnant womenThe ACG Distribution Analysis produces a frequency distribution by ACG code. The report layout is as follows:

Table 2: ACG Distribution Analysis Report Layout

Column Name	Definition
ACG Cd	Each ACG code that was assigned to a patient.
ACG Description	The description for ACG Cd.
Frequency	The number of patients with this ACG in this stratification meeting the optional

Column Name	Definition
	filter criteria.
Freq %	The percentage of patients within this stratification and meeting the optional filter criteria that were assigned this ACG.

ADG Distribution Analysis

ACGs are based on building blocks called Aggregated Diagnosis Groups (**ADGs**). Each ADG is a grouping of diagnosis codes that are similar in terms of severity and likelihood of persistence of the health condition over time. All ICD-9 codes assigned by clinicians over an extended period, such as a year, are assigned to one of 32 ADGs. ADGs can be considered a type of morbidity marker. A person may have multiple ADGs. The ADG Distribution Analysis produces a frequency distribution by ADG code. Since a patient can be assigned to potentially more than one ADG code, the total frequency will probably be larger than the overall patient count. The report layout is as follows:

Table 3: ADG Distribution Analysis Report Layout

Column Name	Definition
ADG Cd	Each ADG code that was assigned to at least one patient in this stratification.
ADG Description	The description for ADG Cd.
Frequency	The number of patients with this ADG in this stratification meeting the optional filter criteria.
Freq %	The percentage of patients within this stratification and meeting the optional filter criteria that were assigned this ADG.

ADG distributions can quickly demonstrate differences in types of morbidity categories across sub-groupings within your organization. An advantage of ADGs is that they can quickly identify clinically meaningful morbidity trends that may be obscured at the disease-specific or relative morbidity index levels.

Population Distribution by Age Band and Morbidity Analysis

The Population Distribution By Age and Morbidity Analysis produces a frequency distribution by Age Band and Resource Utilization Band. This analysis can be used to directly compare two populations to understand differences in risk and to validate the imported data.

Table 4: Population Distribution by Age Band and Morbidity Analysis Report Layout

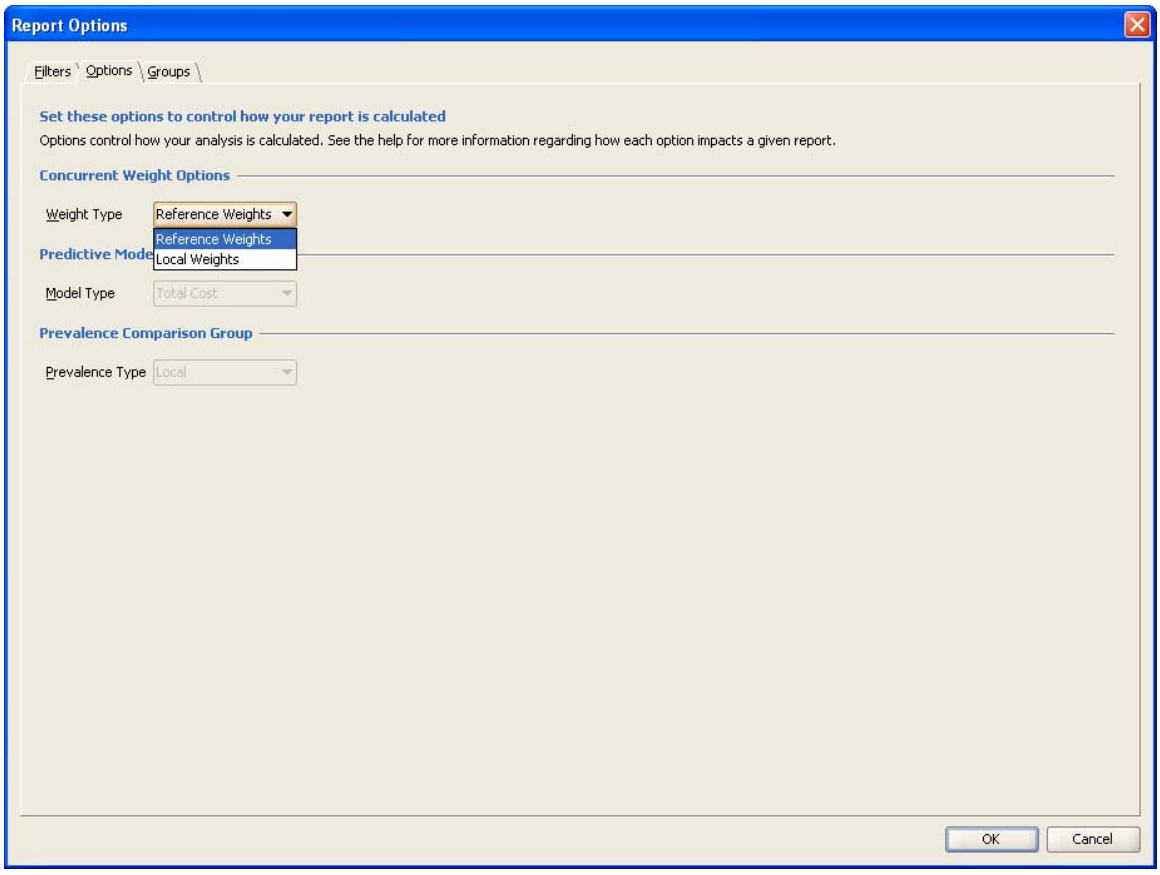
Column Name	Definition
Age Band	Each Age Band that was assigned to a patient within the current stratification.
Patient Count	The number of patients in the related age band and stratification.
RUB 0	The percent of all patients in this stratification in the related Age Band with RUB 0.
RUB 1	The percent of all patients in this stratification in the related Age Band with RUB 1.
RUB 2	The percent of all patients in this stratification in the related Age Band with RUB 2.
RUB 3	The percent of all patients in this stratification in the related Age Band with RUB 3.
RUB 4	The percent of all patients in this stratification in the related Age Band with RUB 4.
RUB 5	The percent of all patients in this stratification in the related Age Band with RUB 5.
Total	The percent of all patients in this stratification in the related Age Band.

MEDC by RUB Distribution Analysis

The MEDC By RUB Distribution Analysis produces a frequency distribution by MEDC and by Resource Utilization Band (RUB). A patient can be assigned to multiple MEDC codes, but only one RUB. This report is useful for case managers because it helps to illustrate that not all individuals with a certain type of condition may be in need of intervention or case management; rather, it is individuals in the far right of the table, those individuals exhibiting a specific condition AND multiple co-occurring conditions who are most likely to need high levels of health care services. This analysis has the option to report the estimated concurrent resource use in terms of local weights or national weights. Using local weights, each of the rows is compared to the average of the population while using reference weights each of the rows is compared to the reference data base described by the Risk Assessment Variables in the Summary Statistics.

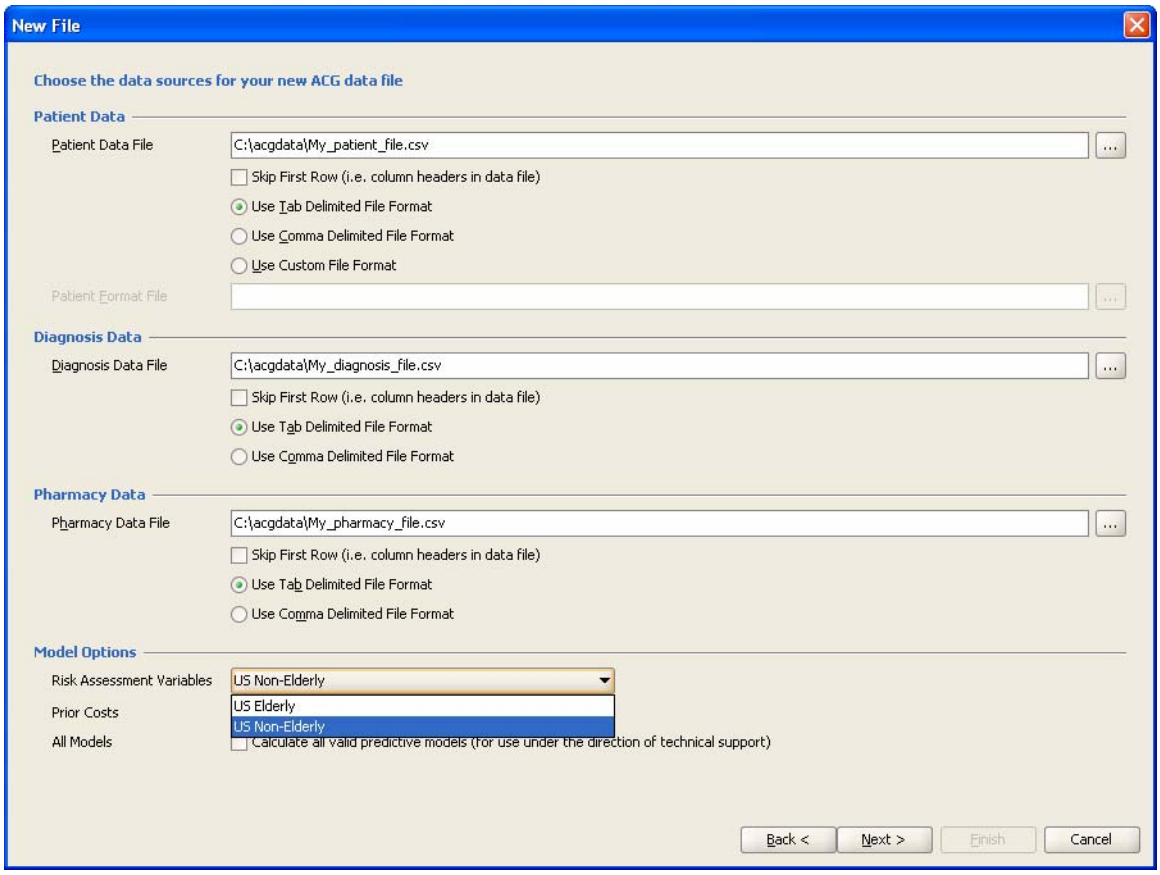
◢ ***Tip*:** Selection of local versus reference weights is determined by selection of Report Options/Options/Weight Type and graphically illustrated in **Figure 20** below.

Figure 20: Report Options for MEDC by RUB Distribution Analysis



◢ ***Tip:*** Risk Assessment Variable, a summary statistic provided on the Summary Statistics and selected during the predictive model selection phase of data input, currently has two defaults, either US elderly or US non-elderly. The underlying weights or predictive modeling scores used in any given report are a function of either the default selected at the time of data input (see **Figure 21** below) OR it is controlled via the Report Options menu shown above in **Figure 20**.

Figure 21: Select the Risk Assessment Variables



Note: The percent distributions are calculated across each row stratification. It is not likely, but possible, for a row to have a total of less than 100% because RUB 0 is not included in the output. The report layout is as follows:

Table 5: MEDC by RUB Distribution Analysis Report Layout

Column Name	Definition
MEDC Cd	Each MEDC code that was assigned to at least one patient with a RUB > 0.
MEDC Description	The description for MEDC Cd.
Total Cases	The number of patients that are assigned the related MEDC Cd.
Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification across all RUBs.
RUB 1 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 1 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 2 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 2 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 3 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 3 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 4 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 4 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 5 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 5 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.

EDC by RUB Distribution Analysis

The EDC by RUB Distribution Analysis produces a frequency distribution by EDC and by Resource Utilization Band (RUB). A patient can be assigned to multiple EDC codes, but only one RUB. This report is useful for case managers because it helps to illustrate that not all individuals with a certain condition may be in need of intervention or case management; rather, it is individuals in the far right of the table, those individuals exhibiting a specific condition AND multiple co-occurring conditions who are most likely to need high levels of health care services. This analysis has the option to report the estimated concurrent resource use in terms of local weights or national weights.

Note: The percent distributions are calculated across each row stratification. It is not likely, but possible, for a row to have a total of less than 100% because RUB 0 is not included in the output. The report layout is as follows:

Table 6: EDC by RUB Distribution Analysis Report Layout

Column Name	Definition
EDC Cd	Each EDC code that was assigned to at least one patient with a RUB > 0.
EDC Description	The description for EDC Cd.
Total Cases	The number of patients that are assigned the related EDC Cd.
Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification across all RUBs.
RUB 1 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 1 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 2 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 2 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 3 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 3 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 4 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.

Column Name	Definition
RUB 4 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 5 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 5 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.

Rx-MG by RUB Distribution Analysis

The Rx-MG by RUB Distribution Analysis produces a frequency distribution of Rx-MG by Resource Utilization Band (RUB). A patient can be assigned to multiple Rx-MG codes, but only one RUB. Just as there is variability of cost across disease category using diagnoses, there is variability of cost across disease category using pharmacy data. This report is useful for case managers because it helps to illustrate that not all individuals taking a certain type of medication may be in need of intervention or case management; rather, it is individuals in the far right of the table, those individuals exhibiting a specific condition AND multiple co-occurring conditions who are most likely to need high levels of health care services. This analysis has the option to report the estimated concurrent resource use in terms of local weights or national weights.

Note: The percent distributions are calculated across each row stratification. It is not likely, but possible, for a row to have a total of less than 100% because RUB 0 is not included in the output. The report layout is as follows:

Table 7: Rx-MG by RUB Distribution Analysis Report Layout

Column Name	Definition
Rx-MG Cd	Each Rx-MG code that was assigned to at least one patient with a RUB > 0.
Rx-MG Description	The description for Rx-MG Cd.
Total Cases	The number of patients that are assigned the related Rx-MG Cd.
Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification across all RUBs.
RUB 1 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 1 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.

Column Name	Definition
RUB 2 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 2 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 3 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 3 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 4 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 4 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.
RUB 5 % Dist	The percentage of patient assignments to this stratification in this RUB is out of the total patients in this RUB.
RUB 5 Est. Concurrent Resource Use	The mean of the national rescaled or local concurrent weight (based upon which weight type was selected in Report Options) for all patients in this stratification in this RUB.

Standardized Morbidity Ratio by EDC Analysis

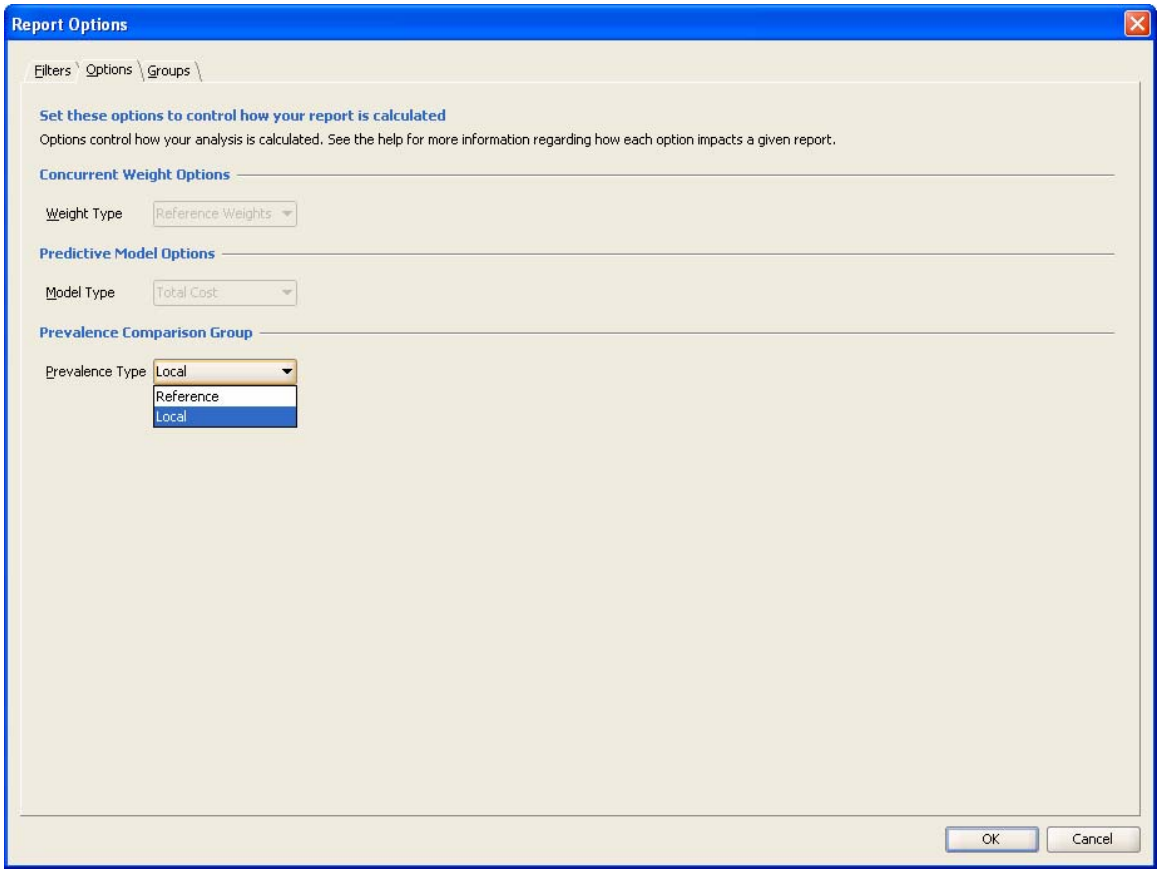
The Standardized Morbidity Ratio Analysis produces a summary by EDC with observed, expected and o/e ratio. This report is useful in understanding how the prevalence of certain conditions, as defined by EDCs, are more or less common than average across the subpopulation of interest. The significance indicator identifies categories that are statistically different from the age/sex adjusted expected value. At the user's discretion, the expected values can be derived from either the population mean or the national benchmark data (see ACG Tip below and remember ACG Tip from above about selecting the appropriate reference benchmark data using the Risk Assessment Variables option on data input). The methodology for calculating the statistics presented in this table are explained more fully in the EDC Chapter in the Reference Manual. The report layout is as follows:

Table 8: Standardized Morbidity Ratio by EDC Analysis Report Layout

Column Name	Definition
EDC Cd	Each EDC code that was assigned to at least one patient.
EDC Name	The description for EDC Cd.
Patient Count	The number of patients assigned this EDC in this stratification.
Observed/1000	The number per 1,000 patients in the current stratification that were assigned to this EDC. Calculated as Patient Count / total Patient Count within the same stratification for all EDCs x 1000.
Age/Sex Expected/1000	The number of expected observations per 1,000 after adjusting for the age/sex distribution in the current stratification. Calculated as total of (overall age/sex prevalence rate x number of patients in age/sex in current stratification) for all age/sex combinations / number of patients in the current stratification for all EDCs x 1000.
SMR	Observed to Expected Ratio. Calculated as (Observed / 1000) / (Age/Sex Expected/1000).
95% Confidence Low	The lower range of the 95% confidence interval. Calculated as SMR - (1.96 x SQRT(SMR / expected count)).
95% Confidence High	The upper range of the 95% confidence interval. Calculated as SMR + (1.96 x SQRT(SMR / expected count)).
Significance	An indication of statistical significance. Contains a "-" (minus sign) when the SMR is significant and less than 1, contains a "+" (plus sign) when the SMR is significant and greater than 1.

◢ ***Tip*:** Local or reference comparisons may be used to produce this report by accessing the Report Options/Options menu shown in **Figure 22** below:

Figure 22: Select Report Options for Standardized Morbidity Ratio by EDC Analysis



Standardized Morbidity Ratio by MEDC Analysis

The Standardized Morbidity Ratio Analysis produces a summary by Major EDC (MEDC) with observed, expected and o/e ratio. This report is useful in understanding how the prevalence of certain conditions, as defined by MEDCs, are more or less common than average across the subpopulation of interest. The significance indicator identifies categories that are statistically different from the age/sex adjusted expected value. At the user's discretion, the expected values can be derived from either the population mean or the national benchmark data. The methodology for this analysis is explained more fully in the EDC Chapter in the Reference Manual. The report layout is as follows:

Table 9: Standardized Morbidity Ratio by MEDC Analysis Report Layout

Column Name	Definition
MEDC Cd	Each MEDC code that was assigned to at least one patient.
MEDC Name	The description for MEDC Cd.
Patient Count	The number of patients assigned this MEDC in this stratification.
Observed/1000	The number per 1,000 patients in the current stratification that were assigned to this MEDC. Calculated as Patient Count / total Patient Count within the same stratification for all MEDCs x 1000.
Age/Sex Expected/1000	The number of expected observations per 1,000 after adjusting for the age/sex distribution in the current stratification. Calculated as total of (overall age/sex prevalence rate x number of patients in age/sex in current stratification) for all age/sex combinations / number of patients in the current stratification for all MEDCs x 1000.
SMR	Observed to Expected Ratio. Calculated as (Observed / 1000) / (Age/Sex Expected/1000).
95% Confidence Low	The lower range of the 95% confidence interval. Calculated as SMR - (1.96 x SQRT (SMR / expected count)).
95% Confidence High	The upper range of the 95% confidence interval. Calculated as SMR + (1.96 x SQRT (SMR / expected count)).
Significance	An indication of statistical significance. Contains a "-" (minus sign) when the SMR is significant and less than 1, contains a "+" (plus sign) when the SMR is significant and greater than 1.

Standardized Morbidity Ratio by Major Rx-MG Analysis

The Standardized Morbidity Ratio Analysis produces a summary by Major Rx-MG with observed, expected and o/e ratio. This report is useful in understanding how the prevalence of certain conditions, as defined by Major Rx-MGs, are more or less common than average across the subpopulation of interest. The significance indicator identifies categories that are statistical different from the age/sex adjusted expected value. At the user's discretion, the expected values can be derived from either the population mean or the national benchmark data. The methodology for this analysis is explained more fully in the EDC Chapter in the Reference Manual. The report layout is as follows:

Table 10: Standardized Morbidity Ratio by Major Rx-MG Analysis Report Layout

Column Name	Definition
Major Rx-MG Cd	Each Major Rx-MG code that was assigned to at least one patient.
Major Rx-MG Name	The description for Major Rx-MG Cd.
Patient Count	The number of patients assigned this Major Rx-MG in this stratification.
Observed/1000	The number per 1,000 patients in the current stratification that were assigned to this Major Rx-MG. Calculated as Patient Count / total Patient Count within the same stratification for all Major Rx-MGs x 1000.
Age/Sex Expected/1000	The number of expected observations per 1,000 after adjusting for the age/sex distribution in the current stratification. Calculated as total of (overall age/sex prevalence rate x number of patients in age/sex in current stratification) for all age/sex combinations / number of patients in the current stratification for all Major Rx-MGs x 1000.
SMR	Observed to Expected Ratio. Calculated as (Observed / 1000) / (Age/Sex Expected/1000).
95% Confidence Low	The lower range of the 95% confidence interval. Calculated as SMR - (1.96 x SQRT(SMR / expected count)).
95% Confidence High	The upper range of the 95% confidence interval. Calculated as SMR + (1.96 x SQRT(SMR / expected count)).
Significance	An indication of statistical significance. Contains a "-" (minus sign) when the SMR is significant and less than 1, contains a "+" (plus sign) when the SMR is significant and greater than 1.

Standardized Morbidity Ratio by Rx-MG Analysis

The Standardized Morbidity Ratio Analysis produces a summary by Rx-MG with observed, expected and o/e ratio. This report is useful in understanding how the prevalence of certain conditions, as defined by Rx-MGs, are more or less common than average across the subpopulation of interest. The significance indicator identifies categories that are statistical different from the age/sex adjusted expected value. At the user's discretion, the expected values can be derived from either the population mean or the national benchmark data. The methodology for this analysis is explained more fully in the EDC Chapter in the Reference Manual. The report layout is as follows:

Table 11: Standardized Morbidity Ratio by Rx-MG Analysis Report Layout

Column Name	Definition
Rx-MG Cd	Each Rx-MG code that was assigned to at least one patient.
Rx-MG Name	The description for Rx-MG Cd.
Patient Count	The number of patients assigned this Rx-MG in this stratification.
Observed/1000	The number per 1,000 patients in the current stratification that were assigned to this Rx-MG. Calculated as Patient Count / total Patient Count within the same stratification for all Rx-MGs x 1000.
Age/Sex Expected/1000	The number of expected observations per 1,000 after adjusting for the age/sex distribution in the current stratification. Calculated as total of (overall age/sex prevalence rate x number of patients in age/sex in current stratification) for all age/sex combinations / number of patients in the current stratification for all Rx-MGs x 1000.
SMR	Observed to Expected Ratio. Calculated as (Observed / 1000) / (Age/Sex Expected/1000).
95% Confidence Low	The lower range of the 95% confidence interval. Calculated as SMR - (1.96 x SQRT (SMR / expected count)).
95% Confidence High	The upper range of the 95% confidence interval. Calculated as SMR + (1.96 x SQRT (SMR / expected count)).
Significance	An indication of statistical significance. Contains a "-" (minus sign) when the SMR is significant and less than 1, contains a "+" (plus sign) when the SMR is significant and greater than 1.

Cost Predictions by Select Conditions Analysis

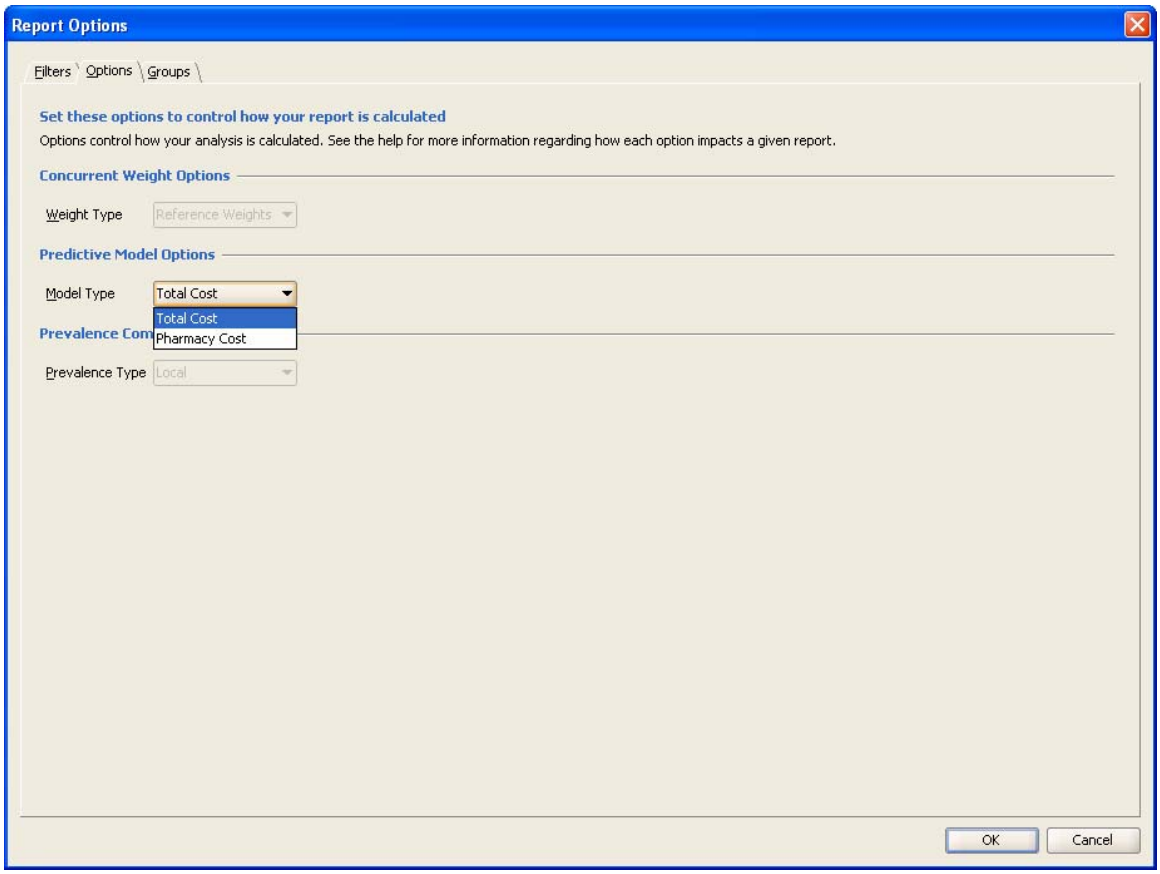
The Cost Predictions by Select Conditions Analysis describes risks and predicts expenditures in the subsequent time period for selected medical conditions.. This analysis allows the user to stratify a particular population by predicted risk. This can be helpful in sizing programs or understanding the resource expectations for specific risk groups. At the user's discretion, the average predicted resource use columns may be selected to reflect either total cost (including pharmacy cost) or pharmacy cost only. The report layout is as follows:

Table 12: Cost Predictions by Select Conditions Analysis Report Layout

Column Name	Definition
Condition	Selected medical conditions and ALL CASES (which includes all patients, even those without any of the listed conditions).
Total Cases	The number of patients that had Condition within the current stratification.
Cases Prob<0.4	The number of Total Cases that have a probability of being high cost < 0.4.
Cases Prob≥0.4	The number of Total Cases that have a probability of being high cost ≥ 0.4.
Cases Prob≥0.6	The number of Total Cases that have a probability of being high cost ≥ 0.6.
Cases Prob≥0.8	The number of Total Cases that have a probability of being high cost ≥ 0.8.
Avg. Pred. Resource Use	The mean of the predicted cost resource index for all patients within the current stratification.
Avg. Pred. Resource Use Prob<0.4	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost < 0.4.
Avg. Pred. Resource Use Prob≥0.4	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost ≥ 0.4.
Avg. Pred. Resource Use Prob≥0.6	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost ≥ 0.6.
Avg. Pred. Resource Use Prob≥0.8	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost ≥ 0.8.

◢ ***Tip*:** Use the Report Options/Options/Model type (**Figure 23** below) to control whether the Avg. Pred. Resource Use displayed is Total Cost or Pharmacy Cost.

Figure 23: Selecting Report Options for Cost Predictions by Select Conditions Analysis



Cost Predictions by Rx-MGs Analysis

The Cost Predictions by Rx-MGs describes risks and predicts expenditures in the subsequent time period by Rx-MGs (and using only pharmacy data). This analysis allows the user to stratify a particular population by predicted risk. This can be helpful in sizing programs or understanding the resource expectations for specific risk groups. The average predicted resource use columns have the option reflect total cost or pharmacy cost. The report layout is as follows:

Table 13: Cost Predictions by Rx-MGs Analysis Report Layout

Column Name	Definition
Rx-Morbidity Groups	Rx-MGs and ALL CASES (all patients, even those without any of the listed Rx-MGs.
Total Cases	The number of patients that had Rx-Morbidity Group within the current stratification.
Cases Prob<0.4	The number of Total Cases that have a probability of being high cost < 0.4.
Cases Prob≥0.4	The number of Total Cases that have a probability of being high cost ≥ 0.4.
Cases Prob≥0.6	The number of Total Cases that have a probability of being high cost ≥ 0.6.
Cases Prob≥0.8	The number of Total Cases that have a probability of being high cost ≥ 0.8.
Avg. Pred. Resource Use	The mean of the predicted resource use for all patients within the current stratification.
Avg. Pred. Resource Use Prob<0.4	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost < 0.4.
Avg. Pred. Resource Use Prob≥0.4	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost ≥ 0.4.
Avg. Pred. Resource Use Prob≥0.6	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost ≥ 0.6.
Avg. Pred. Resource Use Prob≥0.8	The mean of the predicted cost resource index for all patients within the current stratification that have a probability of being high cost ≥ 0.8.

Actuarial Cost Projections

The Actuarial Cost Report represents a summary of information relevant for actuarial purposes and for differentiating groups as high medium and low risk. This analysis provides a number of aggregate measures for both current and future costs expressed as a relative index (scores equal to 1.0 indicate average morbidity or risk, greater than 1.0 indicate greater than average morbidity burden or risk and less than 1.0 less than average). The Reference CMI is a concurrent measure that compares the group case mix to the referenced benchmark used in the selected Risk Assessment Variables based on the mix of ACGs assigned to the members of the group. The Local CMI is a similar measure but the comparison group is based on the population presented to the ACG System. Mean Total PRI is a measure of prospective risk using the ACG predictive model to forecast total cost relative to the plan average. Likewise, the Mean Rx PRI measures the prospective risk of pharmacy cost relative to the plan average. These resource indicators can be compared to the age-sex relative risk. When age-sex relative risk is equal to the local CMI, the risk is driven by the age and sex of the group. When age-sex relative risk is lower than the local CMI, the risk is driven by disease burden more than the age-sex mix of the group. There is an additional index of the observed cost to the expected cost (accounting for the local CMI) as a measure of how efficiently the group utilizes services as compared to the population mean.

There are additional rate-based measures provided to describe the factors contributing to group risk. Groups with higher disease burdens will also generally tend to have higher prevalence rates of high risk members who are more likely to have chronic conditions, higher rates of hospital dominant and frailty conditions, and higher rates of psychosocial conditions. Comparisons can be made between the group and the population mean by comparing the groups tab to the "overall" tab in the analysis window.

The report layout is as follows: **(Note:** The columns that are marked with a (D) only appear when diagnosis data is present in the model.)

Table 14: Actuarial Cost Projections Report Layout

Column Name	Definition
# Cases	Number of patients in this stratification.
National CMI (D)	Average of National Unscaled Concurrent Weight in this stratification. Scores <1.0 indicate healthier, >1.0 indicate sicker than the reference population.
Local CMI (D)	Average of Local Concurrent Weight in this stratification. Useful only for sub-group analysis. Equal to 1.0 for the total population, interpretation the same as National CMI for population sub-groupings.
Mean Total PRI	Average or Rescaled Total Cost Resource Index for patients in this stratification.
Mean Rx PRI	Average or Rescaled Pharmacy Cost Resource Index for patients in this stratification.
% High Risk	Percent of patients with Probability High Total Cost > 0.4 in this stratification.
% HOSDOM (D)	Percent of patients with Hospital Dominant Count ≥ 1 in this stratification.
% Frail (D)	Percent of patients with indications of Frailty in this stratification.
% Psychosocial	Percent of patients with indications of Psychosocial conditions in this stratification.
% Discretionary (D)	Percent of patients with indications of discretionary diagnoses in this stratification.
Age/Sex Relative Risk	The age/sex adjusted relative risk for all patients in this stratification.
Observed to Expected (D)	Observed to Expected ratio, calculated as actual cost / ACG adjusted expected cost. Useful only for sub-group analysis. Scores <1.0 consuming less than expected, >1.0 consuming more than expected.

Simple Profile Analysis

The Simple Profile Analysis compares actual costs to expected costs to present a simplified profile. The report layout and description of the calculation of each data field is as follows:

Table 15: Simple Profile Analysis Report Layout

Column Name	Definition
Patient Count	The number of patients within the current stratification.
Total Actual Cost	Sum of total cost within the current stratification.
Plan Average Total Cost	Sum of total cost / total patient count for entire plan. Note this is taken from the complete data file, ignoring any report-specific filters are applied.
Actual To Plan Average	A ratio expressing the actual cost to plan average cost. A value greater than 1 indicates the actual cost is greater than the plan average. Calculated as Total Actual Cost / Patient Count / Plan Average Total Cost
ACG Adjusted Expected Cost	Expected costs based upon the ACGs experienced within the current stratification. Calculated as the sum of (number of patients within each ACG within the current stratification x the plan-wide average cost per ACG) for all ACGs. Note that the plan-wide average cost per ACG is taken from the complete data file, ignoring any report-specific filters.
Expected to Plan Average	A ratio expressing the expected cost to the plan average cost. A value greater than 1 indicates that the expected costs were higher than the actual costs. Calculated as ACG Adjusted Expected Cost / Patient Count / Plan Average Total Cost.
Actual to Expected Ratio	A ratio expressing the actual costs to the ACG expected costs. A value greater than 1 indicates that the actual costs were higher than the expected costs. Calculated as Total Actual Cost / ACG Adjusted Expected Cost.
Case-Mix vs. National Reference Data	Calculated as the mean of National Unscaled Concurrent Weight within the current stratification.

For additional details on the calculation and interpretation of these statistics please refer to the chapter on Provider Performance Assessment in the Reference Manual.

Care Management List

The Care Management List produces the 1,000 patients that match the selected filters that have the highest probability of having high total costs in the year following the observation period. The data is sorted in descending order by the Probability High Total Cost. The user can use the filtering criteria to isolate a more targeted cohort of patients for further analysis and review. For example, identifying current low users with the high probability of future expense captures individuals who may have the greatest opportunity for early intervention before expenses escalate.

A single member or the filtered list can be sent to the Patient Clinical Profile Report for additional information. The list layout is as follows:

Table 16: Care Management List Layout

Column Name	Definition
Patient ID	A unique identifier for the patient.
Age	The patient's age at the end of the observation period.
Sex	The patient's sex.
Total Cost	The total medical and pharmacy cost for this patient during the observation period.
Rescaled Total Cost Resource Index	The rescaled (adjusted with local data) estimated total costs for the year following the observation period, expressed as a relative weight.
Probability High Total Cost	The probability that this patient will have high total costs in the year following the observation period.
Hospital Dominant Count	The number of ADGs this patient has that indicate hospital dominant diagnoses.
Chronic Condition Count	The number of EDCs this patient has that indicate chronic condition diagnoses.
Frailty Flag	A flag indicating that this patient appears to be clinically frail.
Arthritis	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Asthma	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Congestive Heart Failure	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).

Column Name	Definition
Chronic Renal Failure	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
COPD	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Depression	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Diabetes	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Hyperlipidemia	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Ischemic Heart Disease	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Low Back Pain	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).

Patient Clinical Profile Report

The Patient Clinical Profile Report produces a report for one or more patients that presents a profile of their current and predicted costs, along side relative predicted resource utilization, and clinical indicators. This report assists clients with understanding member level risk and resource needs. It is intended to assist with the clinical screening process.

Table 17: Patient Clinical Profile Report Layout

Column Name	Definition
Patient Id	The patient's unique identifier.
PCP Id	The primary care practitioner assigned to the patient.
Product	The product identifier the patient is assigned to.
Age	The patient's age in years.
Gender	The patient's gender (F=Female, M=Male).
Resource Utilization Band	The resource utilization band assigned to this patient.
Local Weight	The local concurrent weight assigned to this patient. This weight represents the relative expected resource utilization for this patient, based upon their ACG code.
Chronic Condition Count	The chronic condition count assigned to this patient.
Hospital Dominant Count	The hospital dominant count assigned to this patient.
Frailty Flag	The frailty flag for this patient (Y/N).
Total Cost	The patient's total costs during the observation period.
Rx Cost	The patient's pharmacy costs during the observation period.
Model	The specific ACG model parameters used in predicting total cost and pharmacy cost
Probability High Total Cost	The probability that this patient will be in the top 5 percent of total cost in the subsequent year.
Predicted Total Cost Range	The predicted total cost for this patient for the subsequent year.

Column Name	Definition
Probability High Rx Cost	The probability that this patient will be in the top 5 percent of pharmacy cost in the subsequent year.
Predicted Rx Cost Range	The predicted pharmacy cost for this patient for the subsequent year.
Asthma	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Arthritis	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Congestive Heart Failure	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
COPD	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Chronic Renal Failure	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Depression	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Diabetes	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Hyperlipidemia	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Hypertension	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).

Column Name	Definition
Ischemic Heart Disease	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Low Back Pain	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
High Impact Conditions	A subset of EDCs and Rx-MGs assigned to the current patient and which are expected to have a significant contribution to future cost
Moderate Impact Conditions	A subset of EDCs and Rx-MGs assigned to the current patient and which are expected to have a moderate contribution to future cost
Low Impact Conditions	A subset of EDCs and Rx-MGs assigned to the current patient and which are expected to have minimal contribution to future cost

Patient List Analysis

The patient list analysis generates all of the output of the system as a single row per patient. This is very similar to the information that is presented in the patient sample, but the user may apply filters prior to exporting the data.

Table 18: Patient List Analysis Report Layout

Column Name	Definition
Pharmacy Cost Band	A banded indicator of historic pharmacy costs based upon pharmacy cost percentiles. Possible values include: • 0 - 0 pharmacy costs. • 1 - 1-10 percentile. • 2 - 11-25 percentile. • 3 - 26-50 percentile. • 4 - 51-75 percentile. • 5 - 76-90 percentile. • 6 - 91-93 percentile. • 7 - 94-95 percentile. • 8 - 96-97 percentile. • 9 - 98-99 percentile.
Total Cost Band	A banded indicator of historic total costs based upon total cost percentiles. Possible values include: • 0 - 0 total costs. • 1 - 1-10 percentile. • 2 - 11-25 percentile. • 3 - 26-50 percentile. • 4 - 51-75 percentile. • 5 - 76-90 percentile. • 6 - 91-93 percentile. • 7 - 94-95 percentile. • 8 - 96-97 percentile. • 9 - 98-99 percentile.
Age Band	A banded indicator of patient age. Possible values include: • <0

Column Name	Definition
	• 00-04 • 05-11 • 12-17 • 18-34 • 35-44 • 45-54 • 55-69 • 70-74 • 75-79 • 80-84 • 85+ • Unknown
ACG Cd	Adjusted Clinical Groups -- the ACG code assigned to this patient. ACGs assign persons to unique, mutually exclusive morbidity categories based on patterns of disease and expected resource requirements.
Resource Utilization Band	Aggregations of ACGs based upon estimates of concurrent resource use providing a way of separating the population into broad co-morbidity groupings as follows: • 0 - No or Only Invalid Dx • 1 - Healthy Users • 2 - Low • 3 - Moderate • 4 - High • 5 - Very High
National Unscaled Weight	An estimate of concurrent resource use associated with a given ACG based on a national reference database and expressed as a relative value. Each patient is assigned a weight based on their ACG Cd.
National Rescaled Weight	National weights that are rescaled so that the mean across the population is 1.0.
Local Weight	A concurrent weight assigned to this patient based upon their ACG Cd using local cost data. The weight for each ACG is calculated as the simple average total cost of all individuals assigned to each category divided by the average total cost of all

Column Name	Definition
	individuals in the source data file.
ADG Codes	Aggregated Diagnosis Groups -- the building blocks of the ACG System, each ADG is a grouping of diagnosis codes that are similar in terms of severity and likelihood of persistence of the health condition over time. This column contains a listing of all ADG codes assigned to this patient, separated by spaces.
ADG Vector	A vector of zeros and ones to indicate which ADG codes this patient was assigned. A "1" in the fifth position indicates the patient was assigned ADG 5. "ADG" is prepended to this vector as a convenience to help other database systems (like Microsoft Access) treat this vector as a String. **Note:** ADG15 and ADG19 are no longer in use and thus should always be zero.
EDC Codes	Expanded Diagnosis Clusters -- all of the EDC codes assigned to this patient, separated by spaces. The EDC taxonomy identifies patients with specific diseases or symptoms that are treated in ambulatory and inpatient settings.
MEDC Codes	Major Expanded Diagnoses Clusters -- All of the MEDC codes assigned to this patient, separated by spaces. The EDC taxonomy is structured into broad clinical categories, called MEDCs.
Rx-MG Codes	Pharmacy Morbidity Group Codes -- all of the Rx-MG codes assigned to this patient, separated by spaces.
Major Rx-MG Codes	Major Pharmacy Morbidity Group Codes -- All of the Major Rx-MG codes assigned to this patient, separated by spaces.
Major ADG Count	The number of major ADGs assigned to this patient. A "major ADG" is an ADG found to have a significant impact on concurrent or future resource consumption. There are separate "major ADGs" for pediatric and adult populations.
Frailty Flag	A flag for any one of 11 diagnostic clusters that represent discrete conditions consistent with frailty (e.g., malnutrition, dementia, incontinence, difficulty in walking, ...)
Hospital Dominant Count	A count of ADGs containing trigger diagnoses indicating a high probability (typically greater than 50 percent) of future admission.

Column Name	Definition
Chronic Condition Count	A count of EDCs containing trigger diagnoses indicating a chronic condition with significant expected duration and resource requirements.
Asthma	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Arthritis	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Congestive Heart Failure	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
COPD	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Chronic Renal Failure	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Depression	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Diabetes	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Hyperlipidemia	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Hypertension	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Ischemic Heart Disease	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication,

Column Name	Definition
	BTH=ICD and Rx Indication).
Low Back Pain	A flag indicating if this patient has this medical condition and how it was indicated (NP=Not Present, ICD=ICD Indication, Rx=Rx Indication, BTH=ICD and Rx Indication).
Unscaled Total Cost Resource Index	ACG Predictive Model (ACG-PM) Predicted Resource Index (PRI) for Total Cost -- the estimated total costs (including pharmacy costs) for this patient for the year following the observation period. Based upon a national reference database (with a mean of 1.0), the predicted value is expressed as a relative weight. Population or sub-group analyses provide comparisons to national norms. Value based on best model selection. The model used can be found in the Summary Statistics.
Rescaled Total Cost Resource Index	The Total Cost Resource Index rescaled so that the local population mean is 1.0. Sub-group analyses provide comparisons to local norms.
Probability High Total Cost	ACG-PM Probability Score for total cost -- the probability that this patient will have high total costs (including pharmacy costs) in the year following the observation period.
Unscaled Pharmacy Cost Resource Index	ACG-PM PRI Score for Pharmacy Costs -- the estimated pharmacy costs for this patient for the year following the observation period. Based upon a national reference database (with a mean of 1.0), the predicted value is expressed as a relative weight. Population or sub-group analyses provide comparisons to national norms. Value based on best model selection. The model used can be found in the Summary Statistics.
Rescaled Pharmacy Cost Resource Index	The Pharmacy Cost Resource Index rescaled so that the overall population mean is 1.0. Sub-group analyses provide comparisons to local norms.
Probability High Pharmacy Cost	ACG-PM Probability Score for pharmacy cost -- the probability that this patient will have high pharmacy costs in the year following the observation period.

Warning List

The Warning List produces a list of all patients that had ACG calculation warnings. The list layout is as follows:

Table 19: Warning List Layout

Column Name	Definition
Patient ID	A unique identifier for this patient.
ACG Cd	The ACG code that was assigned to this patient.
Age	The patient's age as of the end of the observation period.
Sex	The patient's gender.
Total Cost	The total medical and pharmacy costs for this patient during the observation period.
Pharmacy Cost	The total pharmacy costs for this patient during the observation period.
Warning Codes	A set of warnings that were generated for this member during the ACG grouping process. The possible codes include: • 6 means the patient was greater than 107 years old. • 7 means the person was pregnant but not a female. • 8 means the person was pregnant but not of child bearing age (<5 or >55). • 11 means there was an indication of delivery but not of pregnancy, and the person was of child bearing years, so the patient is assumed to be pregnant. • 12 means the patient had $0 total costs, but had diagnoses. • 13 means the patient had $0 pharmacy costs, but had pharmacy codes.

Review of data warnings is an important part of assuring data quality.

Warning Distribution Analysis

The Warning Distribution Analysis produces a frequency distribution by Warning. The report layout is as follows:

Table 20: Warning Distribution Analysis Report Layout

Column Name	Definition
Warning Code	Each warning that was assigned to a patient within the current stratification.
Warning Description	The description for the warning.
Frequency	The number of patients that encountered this warning within this stratification.
Freq %	The percentage that frequency represents out of the total patients processed.

Tools Menu

The Tools menu provides access to the export utility which exports both the data and/or reports produced by the software. The Tools menu also provides management functions for installing license files and updated mappings. See the section on Installing the Software for more information on these functions.

Help Menu

The Help menu provides access to quick reference information for the ACGs for Windows interface. Much of the information provided below is also accessible directly from within the software.

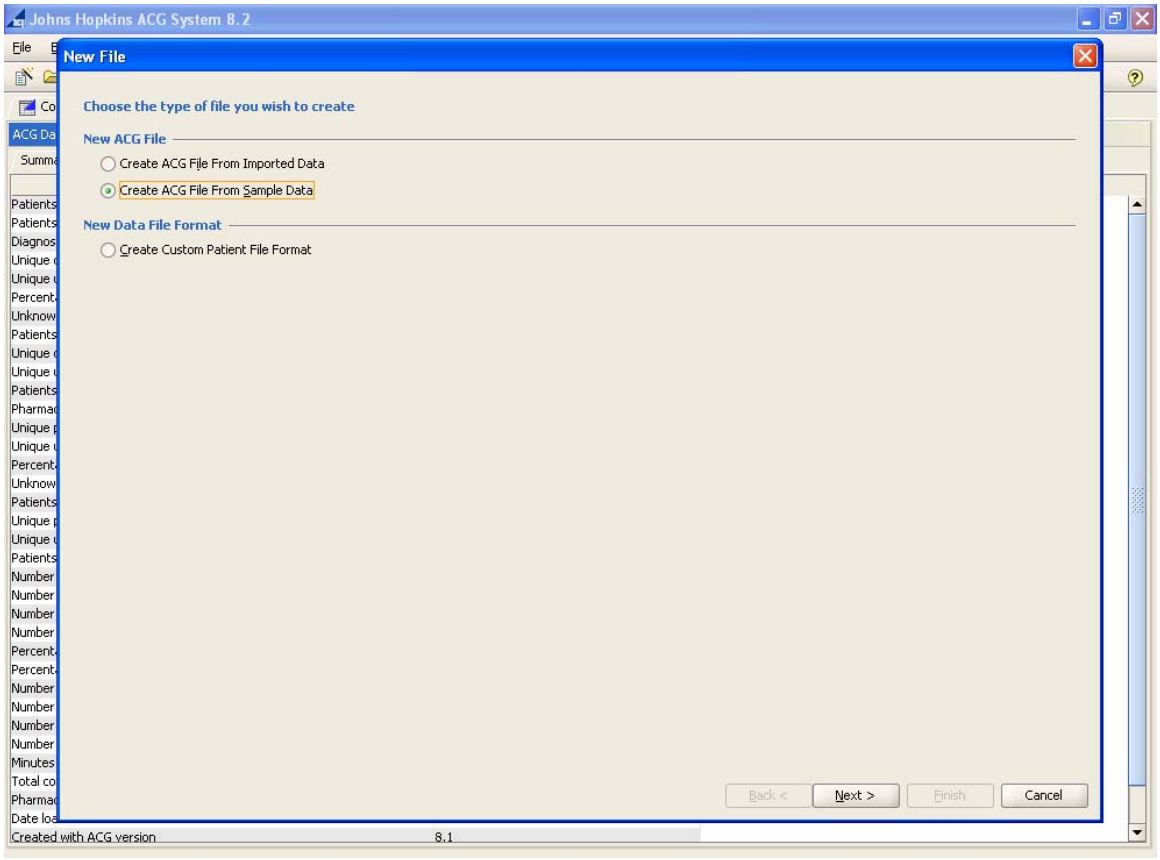
Load the Sample Dataset

The ACG System Version 8.2 includes sample data representing approximately 20,000 members. The sample data is provided to familiarize users with the system and it will be used here to demonstrate use of the software.

Use the following instructions to begin using the sample data from within the Johns Hopkins ACG System Desktop:

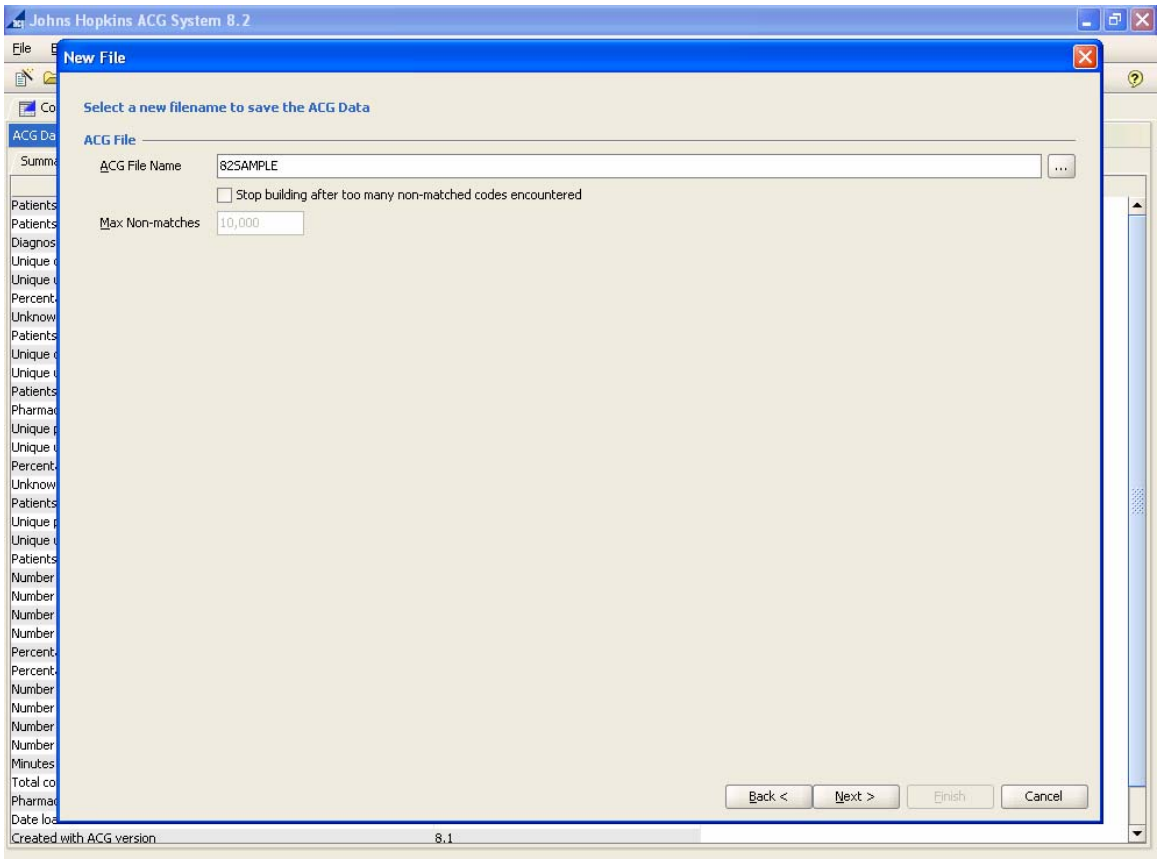
1. Select **File**
2. Select **New**
3. From the New File window, click the radial button for **Create ACG File From Sample Data**
4. Click **Next**

Figure 24: Create ACG File from Sample Data



5. When prompted, type the name of the file to which the ACG database will be saved.

Figure 25: Save ACG Sample



6. Click **Next**

7. Click **Finish**

◢ ***Tip*:** To open an existing data file, select the folder button in the tool bar and then navigate to the destination folder.

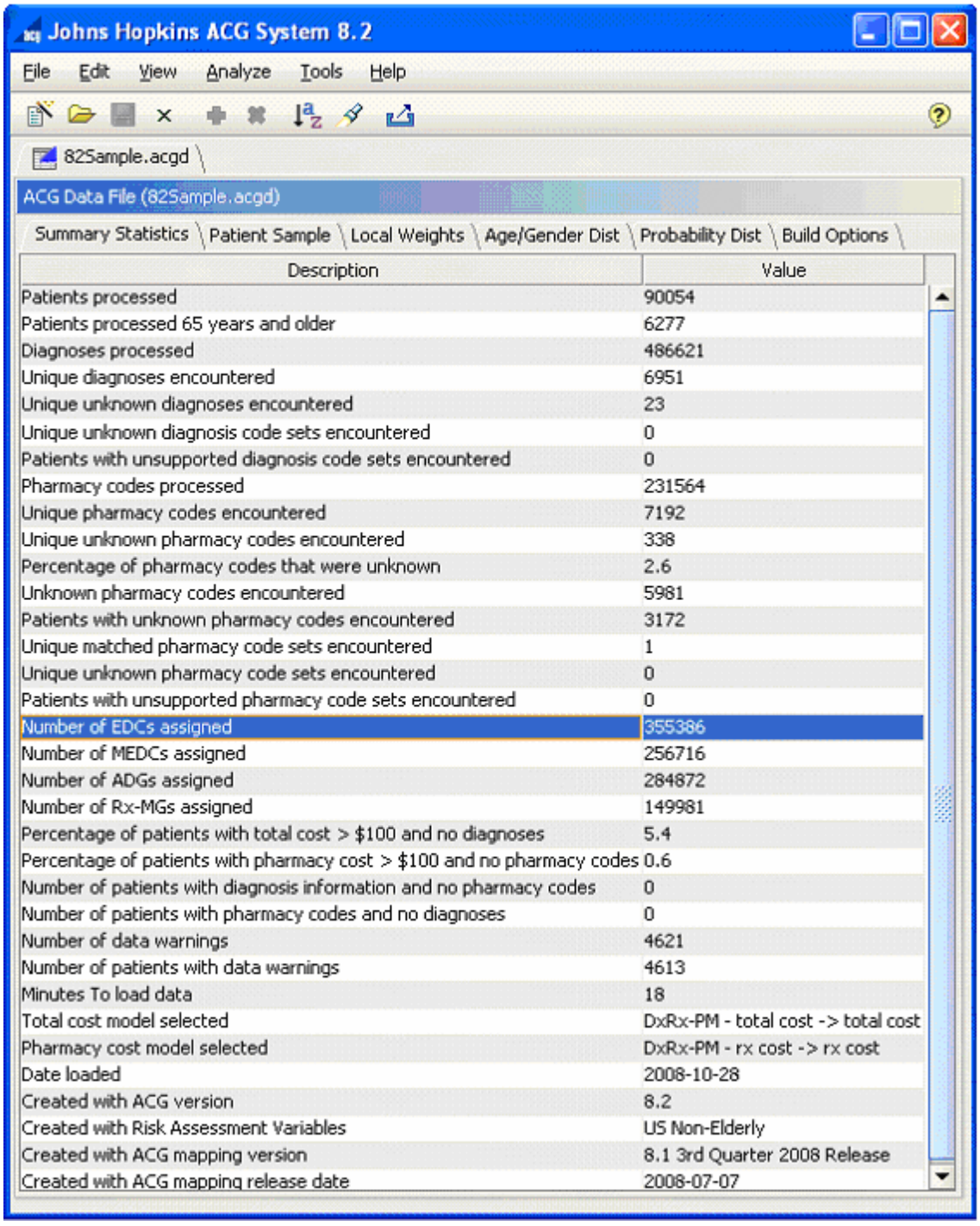
View Results of the Grouping Process

Once the ACG processing is complete, you are returned to the ACGs for Windows desktop. You can now begin to review the results of the grouping process, customize the standard analyses using filters and groups, or save the data for future review and/or analysis. The following three report tabs will be on the desktop:

Summary Statistics Tab

The first tab presented is Summary Statistics. This information should be used to validate the number of input records, data warnings, and percentage of non-grouped diagnosis and pharmacy codes. Percentages of non-grouped codes above 1% for diagnoses and above 10% for pharmacy codes warrant further investigation.

Figure 26: Summary Statistics



Description	Value
Patients processed	90054
Patients processed 65 years and older	6277
Diagnoses processed	486621
Unique diagnoses encountered	6951
Unique unknown diagnoses encountered	23
Unique unknown diagnosis code sets encountered	0
Patients with unsupported diagnosis code sets encountered	0
Pharmacy codes processed	231564
Unique pharmacy codes encountered	7192
Unique unknown pharmacy codes encountered	338
Percentage of pharmacy codes that were unknown	2.6
Unknown pharmacy codes encountered	5981
Patients with unknown pharmacy codes encountered	3172
Unique matched pharmacy code sets encountered	1
Unique unknown pharmacy code sets encountered	0
Patients with unsupported pharmacy code sets encountered	0
Number of EDCs assigned	355386
Number of MEDCs assigned	256716
Number of ADGs assigned	284872
Number of Rx-MGs assigned	149981
Percentage of patients with total cost > $100 and no diagnoses	5.4
Percentage of patients with pharmacy cost > $100 and no pharmacy codes	0.6
Number of patients with diagnosis information and no pharmacy codes	0
Number of patients with pharmacy codes and no diagnoses	0
Number of data warnings	4621
Number of patients with data warnings	4613
Minutes To load data	18
Total cost model selected	DxRx-PM - total cost -> total cost
Pharmacy cost model selected	DxRx-PM - rx cost -> rx cost
Date loaded	2008-10-28
Created with ACG version	8.2
Created with Risk Assessment Variables	US Non-Elderly
Created with ACG mapping version	8.1 3rd Quarter 2008 Release
Created with ACG mapping release date	2008-07-07

Which Predictive Model

The Summary Statistics Tab also provides the user with information on which predictive model was used in selecting the scores (predictions of total cost, pharmacy cost and probability scores for high total cost and high pharmacy costs) in the summary patient file. The descriptions for each model are described in four sections using the following example:

Total Cost Model Selected	DxRx-PM[1] - total cost[2] → total cost[3]
Risk Assessment Variables	US non-elderly[4]

[1] Indicates the type of ACG predictive model. Possible values include:

Dx-PM (for diagnosis based predictive modeling),

Rx-PM (for pharmacy based predictive modeling), or

DxRx-PM (for diagnosis plus pharmacy based predictive modeling).

[2] Indicates whether or not and the type of prior cost information included in the calibration of the predictive model. Possible values include:

No cost (for no cost information was incorporated),

Total cost (for total cost), or

Rx cost (for pharmacy cost).

[3] Indicates what is being predicted. Possible values include:

Total cost (for total cost)

Rx cost (for pharmacy cost).

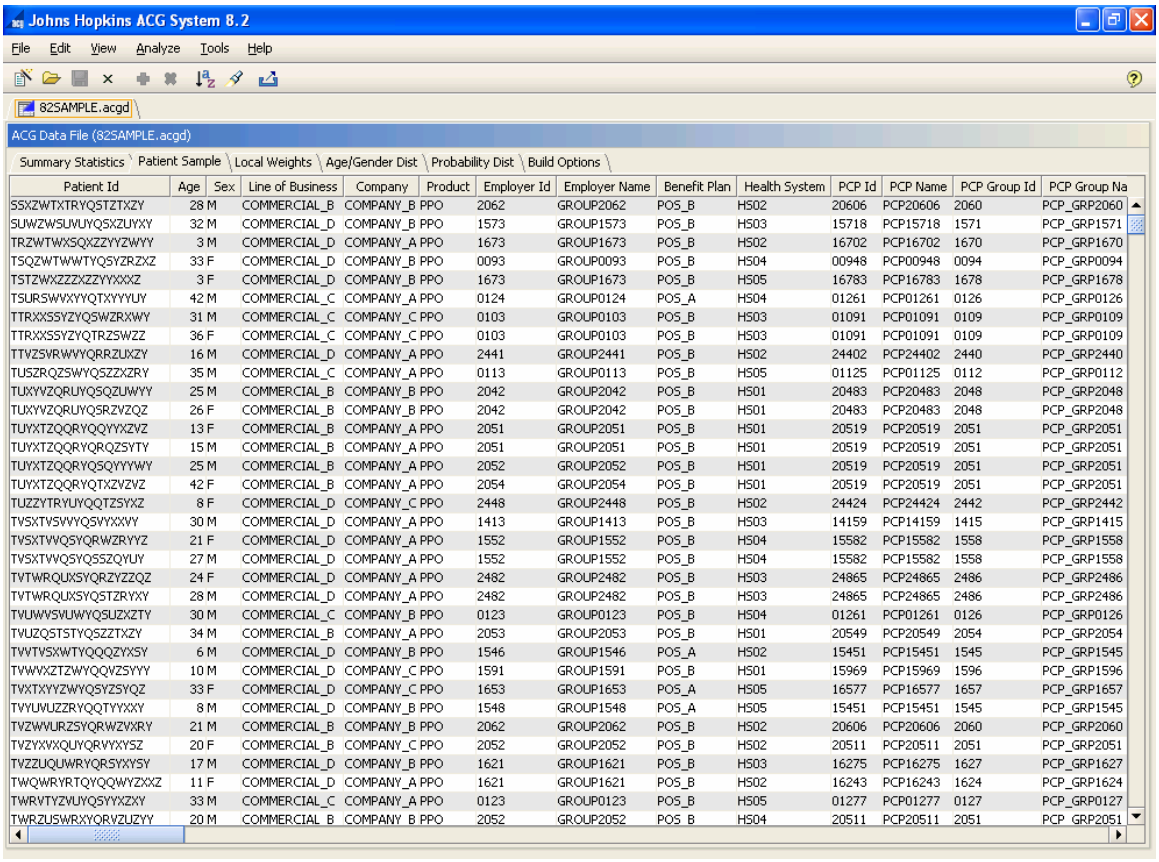
[4] Indicates the population to which the model has been calibrated. Possible values include:

US Non-elderly for less than 65 years old and

US Elderly for populations 65 years or older.

Figure 27: Patient Sample Tab

The Patient Sample tab is a sample of records from the ACG output file.



Patient Id	Age	Sex	Line of Business	Company	Product	Employer Id	Employer Name	Benefit Plan	Health System	PCP Id	PCP Name	PCP Group Id	PCP Group Na
SSXZWTXTRYQSTZTXZY	28	M	COMMERCIAL_B	COMPANY_B	PPO	2062	GROUP2062	POS_B	HS02	20606	PCP20606	2060	PCP_GRP2060
SUWZWSUVUYQSXZUYXY	32	M	COMMERCIAL_D	COMPANY_B	PPO	1573	GROUP1573	POS_B	HS03	15718	PCP15718	1571	PCP_GRP1571
TRZWTWXSQXZZYYZWYY	3	M	COMMERCIAL_D	COMPANY_A	PPO	1673	GROUP1673	POS_B	HS02	16702	PCP16702	1670	PCP_GRP1670
TSQZWTWWTYQSYZRZXZ	33	F	COMMERCIAL_D	COMPANY_B	PPO	0093	GROUP0093	POS_B	HS04	00948	PCP00948	0094	PCP_GRP0094
TSTZWXZZZXZZYYXXXZ	3	F	COMMERCIAL_D	COMPANY_B	PPO	1673	GROUP1673	POS_B	HS05	16783	PCP16783	1678	PCP_GRP1678
TSURSWVXYYQTXYYYUY	42	M	COMMERCIAL_C	COMPANY_A	PPO	0124	GROUP0124	POS_A	HS04	01261	PCP01261	0126	PCP_GRP0126
TTRXXSSYZYQSWZRXWY	31	M	COMMERCIAL_C	COMPANY_C	PPO	0103	GROUP0103	POS_B	HS03	01091	PCP01091	0109	PCP_GRP0109
TTRXXSSYZYQTRZSWZZ	36	F	COMMERCIAL_C	COMPANY_C	PPO	0103	GROUP0103	POS_B	HS03	01091	PCP01091	0109	PCP_GRP0109
TTVZSVRWYYQRRZUXZY	16	M	COMMERCIAL_D	COMPANY_A	PPO	2441	GROUP2441	POS_B	HS02	24402	PCP24402	2440	PCP_GRP2440
TU5ZRQZSWYQ5ZZXZRY	35	M	COMMERCIAL_C	COMPANY_A	PPO	0113	GROUP0113	POS_B	HS05	01125	PCP01125	0112	PCP_GRP0112
TUXYVZQRUYQSQZUWYY	25	M	COMMERCIAL_B	COMPANY_B	PPO	2042	GROUP2042	POS_B	HS01	20483	PCP20483	2048	PCP_GRP2048
TUXYVZQRUYQSRZVZQZ	26	F	COMMERCIAL_B	COMPANY_B	PPO	2042	GROUP2042	POS_B	HS01	20483	PCP20483	2048	PCP_GRP2048
TUYXTZQQRYQQYYXZVZ	13	F	COMMERCIAL_B	COMPANY_A	PPO	2051	GROUP2051	POS_B	HS01	20519	PCP20519	2051	PCP_GRP2051
TUYXTZQQRYQRQZSYTY	15	M	COMMERCIAL_B	COMPANY_A	PPO	2051	GROUP2051	POS_B	HS01	20519	PCP20519	2051	PCP_GRP2051
TUYXTZQQRYQSQYYYWY	25	M	COMMERCIAL_B	COMPANY_A	PPO	2052	GROUP2052	POS_B	HS01	20519	PCP20519	2051	PCP_GRP2051
TUYXTZQQRYQTXZVZVZ	42	F	COMMERCIAL_B	COMPANY_A	PPO	2054	GROUP2054	POS_B	HS01	20519	PCP20519	2051	PCP_GRP2051
TUZZYTRYUYQQTZSYXZ	8	F	COMMERCIAL_D	COMPANY_C	PPO	2448	GROUP2448	POS_B	HS02	24424	PCP24424	2442	PCP_GRP2442
TVSXTVSVVYQ5VYXXVY	30	M	COMMERCIAL_D	COMPANY_A	PPO	1413	GROUP1413	POS_B	HS03	14159	PCP14159	1415	PCP_GRP1415
TVSXTVVQSYQRWZRYYZ	21	F	COMMERCIAL_D	COMPANY_A	PPO	1552	GROUP1552	POS_B	HS04	15582	PCP15582	1558	PCP_GRP1558
TVSXTVVQSYQS5ZQYUY	27	M	COMMERCIAL_D	COMPANY_A	PPO	1552	GROUP1552	POS_B	HS04	15582	PCP15582	1558	PCP_GRP1558
TVTWRQUX5YQRZYZZQZ	24	F	COMMERCIAL_D	COMPANY_A	PPO	2482	GROUP2482	POS_B	HS03	24865	PCP24865	2486	PCP_GRP2486
TVTWRQUX5YQ5TZRYXY	28	M	COMMERCIAL_D	COMPANY_A	PPO	2482	GROUP2482	POS_B	HS03	24865	PCP24865	2486	PCP_GRP2486
TVUWVSVUWYQSUZXZTY	30	M	COMMERCIAL_C	COMPANY_B	PPO	0123	GROUP0123	POS_B	HS04	01261	PCP01261	0126	PCP_GRP0126
TVUZQSTSTYQSZZTXZY	34	M	COMMERCIAL_B	COMPANY_A	PPO	2053	GROUP2053	POS_B	HS01	20549	PCP20549	2054	PCP_GRP2054
TVVTVSXWTYQQQZYXSY	6	M	COMMERCIAL_D	COMPANY_B	PPO	1546	GROUP1546	POS_A	HS02	15451	PCP15451	1545	PCP_GRP1545
TVWVXZTZWYQQVZSYYY	10	M	COMMERCIAL_D	COMPANY_C	PPO	1591	GROUP1591	POS_B	HS01	15969	PCP15969	1596	PCP_GRP1596
TVXTXYYZWYQSYZSYQZ	33	F	COMMERCIAL_D	COMPANY_C	PPO	1653	GROUP1653	POS_A	HS05	16577	PCP16577	1657	PCP_GRP1657
TVYUVUZZRYQQTYYXXY	8	M	COMMERCIAL_D	COMPANY_B	PPO	1548	GROUP1548	POS_A	HS05	15451	PCP15451	1545	PCP_GRP1545
TVZWVURZSYQRWZVXRY	21	M	COMMERCIAL_B	COMPANY_B	PPO	2062	GROUP2062	POS_B	HS02	20606	PCP20606	2060	PCP_GRP2060
TVZYXVXQUYQRVYXYSZ	20	F	COMMERCIAL_B	COMPANY_C	PPO	2052	GROUP2052	POS_B	HS02	20511	PCP20511	2051	PCP_GRP2051
TVZZUQUWRYQRSYXYSY	17	M	COMMERCIAL_D	COMPANY_B	PPO	1621	GROUP1621	POS_B	HS03	16275	PCP16275	1627	PCP_GRP1627
TWQWRYRTQYQQWYZXXZ	11	F	COMMERCIAL_D	COMPANY_A	PPO	1621	GROUP1621	POS_B	HS02	16243	PCP16243	1624	PCP_GRP1624
TWRVTYZVUYQ5YYXZXY	33	M	COMMERCIAL_C	COMPANY_A	PPO	0123	GROUP0123	POS_B	HS05	01277	PCP01277	0127	PCP_GRP0127
TWRZUSWRXYQRVZUZYY	20	M	COMMERCIAL_B	COMPANY_B	PPO	2052	GROUP2052	POS_B	HS04	20511	PCP20511	2051	PCP_GRP2051

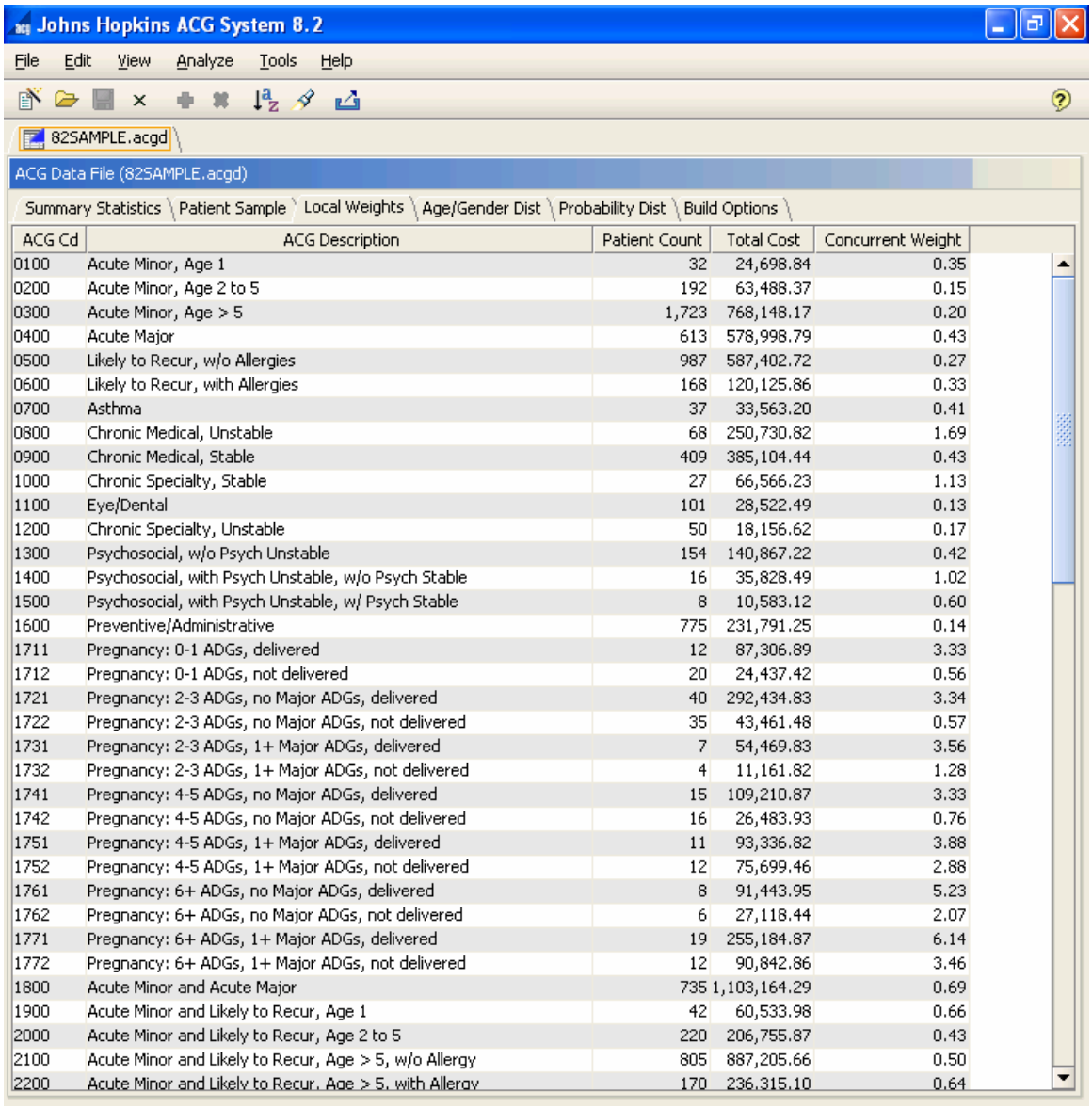
Note: The Patient Sample view display is limited to only the first 1,000 records (though an export of the data at this point would yield the entire data set). The sample is meant to help with validating data. Not all of the columns available for viewing are presented above.

ACG Output Data

In addition to most of the variables found on the input data (age, gender, string of diagnoses), the ACG Output Data contains the list of risk assessment variables assigned by the software. Please see Appendix A at the end of this chapter for additional detail on the ACG Output Data.

Figure 28: Local Weights Tab

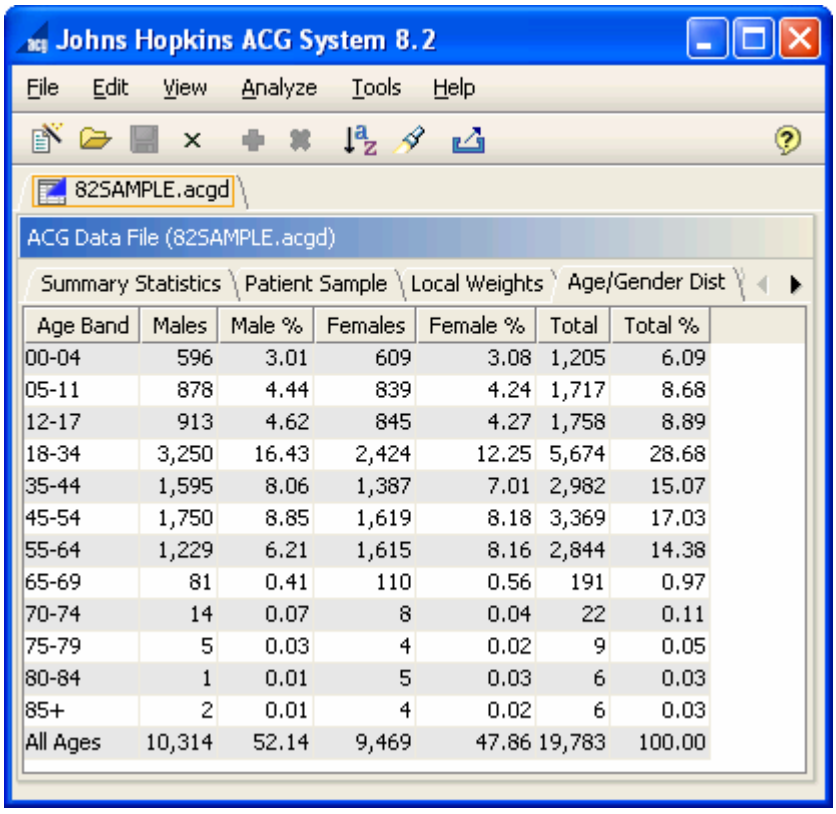
The Local Weights tab provides a distribution of members and cost by ACG. In addition, relative weights have been calculated using the local cost data provided during the import phase. These weights are calculated as the average cost per member for each ACG divided by the average cost per member overall. Relative weights are presented in several standard analyses produced by the software. The choice of local or national weights is also offered within these analyses.



ACG Cd	ACG Description	Patient Count	Total Cost	Concurrent Weight
0100	Acute Minor, Age 1	32	24,698.84	0.35
0200	Acute Minor, Age 2 to 5	192	63,488.37	0.15
0300	Acute Minor, Age > 5	1,723	768,148.17	0.20
0400	Acute Major	613	578,998.79	0.43
0500	Likely to Recur, w/o Allergies	987	587,402.72	0.27
0600	Likely to Recur, with Allergies	168	120,125.86	0.33
0700	Asthma	37	33,563.20	0.41
0800	Chronic Medical, Unstable	68	250,730.82	1.69
0900	Chronic Medical, Stable	409	385,104.44	0.43
1000	Chronic Specialty, Stable	27	66,566.23	1.13
1100	Eye/Dental	101	28,522.49	0.13
1200	Chronic Specialty, Unstable	50	18,156.62	0.17
1300	Psychosocial, w/o Psych Unstable	154	140,867.22	0.42
1400	Psychosocial, with Psych Unstable, w/o Psych Stable	16	35,828.49	1.02
1500	Psychosocial, with Psych Unstable, w/ Psych Stable	8	10,583.12	0.60
1600	Preventive/Administrative	775	231,791.25	0.14
1711	Pregnancy: 0-1 ADGs, delivered	12	87,306.89	3.33
1712	Pregnancy: 0-1 ADGs, not delivered	20	24,437.42	0.56
1721	Pregnancy: 2-3 ADGs, no Major ADGs, delivered	40	292,434.83	3.34
1722	Pregnancy: 2-3 ADGs, no Major ADGs, not delivered	35	43,461.48	0.57
1731	Pregnancy: 2-3 ADGs, 1+ Major ADGs, delivered	7	54,469.83	3.56
1732	Pregnancy: 2-3 ADGs, 1+ Major ADGs, not delivered	4	11,161.82	1.28
1741	Pregnancy: 4-5 ADGs, no Major ADGs, delivered	15	109,210.87	3.33
1742	Pregnancy: 4-5 ADGs, no Major ADGs, not delivered	16	26,483.93	0.76
1751	Pregnancy: 4-5 ADGs, 1+ Major ADGs, delivered	11	93,336.82	3.88
1752	Pregnancy: 4-5 ADGs, 1+ Major ADGs, not delivered	12	75,699.46	2.88
1761	Pregnancy: 6+ ADGs, no Major ADGs, delivered	8	91,443.95	5.23
1762	Pregnancy: 6+ ADGs, no Major ADGs, not delivered	6	27,118.44	2.07
1771	Pregnancy: 6+ ADGs, 1+ Major ADGs, delivered	19	255,184.87	6.14
1772	Pregnancy: 6+ ADGs, 1+ Major ADGs, not delivered	12	90,842.86	3.46
1800	Acute Minor and Acute Major	735	1,103,164.29	0.69
1900	Acute Minor and Likely to Recur, Age 1	42	60,533.98	0.66
2000	Acute Minor and Likely to Recur, Age 2 to 5	220	206,755.87	0.43
2100	Acute Minor and Likely to Recur, Age > 5, w/o Allergy	805	887,205.66	0.50
2200	Acute Minor and Likely to Recur, Age > 5, with Allergy	170	236,315.10	0.64

Figure 29: Age/Gender Distribution Tab

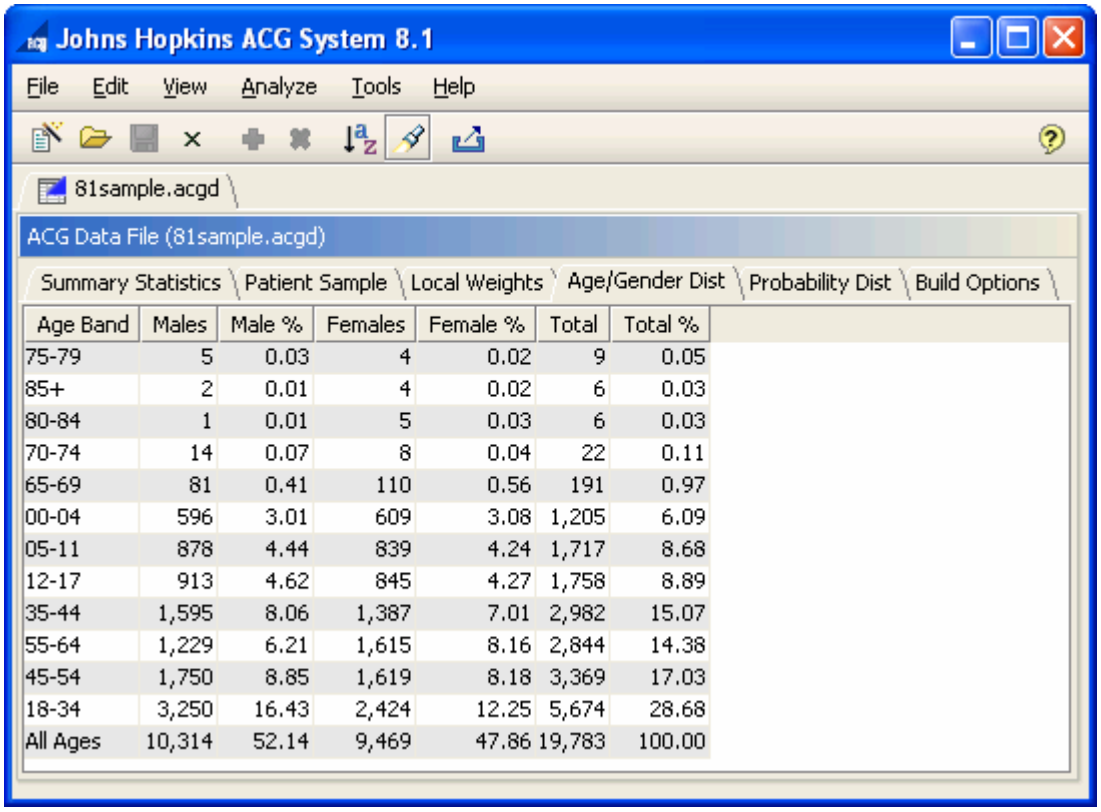
The Age/Gender Distribution displays the percent distribution of members in the population by age and gender. The age bands are calculated by the system and are used as input to the predictive model and as the basis for age/sex adjusting the standardized morbidity ratio analyses. This tab provides an opportunity to review the distribution and to ensure that the age field was input into the system correctly.



Age Band	Males	Male %	Females	Female %	Total	Total %
00-04	596	3.01	609	3.08	1,205	6.09
05-11	878	4.44	839	4.24	1,717	8.68
12-17	913	4.62	845	4.27	1,758	8.89
18-34	3,250	16.43	2,424	12.25	5,674	28.68
35-44	1,595	8.06	1,387	7.01	2,982	15.07
45-54	1,750	8.85	1,619	8.18	3,369	17.03
55-64	1,229	6.21	1,615	8.16	2,844	14.38
65-69	81	0.41	110	0.56	191	0.97
70-74	14	0.07	8	0.04	22	0.11
75-79	5	0.03	4	0.02	9	0.05
80-84	1	0.01	5	0.03	6	0.03
85+	2	0.01	4	0.02	6	0.03
All Ages	10,314	52.14	9,469	47.86	19,783	100.00

Figure 30: Probability Distribution Tab

The probability distribution tab shows the percent distribution of the population across 4 ranges of probability scores. In a typical population, a very small percentage of patients will have probability scores greater than 0.40. This distribution gives the user a sense of the percentage of patients that would be reviewed when selecting each of these high risk cutpoints.



Age Band	Males	Male %	Females	Female %	Total	Total %
75-79	5	0.03	4	0.02	9	0.05
85+	2	0.01	4	0.02	6	0.03
80-84	1	0.01	5	0.03	6	0.03
70-74	14	0.07	8	0.04	22	0.11
65-69	81	0.41	110	0.56	191	0.97
00-04	596	3.01	609	3.08	1,205	6.09
05-11	878	4.44	839	4.24	1,717	8.68
12-17	913	4.62	845	4.27	1,758	8.89
35-44	1,595	8.06	1,387	7.01	2,982	15.07
55-64	1,229	6.21	1,615	8.16	2,844	14.38
45-54	1,750	8.85	1,619	8.18	3,369	17.03
18-34	3,250	16.43	2,424	12.25	5,674	28.68
All Ages	10,314	52.14	9,469	47.86	19,783	100.00

Figure 31: Build Options Tab

The build options tab stores information about the source files, filters and parameters used to build the .acgd file. The parameters include

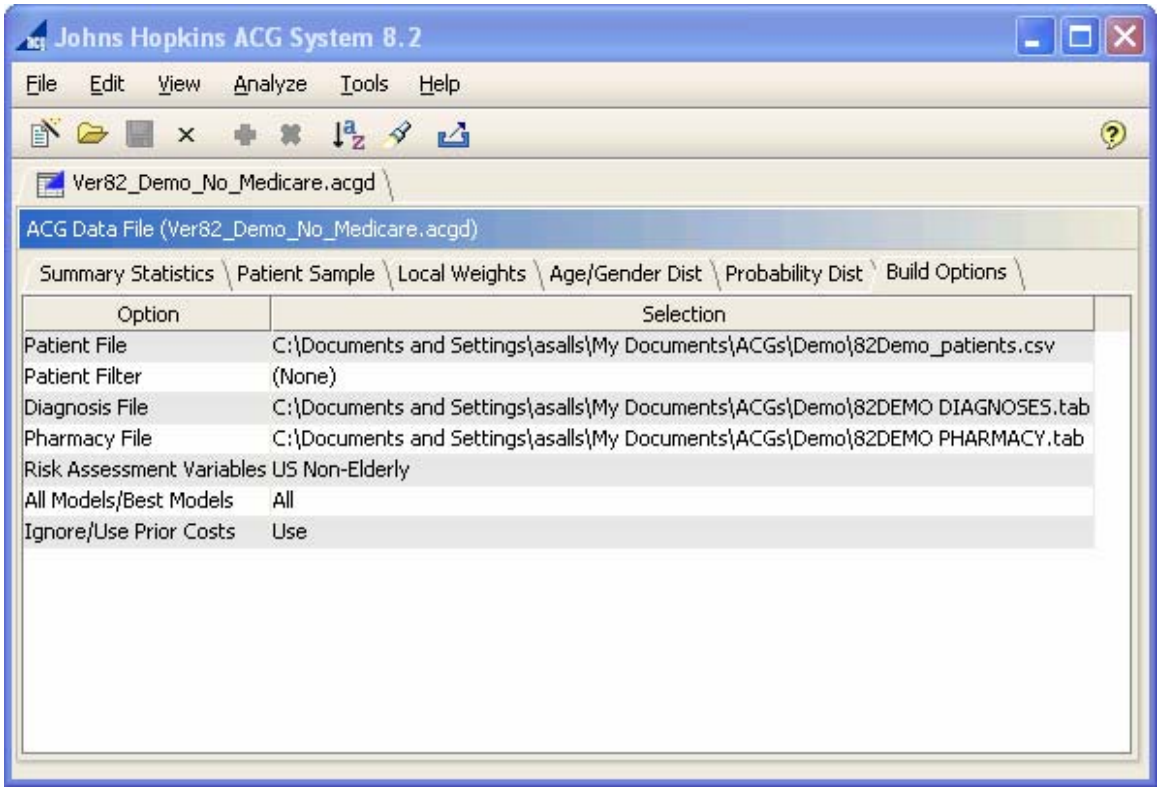
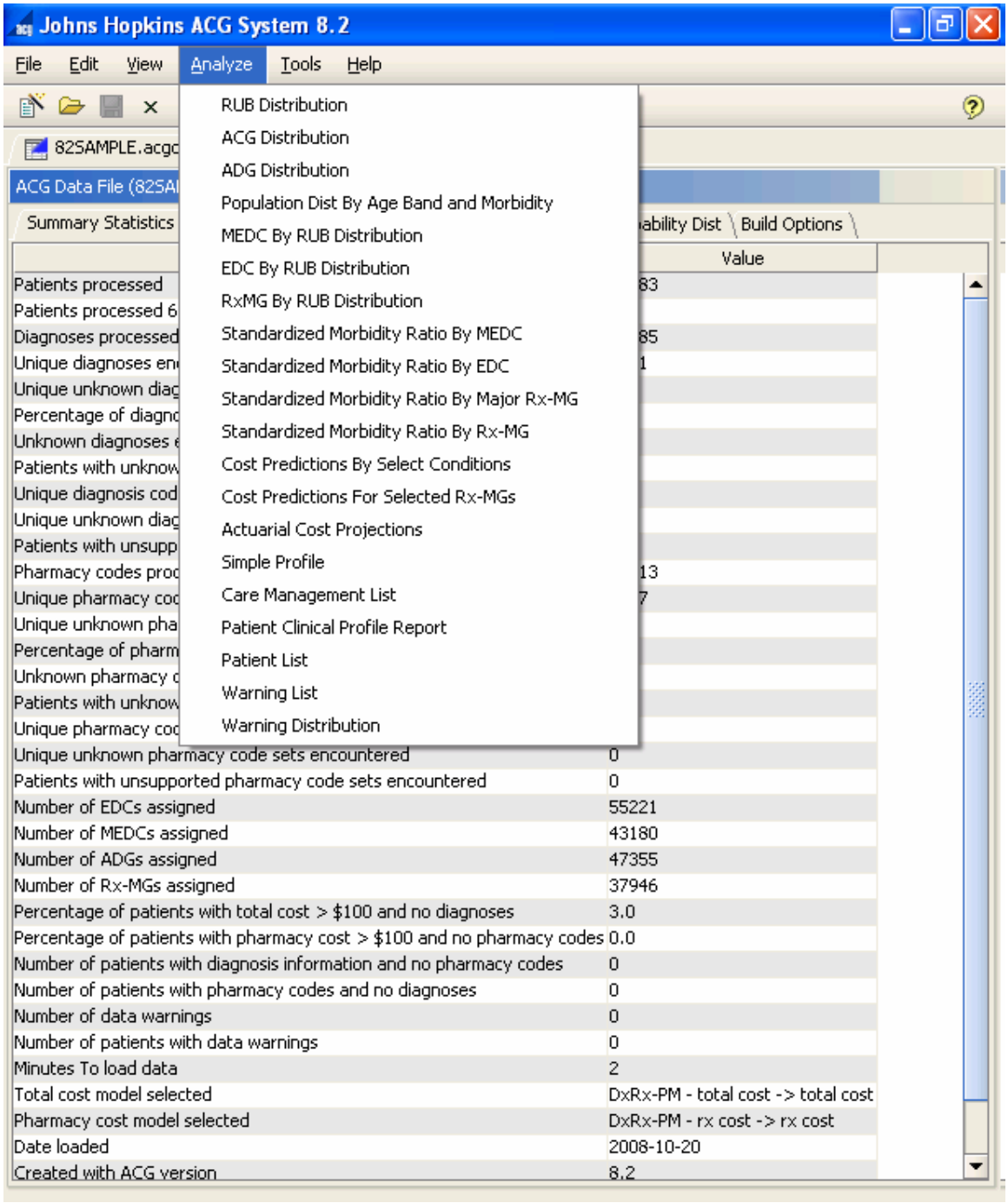


Figure 32: Analyze Menu

The Analyze menu provides access to several additional reports. The report content provided is static, but may be customized to the needs of the user with the application of groups and filters described below.



Analyze Report Options

Many of the reports available on the Analyze menu may be customized at the user's discretion. Customization is controlled via the Report Options menu that includes up to three screens:

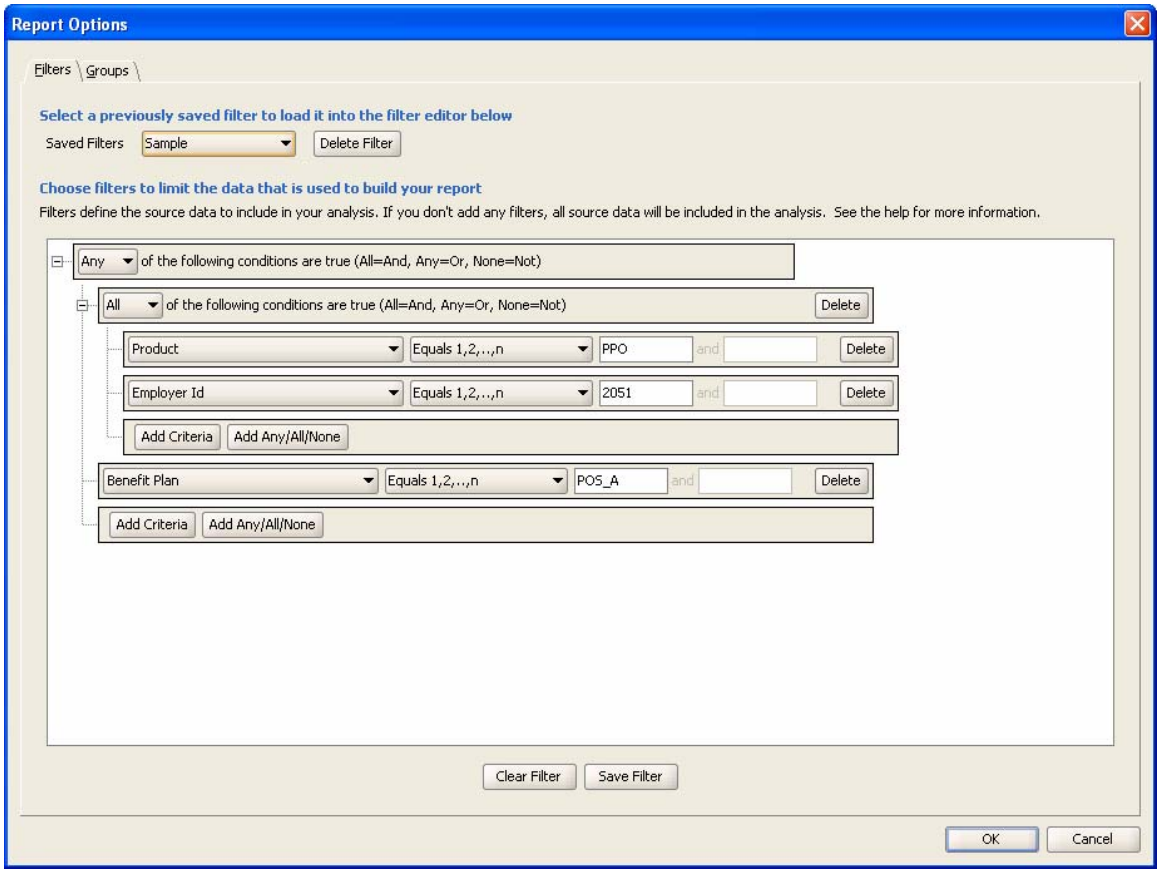
1. Filters,
2. Options, and
3. Groups.

Each screen will be discussed in more detail below.

Filters

Use filters to control the selection of patients from the active data file to be included in the analytical view. If no filters are defined, all patients will be included in an analysis. A typical use for filters is to run an analysis on a sub-set of a population, such as a single benefit plan, company, product, or line of business. Filters can be defined on any available column in the patient data, which also includes all ACG-calculated elements and additional custom fields imported as part of the data file. It is possible to stack filters using Boolean "And" or "Or" operators. For example, to run an analysis on all patients in the PPO Product that have Employer ID 2051 or all patients in the Benefit Plan POS_A, fill out the filter as follows:

Figure 33: Filters



Note: The effect of an "Any" line is to apply the filter criteria on each side of the Or separately. In the example used, a patient in the Benefit Plan POS_A would be included even if they didn't have the Employer 2051 due to the "Any" condition. However, a patient in the PPO Product would only be included if they have the Employer 2051 due to the "All" criteria at that level.

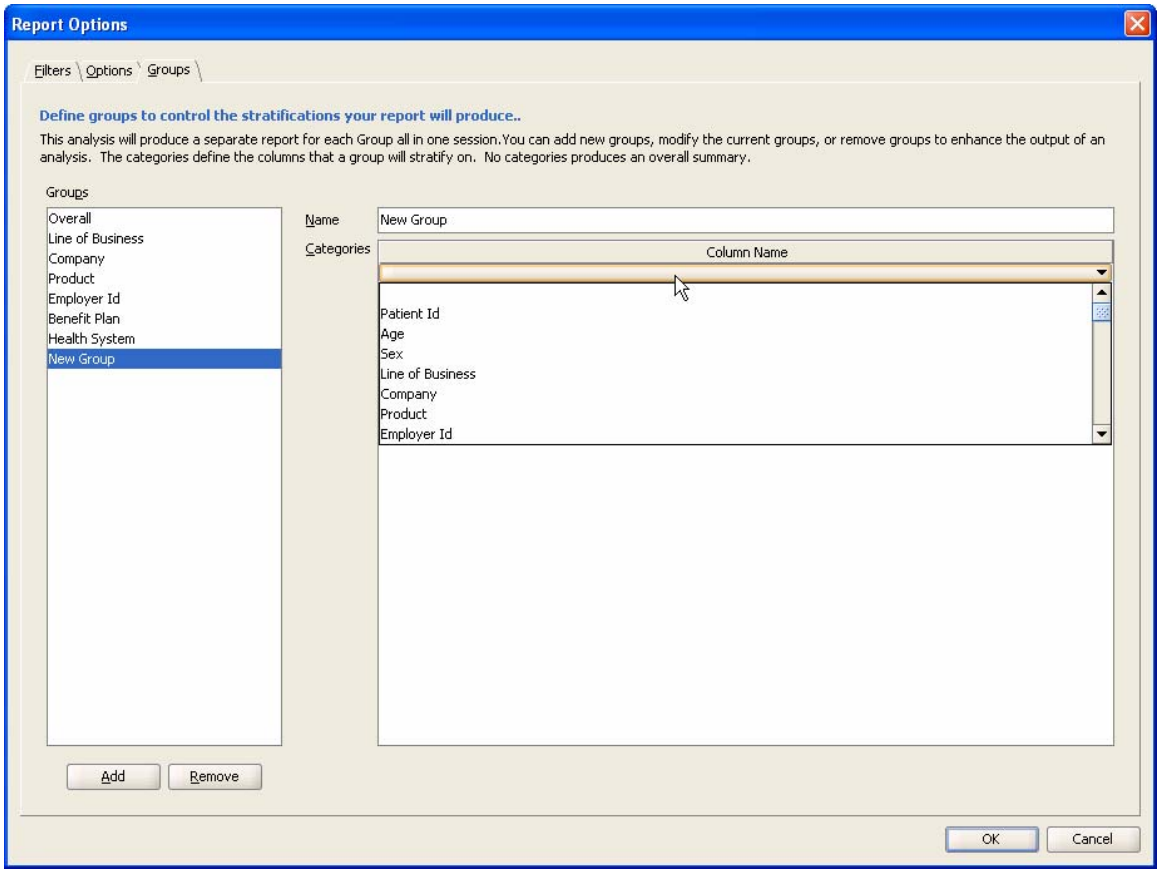
Filters can be saved and recalled for any future analysis. Filters are saved within a users' Windows profile so they are specific to a single computer and user.

Groups

The analyses in the ACG System are conceptually different from reports in other systems and are best conceived as data views. The primary difference is that a single analysis can generate several stratifications in one single session. The Groups define the stratifications that an analysis will produce.

The Groups tab is originally populated with the default population stratifiers for the selected analysis. The underlying details of a group can be displayed by selecting it (i.e., clicking on it). The currently selected group displays a Name, which is the title of the section on the analysis, and the categories, which are the list of columns that define the stratifiers for that group. You can add new groups, modify groups, or remove groups before an analysis is run. If custom fields have been created, you can build groups on these columns as well.

Figure 34: Groups



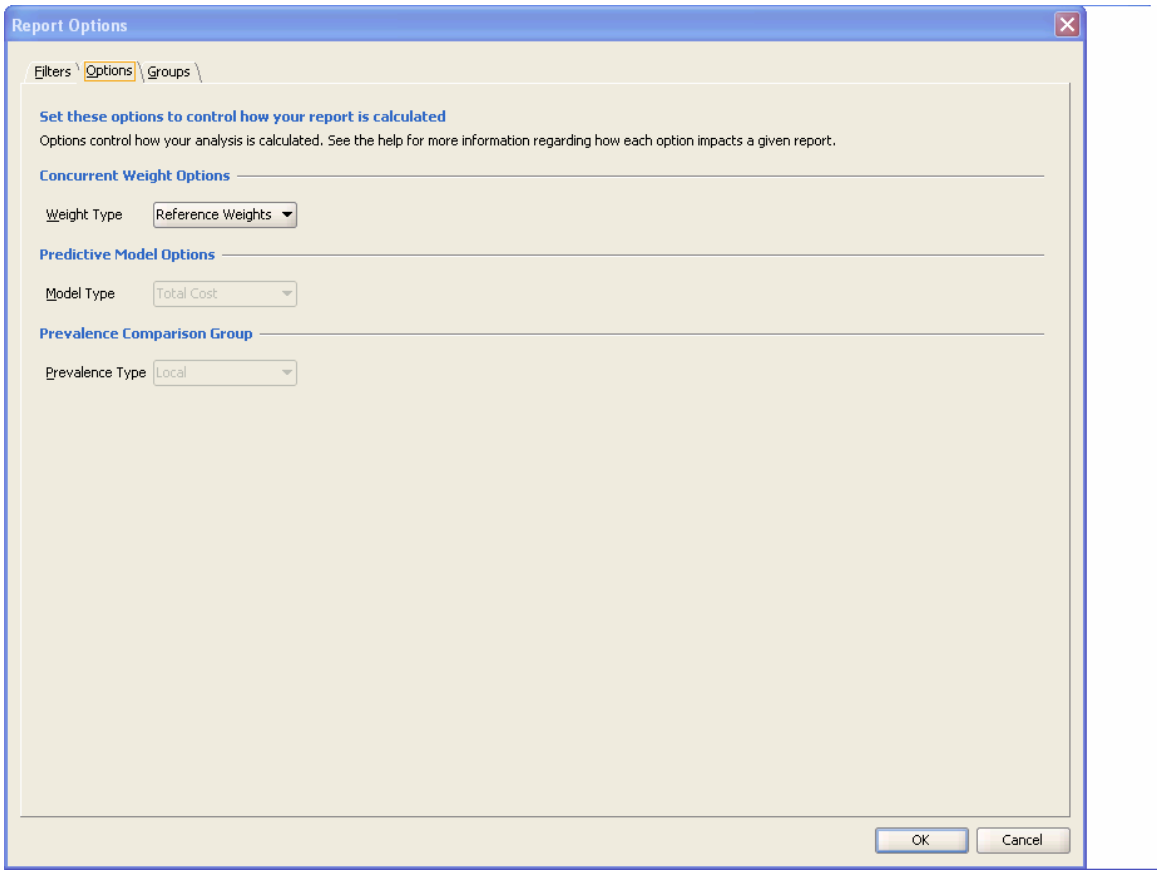
Options

For some of the analyses, there is an additional report option tab. This provides the user the option to use local or national concurrent weights, local or national prevalence rates or total or pharmacy predicted resource use as appropriate. Examples of where and how each report might be affected have been provided previously but to summarize the analyses and corresponding options are listed below.

- Local or National Concurrent weights: Estimated concurrent resource use in EDC by RUB Distribution, MEDC by RUB Distribution, and Rx-MG by RUB Distribution. Such comparisons allow within group comparisons to be contrasted to external or reference comparisons.
- Local or National Prevalence Rates: Age/sex adjusted expected rate/1000 in Standardized Morbidity Ratio by EDC, Standardized Morbidity Ratio by MEDC, Standardized Morbidity Ratio by Rx-MG and Standardized Morbidity Ratio by Major Rx-MG.

- Total or Pharmacy Model Type: Predicted Resource Use in Cost Predictions by Selected Condition, Cost Predictions by Rx-MGs. Again, the interpretation is how do sub-populations compare to the within group average contrasted to comparing the same sub-population to an external reference.

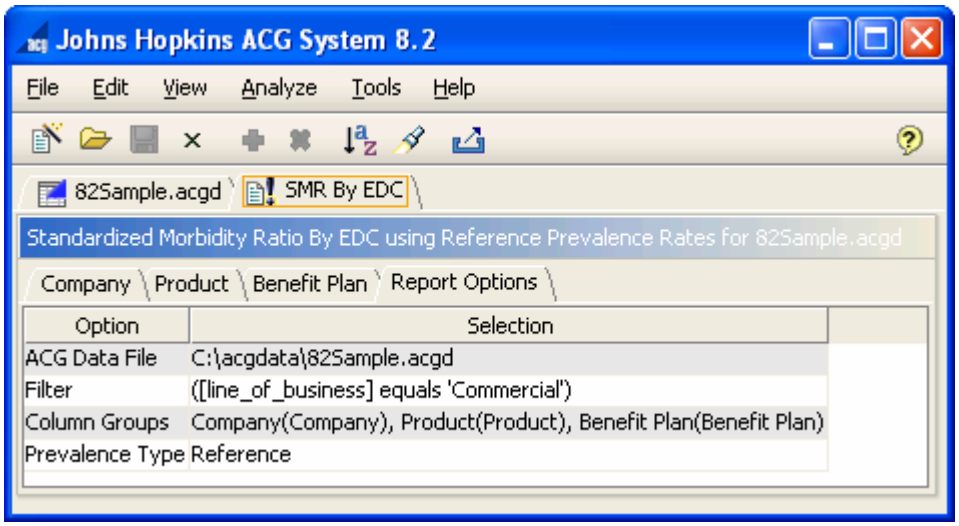
Figure 35: Options



Report Options

For each analysis generated, a tab is generated which displays any filtering options, analysis groupings or options applied.

Figure 36: Report Options

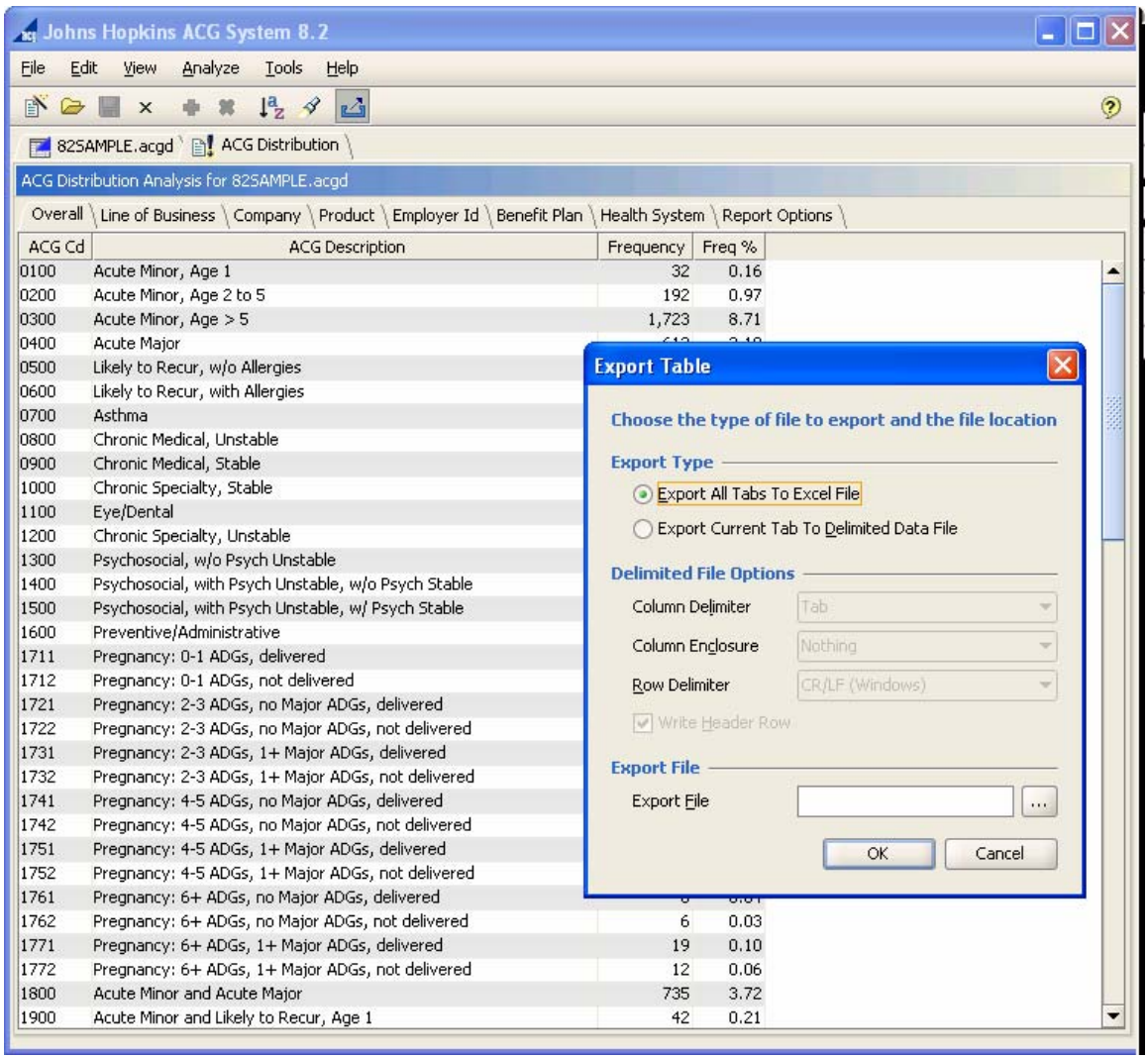


Export Report Tables

From each analysis tab it is possible to select the **Export Table** option ( or from **Tools - Export**) to export the complete analysis results to Microsoft Excel™ or to export a single tab's data to a Delimited Data File (like a CSV file).

Choose the type of file to export to. The Export All Tabs To Excel File option will export all data in the analysis, saving each tab to a separate Microsoft Excel worksheet. The Export Current Tab To Delimited Data File will export the data in the currently selected tab to a single data file (comma-delimited or tab-delimited text file). You can choose to write out a header row as the first row in the data file. This row contains the names of the columns and is useful when importing the data into another database.

Figure 37: Export Report Tables



◢ ***Tip*:** The Export All Tabs To Excel File option will not be available if the current analysis contains at least one tab that has over 65,000 rows because Microsoft Excel cannot accept data extracts that large.

If exporting data to a delimited data file, it is necessary to specify the type of column delimiter, column enclosure, and row delimiter to use. The defaults are already setup for import into Microsoft Access™. The Write Header Row option will write the first row in the export file with the column names. This makes it easier to import into Microsoft Access. Only one tab can be exported at a time in the delimited data file mode.

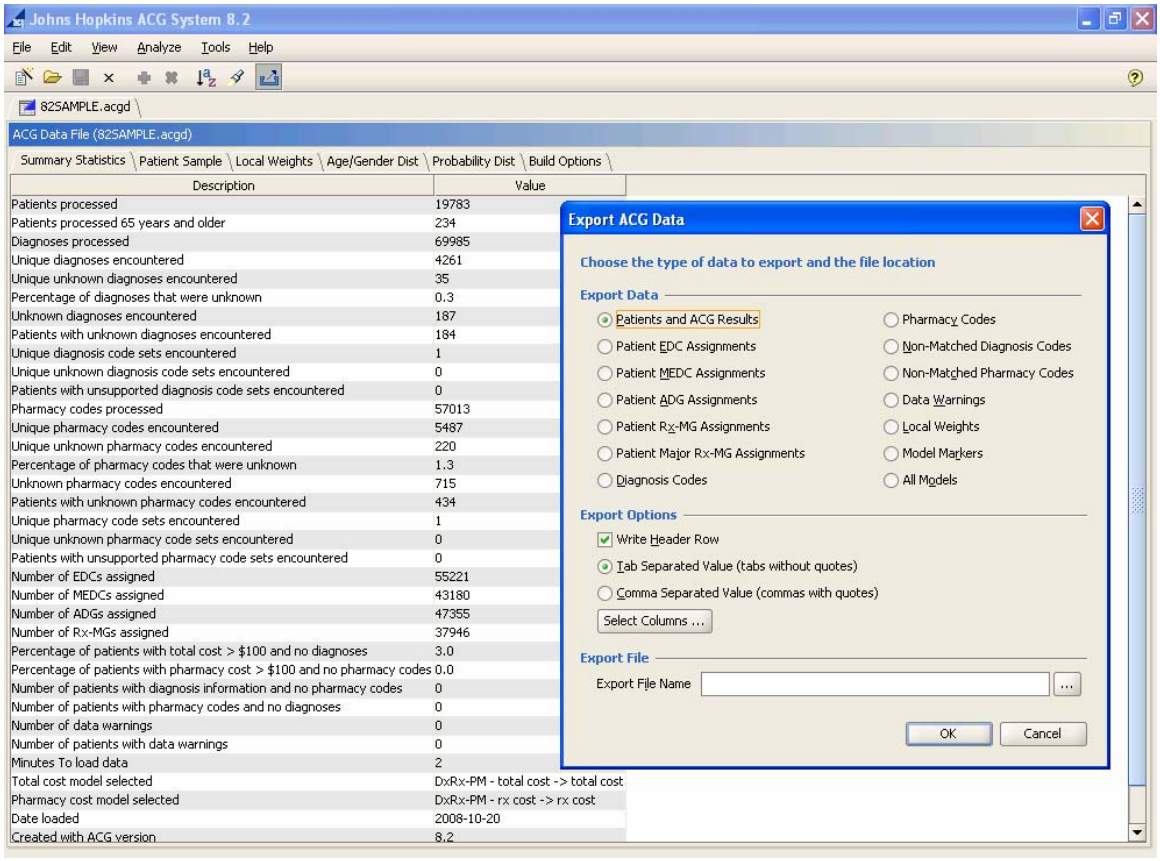
Finally, click the **File Selection** button (...) and choose a filename for the exported data. Click **OK** on the Export Table window to begin the export.

Export Data Files

From an active data file tab it is possible to export the entire data file to another application. The Export ACG Data option will create a tab-delimited text file from your ACG data. This data format is directly supported by Microsoft Excel, Microsoft Access, and many other mainstream databases and statistical applications.

Using the **Tools -Export** or  menu button, simply click the **File Selection** button (...) and choose a filename in which to save the exported data. Click **OK** on the Export ACG Data window to begin the export.

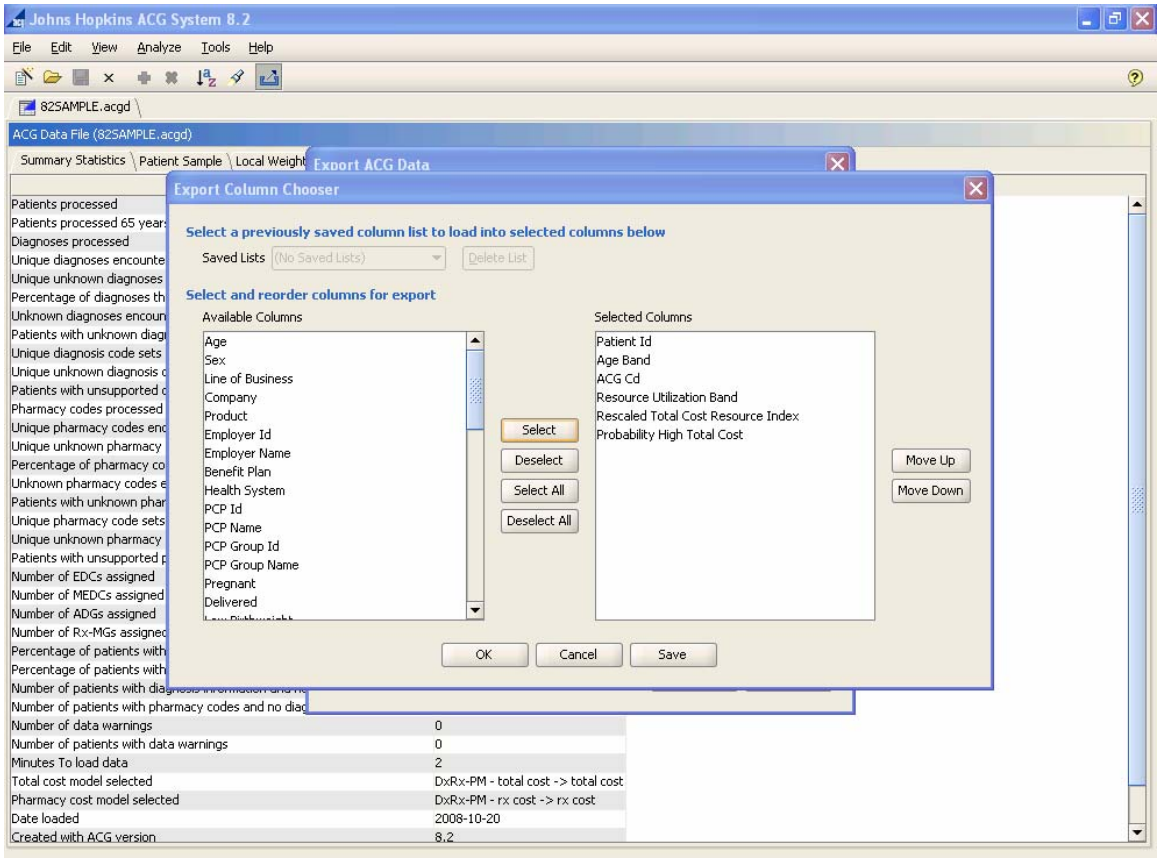
Figure 38: Export Data Files



All of the underlying ACG data elements that are used throughout the ACG System are exportable through this option. When the Export ACG Data options are displayed, you must choose one of the following data sets to export:

- **Patients and ACG Results.** By default, this data file contains all of the data elements from your original patient import file, with any missing default columns added as blanks, and all of the ACG calculated fields. The columns in this export file are the same columns (in the same order) as shown in the Patient Sample section of the ACG Data File (see Appendix A). The output file can be customized by selecting the "Select Columns…" button on the Export ACG Data Screen.

Figure 39: Select Columns



- **Patient EDC Assignments.** This data file contains one row for each EDC code assigned to a Patient ID. This file is organized in a manner so that it can be easily loaded into a database like Microsoft Access or another relational database. The columns in this file are:
  - Patient ID
  - EDC Code
  - EDC Description
  - MEDC Code
  - MEDC Description
- **Patient MEDC Assignments.** This data file contains one row for each MEDC code assigned to a Patient ID. An MEDC code is a higher-level grouping for an EDC code. The MEDC code is also included in the Patient EDC Assignments file. This file provides the added advantage of removing duplicate MEDC codes for each patient, whereas the Patient EDC Assignment file may contain duplicates for an MEDC code for a patient. The columns in the file are:
  - Patient ID

  - MEDC Code
  - MEDC Description
- **Patient ADG Assignments.** This data file contains one row for each ADG code assigned to a Patient ID. The columns in the file are:
  - Patient ID
  - ADG Code
  - ADG Description
- **Patient Rx-MG Assignments.** This data file contains one row for each Rx-MG code assigned to a Patient ID. The columns in the file are:
  - Patient ID
  - Rx-MG
  - Rx-MG Description
- **Patient Major Rx-MG Assignments.** This data file contains one row for each Major Rx-MG code assigned to a Patient ID. The columns in the file are:
  - Patient ID
  - Major Rx-MG
  - Major Rx-MG Description
- **Diagnoses.** This data file contains one row for each diagnosis experienced for a Patient ID. This file is basically an unduplicated version of the diagnosis import file. The columns in this file are:
  - Patient ID
  - ICD Version
  - ICD Code
- **Pharmacy Codes.** This data file contains one row for each pharmacy code experienced for a Patient ID. The file is basically an unduplicated version of the pharmacy import file. The columns in this file are:
  - Patient ID
  - Rx Fill Date
  - Rx Code
  - Rx Code Type
- **Non-Matched Diagnoses.** This data file contains one row for each non-matched (unknown) diagnosis code encountered for a Patient ID. The columns in this file are:
  - Patient ID
  - ICD Version
  - ICD Code

- **Non-Matched Pharmacy Codes.** This data file contains one row for each non-matched (unknown) pharmacy code encountered for a Patient ID. The columns in this file are:
  - Patient ID
  - Rx Code Type
  - Rx Code
- **Data Warnings.** This data file contains one row for each patient that had data warnings. This data is the same information presented in the Warning List Analysis. The columns in this file are:
  - Patient ID
  - ACG Code
  - Age
  - Sex
  - Total Cost
  - Pharmacy Cost
  - Warning Codes
- **Local Weights.** This data file contains the Local Weights data that is displayed in the ACG Data File screen. This data is calculated during the ACG grouping process and summarizes the local costs by ACG code. The columns in this file are:
  - ACG Code
  - ACG Description
  - Patient Count
  - Total Cost
  - Concurrent Weight
- **Model Markers.** This data file contains a set of flags that are used during the ACG grouping process for each Patient ID. You will need to contact technical support for assistance in using this data. The columns in this file are:
  - Patient ID
  - Demographic Markers - gender, age bands
  - Dx-PM Covariates - frailty, hospital dominant conditions, prospective RUBs, pregnancy w/o delivery, ACG markers, EDC markers
  - Rx-PM Covariates – Rx-MG markers
  - Cost Percentile Groups - total cost bands, rx cost bands

- **All Models.** This data file contains all possible predictive model scores for each patient. You will need to contact technical support for assistance in using this data. The MODEL_NAME component is repeated for every model included in the ACG system. If a model does not apply to a data set, it will be left blank. The columns in this file are as follows:
  - Patient ID
  - MODEL_NAME_pri
  - MODEL_NAME_prir
  - MODEL_NAME_prob

Use Your Own Data

Using the chapter "Basic Data Requirements" as a guide, you may use your own data to create a Patient (or enrollment) Data File and a Diagnosis Data File according to the following specifications:

Patient File Format

The default enrollee data file format is a tab-delimited or comma-delimited, optionally quote enclosed, text file (sometimes called a tab-delimited data file or CSV) with the following columns in order. This format is directly supported by Microsoft Excel and Microsoft Access and a variety of other tools.

This file contains one row per Patient ID only. The only required columns in this file are patient_ID, age, and sex. We encourage providing as many data elements as possible.

◢ ***Tip*:** While the minimum data requirements are only patient_ID, age and sex, the suite of ACG Predictive Models are calibrated, at your discretion (see additional details below) to take advantage of all available data. To maximize performance of these models users should be sure to provide both pharmacy_cost and total_cost information for each member.

◢ ***Tip*:** The ACG application will use the Windows Regional settings to format the pharmacy cost and total cost fields on input and for display. If these costs fields are formatted other than a comma thousands separator and period decimal separator, make sure that this is reflected in your Regional Options in the Windows Control Panel.

Table 15: Patient File Format

Column Name	Column Description	Data Type	Example
patient_id	A unique string to identify this individual member.	Text	9567213984-01
age	The patient's age (in years) as of the end of the observation/reporting period.	Number	25
sex	A single character or digit to indicate whether the patient is a Male or Female. The software will use F or 2 to identify a Female, all other values indicate Male.	Text	M
line_of_business	A code to indicate the category of the patient's insurance type. This is typically used by a health plan to identify Commercial, Medicaid, Medicare+Choice, or some other similar category.	Text	COMM
company	A code to indicate the financial company for this patient. This is typically used by a health plan to differentiate financial companies, financial products, or state or regional company systems.	Text	Generic Care 01
product	A code to indicate the patient's insurance product type. This is typically used by a health plan to differentiate an HMO, PPO, or POS product line.	Text	HMO
employer_group_id	A code to indicate the employer or group that this patient is covered under. This is typically used by a health plan to identify an employer (e.g. General Motors) or another logical member/patient grouping (e.g. Maryland Medicaid).	Text	GM
employer_group_name	The readable name associated with employer_group_id.	Text	General Motors, Inc.
benefit_plan	The patient's benefit plan. This is typically used by a health plan to identify a benefit package or group of benefit packages.	Text	HMO Preferred
health_system	The health system that this patient is assigned to. This is typically used by a health plan to identify a risk-sharing arrangement or the hospital system in which the patient's PCP belongs.	Text	SignaMed MidWest
pcp_id	A code to identify the patient's Primary Care Practitioner.	Text	P24050
pcp_name	The readable name associated with pcp_id.	Text	Dr. John Doe M.D.
pcp_group_id	A code to identify the group or financial company for the patient's primary care practitioner.	Text	V9604

Column Name	Column Description	Data Type	Example
pcp_group_name	A readable name associated with pcp_group_id.	Text	SignaMed MidWest Family Practice
pregnant	A code to control the ACG pregnancy related grouping logic. • 0 or Blank - Determine pregnancy based upon the patient's diagnoses. • 1 - Patient was pregnant during the observation period. • Other Value - Patient was not pregnant during the observation period.	Number	0
delivered	A code to control the ACG delivery related grouping logic. • 0 or Blank - Determine delivery based upon the patient's diagnosis. • 1 - Patient delivered a baby during the observation period. • 9 - Ignore all information about delivery status. • Other Value - Patient did not deliver a baby during the observation period.	Number	1
low_birthweight	A code to control the low birth weight related grouping logic. • 9 or Blank - Ignore all information about low birth weight. • 1 - Patient was born with a low birth weight. • Other Value - Patient was not born with a low birth weight. **Note:** The ACG grouping logic cannot determine low birth weight information via diagnosis codes. So this is the only way to know that a patient was delivered with a low birth weight.	Number	9
pharmacy_cost	The total pharmacy cost for this patient during the observation period.	Number	10250.00
total_cost	The total cost (pharmacy plus medical) for this patient during the observation period.	Number	125000.00

Diagnosis Data File Format

The default diagnosis data file format is a tab-delimited or comma-delimited, optionally quote enclosed, text file with the following columns in order. This format is directly supported by Microsoft Excel and Microsoft Access and a variety of other tools.

This file should contain all diagnosis codes that were experienced for each patient during the observation period. There can be zero, 1, or more rows per Patient ID. The patient_id, icd_version_1, and the icd_cd_1 columns are required. You can optionally provide icd codes 2 through 5 for each row.

Table 16: Diagnosis Data File Format

Column Name	Column Description	Data Type	Example
patient_id	A unique string to identify this individual patient.	Text	9567213984-01
icd_version_1	The version of the ICD code in icd_cd_1. The ACG grouping logic currently supports ICD version 9 and 10.	Number	9
icd_cd_1	The ICD code. This code cannot be longer than 6 characters. You may optionally include an explicit decimal. If a decimal is included, it must be in the fourth position. If a decimal is not included, then the ICD code cannot be longer than 5 characters.	Text	070.22
icd_version_2	The version for the related icd_cd_n column.	Number	9
icd_cd_2	The ICD code.	Text	070.22
icd_version_3	The version for the related icd_cd_n column.	Number	9
icd_cd_3	The ICD code.	Text	070.22
icd_version_4	The version for the related icd_cd_n column.	Number	9
icd_cd_4	The ICD code.	Text	070.22
icd_version_5	The version for the related icd_cd_n column.	Number	9
icd_cd_5	The ICD code.	Text	070.22

Pharmacy Data File Format

The default pharmacy data file format is a tab-delimited or comma-delimited, optionally quote enclosed, text file with the following columns in order. This format is directly supported by Microsoft Excel and Microsoft Access and a variety of other tools.

This file should contain all pharmacy codes that were experienced for each patient during the observation period. There can be zero, 1, or more rows per Patient ID. The patient ID, icd_version_1, and the icd_cd_1 columns are required.

Table 17: Pharmacy Data File Format

Column Name	Column Description	Data Type	Example
patient_id	A unique string to identify this individual patient.	Text	9567213984-01
rx_fill_date	The date the prescription was filled in CCYY-MM-DD format.	Date	2006-01-01
rx_code	The pharmacy code.	Text	00591505210
rx_code_type	The type of Rx code in the rx_code column. This column can contain a N for NDC code, or an A for an ATC code.	Text	N

◢ ***Tip*:** NDC codes and ATC codes are licensed individually. You must have a license to Rx-PM with the appropriate code type in order for the application to recognize pharmacy codes.

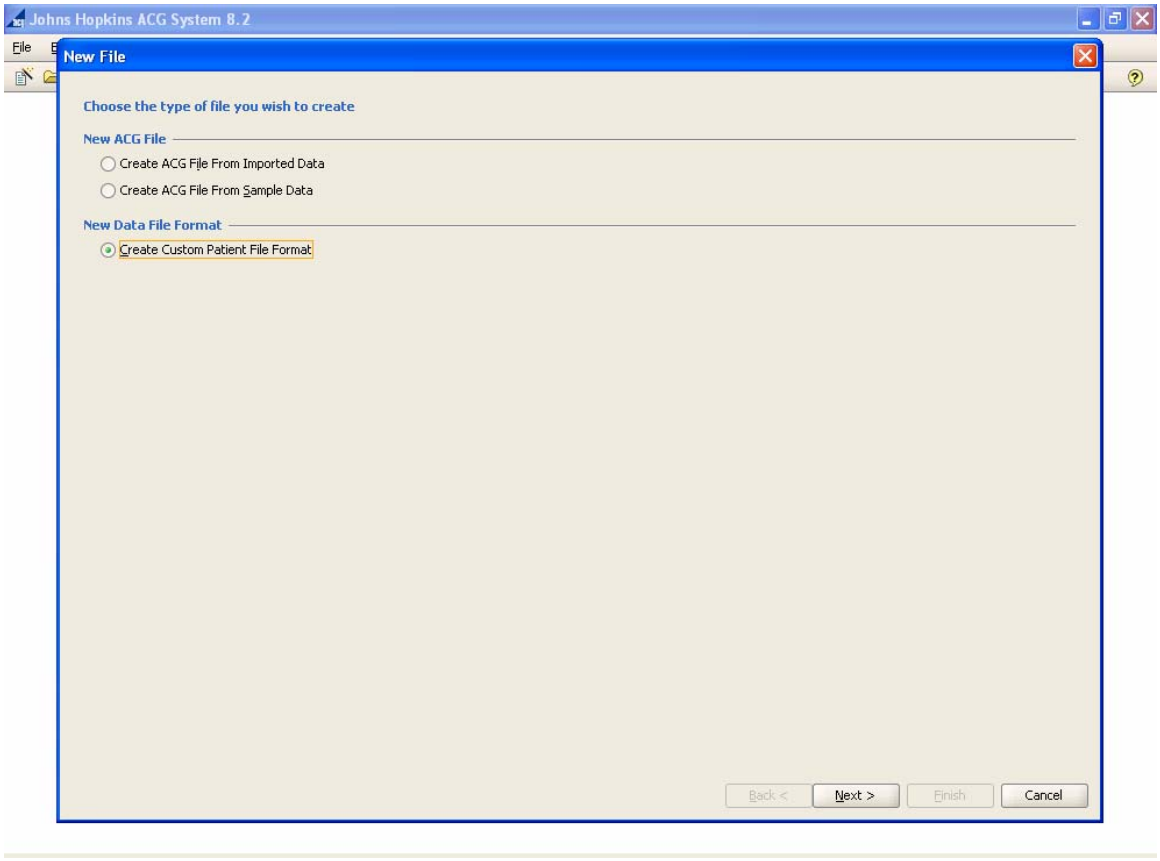
Custom File Formats

ACGs for Windows is designed to handle custom file formats. You can add, delete, and rename fields in the patient file. Patient ID, age, and sex are required fields. Once you have added custom fields, these can then be used in the analyses for filters and groups.

Use the following steps to create a custom patient file format:

1. Select **File**.
2. Select **New**.
3. From the New File window click the radial button for **Create Custom Patient File**.
4. Click **Next**.

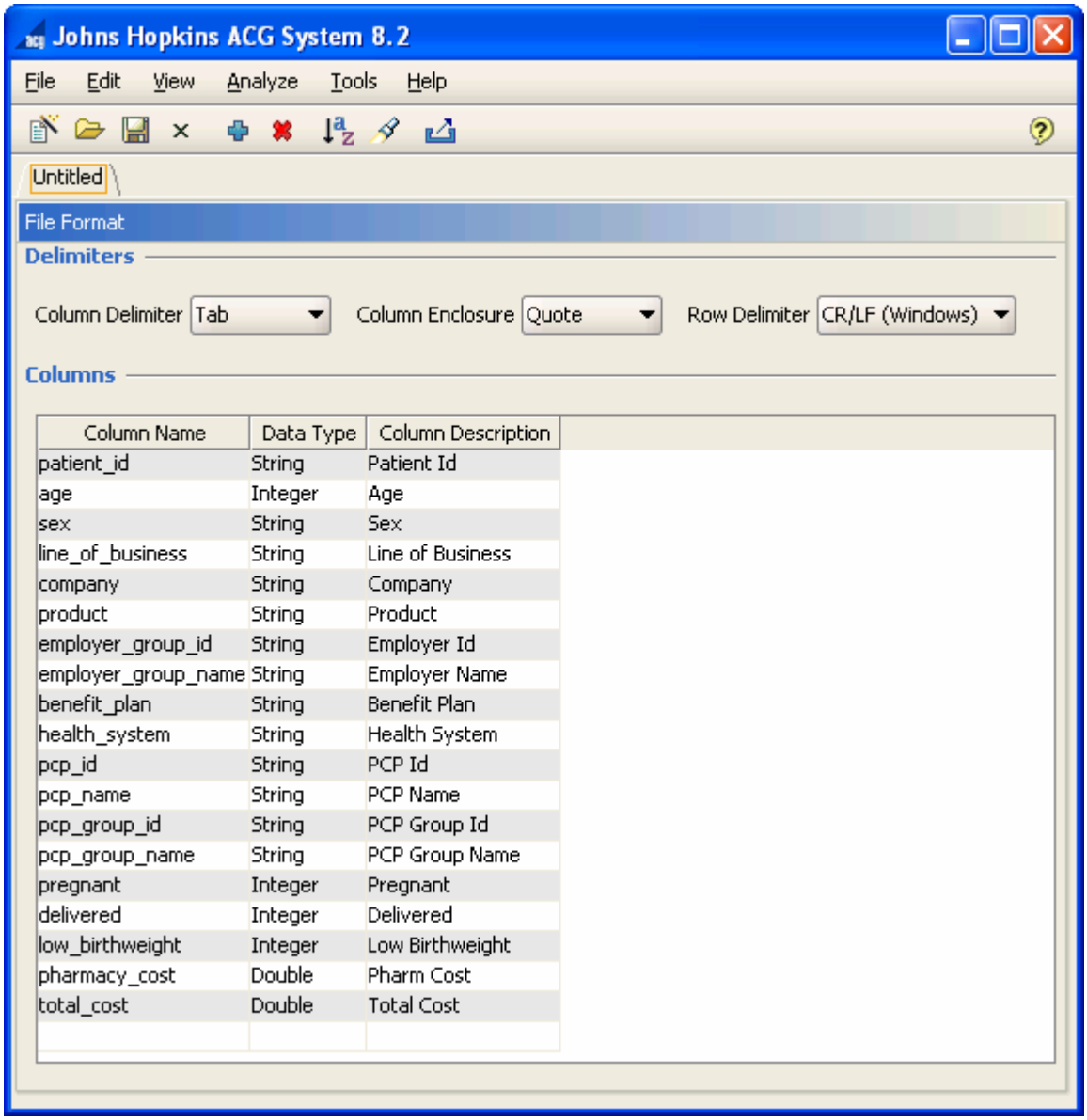
Figure 40: Create Custom File Format



5. Click **Finish**.
6. To rename a column, double-click on the existing name and insert new name
7. To delete a column, click on the column name and then click the delete button  (or select **Edit** - **Delete**).

8. To add a column, click on the empty column name and type your new column name. Add data type and column description, and press **Enter**.

Figure 41: Enter Custom File Format



9. Select **File**.
10. Select **Save As** to save the file format.

Open *.acgd files

Once the input text files have been processed by the system, the results will be stored in a *.acgd format. Use the Open option on the File menu to select a previously processed .acgd file. If you attempt to open a *.acgd file created under The Johns Hopkins ACG System version 8.0, you will be prompted to upgrade the file. This will allow you to use the current version of the software to files created under a previous release. Note: the software will not recalculate any of the categories or scores, so the data will reflect older mapping files. To update to the most current mapping files, the user will need to revert to the original text files and run the import process again.

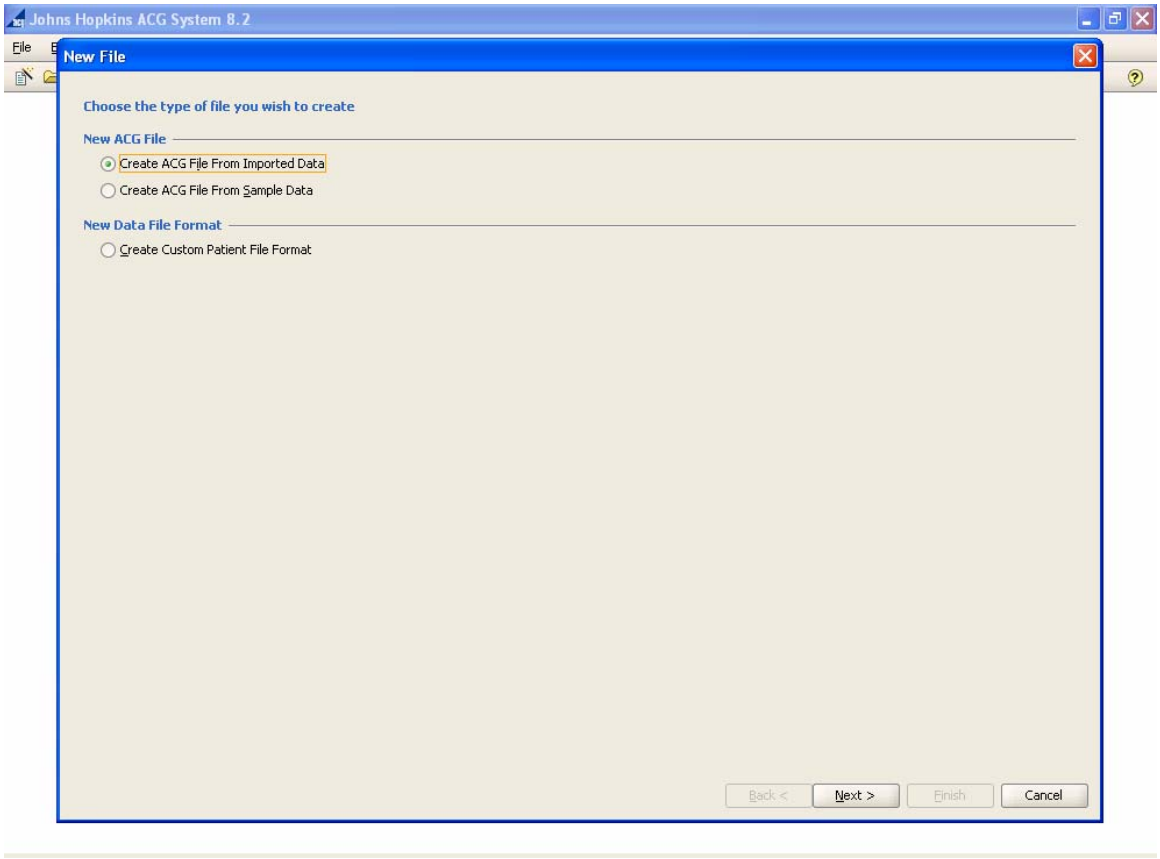
Load Your Own Data - Case Study

All input data files are required to be either tab or comma delimited with quotes. In this example, a custom patient data file is utilized (see Custom File Format section under Using Your Own Data) while the diagnosis and pharmacy input files are standard layouts.

Use the following steps to process new input data:

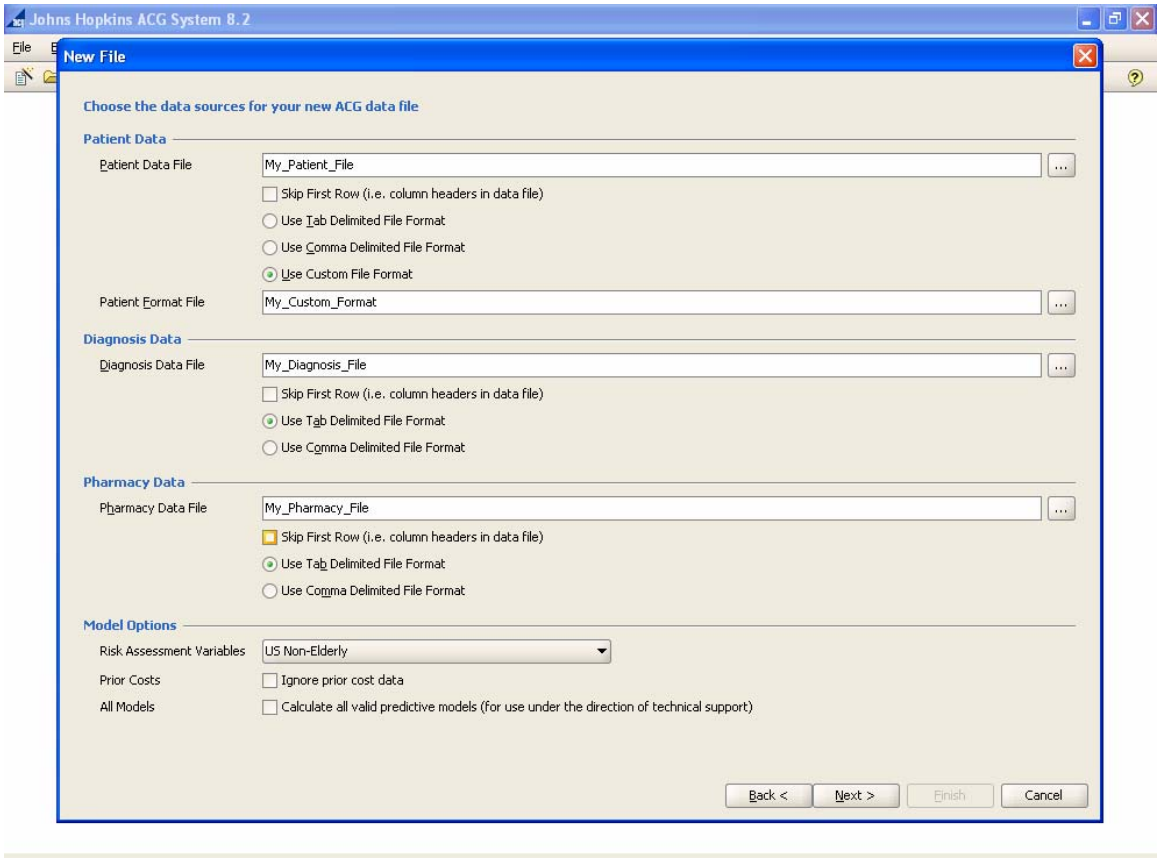
1. To import data using the custom file format select **File**.
2. Select **New**.

Figure 42: Step 1 - Load Your Own Data



From the New File window, click the **Create ACG File from Imported Data** radio button, and then click **Next**. **Figure 43** appears on the following page.

Figure 43: Step 2 – Load Your Own Data



In the second step of importing your own data, you must provide the names of your patient data file and specify the file format and the location of the custom file format if applicable; provide the location of the diagnosis and pharmacy data files and specify their file formats; and finally, specify predictive modeling options. All of the options on this screen are simple point and click windows commands. Click on the radio button, or the area of interest, or click on the **File Selection** button (...) to activate Windows explorer to find and highlight the requested file(s).

Model Options

By default, the ACG for Windows software automatically selects the best predictive model based on the data found in the patient file (that is, whether or not total cost or pharmacy cost data is available for each member) and the data found in the diagnoses and pharmacy input files (depending on whether or not one or both are present). Optionally the user may request that the software:

- Use a specific reference data set when assigning risk assessment variables such as reference concurrent weights, reference prevalence rates and predictive modeling scores;
- Ignore prior cost data in the estimation of the models; and/or
- Calculate all valid predictive models (for use under the direction of technical support).

The selection of these options is controlled by clicking the buttons under the Risk Assessment Variables, Prior Costs and the All Models section of the screen above. The default settings are to calculate scores for an under age 65 population and to include prior cost in the predictive modeling algorithm. In general, including prior costs will improve performance of the predictive model performance. It is true, however, that including prior costs in the model makes it look more like a prior cost model. Therefore, in certain instances, such as a federal agency interested in using predictive modeling scores for payment, you may want to exclude prior cost from the model so this option has been provided. This option may also prove useful for certain disease or case management applications, which may possibly prove more robust to removing the prior cost information.

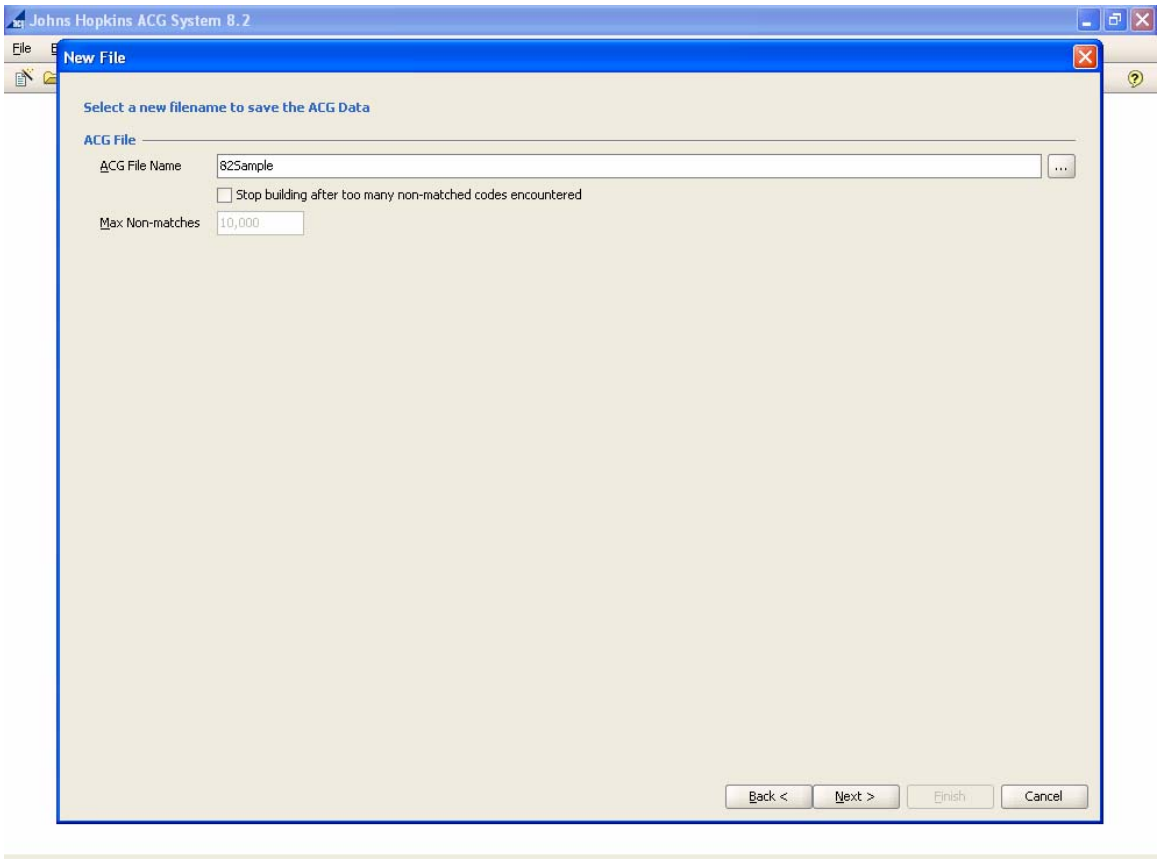
If an elderly model is selected, then all predictive modeling scores will be calibrated against an elderly managed care population aged 65 or greater. The reference population includes pharmacy benefits and expenditures so that pharmacy expense can be predicted relative to a Medicare-eligible population. When this option is selected, the national concurrent weights will also be based upon an elderly population. While adjustments have been made to accommodate the occasional under age 65 enrollee, if your Medicare-eligible population is disabled and predominantly non-elderly, the non-elderly option is better suited for your application.

The last check box, calculating all valid predictive models, produces a separate output file where the rows are the patients and the columns are all possible predictive modeling scores. This file is useful for analysts wishing to compare the suite of ACG predictive modeling tools looking to contrast the diagnosis, pharmacy, and diagnosis + pharmacy-based predictive models.

◢ ***Tip/Caution*:** Clicking the check box to calculate all valid models may cause substantial processing delays. This is a data intensive activity producing multiple scores for each individual.

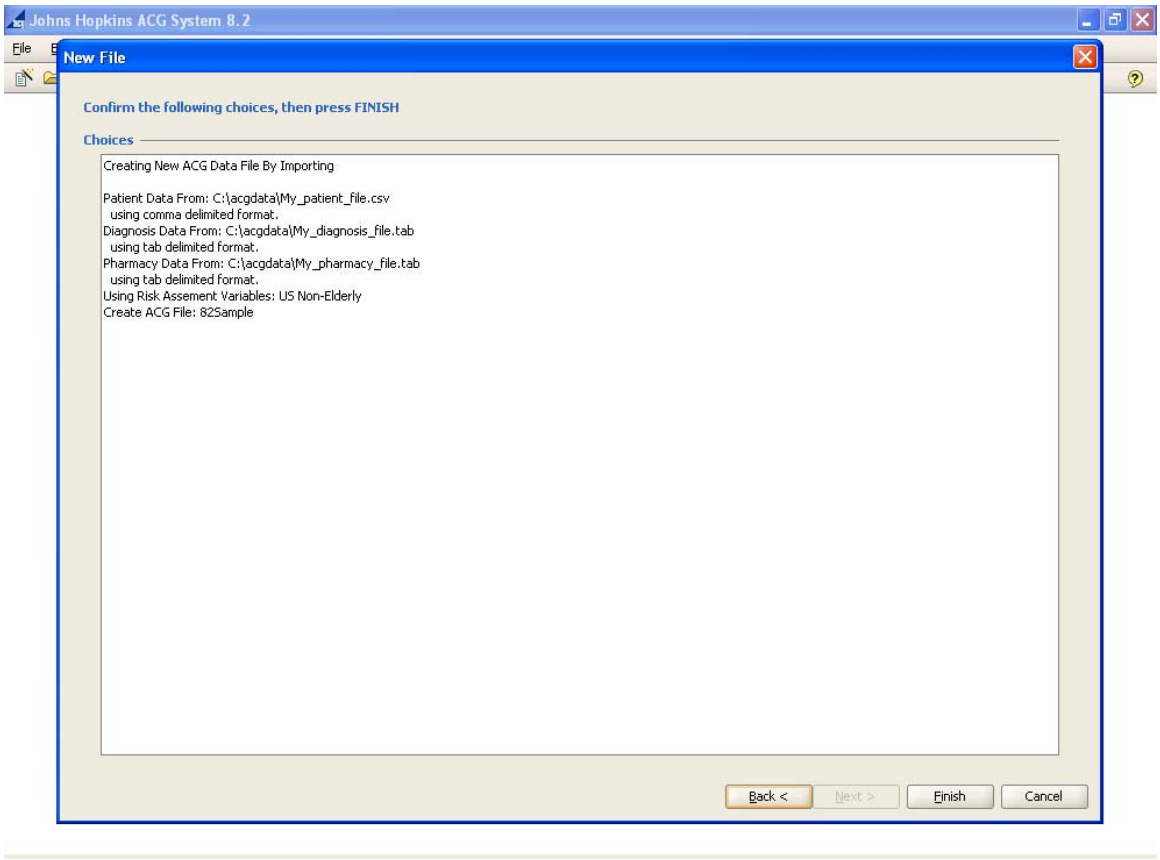
After filling in all the filenames (patient data file, file formats, location of diagnosis and pharmacy data files) and specifying your predictive modeling options, press **Next**. A pop-up menu provides filter options to control the selection of patients from the active data file to be included in the analysis (a screen shot and discussion of this functionality was presented previously in the section Report Options). After implementing any filters, press **Next**.

Figure 44: Step 3 - Load Your Own Data



As shown in **Figure 44**, you must type the name and location of the files to which the ACG database will be saved. If you are uncertain as to the quality or source of diagnosis or pharmacy codes, you can enforce a maximum number of unmatched codes. When checked, if the ACG System encounters non-matched codes (either diagnosis or pharmacy) in excess of the typed threshold, the application will stop processing with an error message. By default, the application will process all records regardless of the number of non-matched codes encountered.

Figure 45: Final Step – Load Your Own Data



You will be given one last opportunity to confirm your file selections before the ACG assignment process begins. Click **Finish** to begin processing files.

Additional Sources of Information

It is hoped that this chapter, combined with the chapter entitled "Basic Data Requirements," and the built-in (and searchable) help function of the ACGs for Windows software will be enough to get most users up and running - at least with the mechanics of most ACG-based analyses. However, we encourage you to use the other important chapters of this detailed *Technical User Guide* and *Reference Manual* for a complete understanding of the implementation of the ACG System.

Appendix A: ACG Output Data

The ACG import process imports patient demographic and utilization data from the patient import file, all of the diagnoses that a patient has experienced over the observation period from the diagnosis import file, and adds a number of calculated data elements. These data elements form the basis for all analyses provided in the ACG System. You can see each of these data elements in the Patient Sample section of the ACG Data File (see **Table 18**).

Table 18: Column Definitions for the ACG Output File

Column	Definition
Pharmacy Cost Band	A banded indicator of historic pharmacy costs based upon pharmacy cost percentiles. Possible values include: • 0 – 0 pharmacy costs. • 1 – 1-10 percentile. • 2 – 11-25 percentile. • 3 – 26-50 percentile. • 4 – 51-75 percentile. • 5 – 76-90 percentile. • 6 – 91-93 percentile. • 7 – 94-95 percentile. • 8 – 96-97 percentile. • 9 – 98-99 percentile.
Total Cost Band	A banded indicator of historic total costs based upon total cost percentiles. Possible values include: • 0 – 0 pharmacy costs. • 1 – 1-10 percentile. • 2 – 11-25 percentile. • 3 – 26-50 percentile. • 4 – 51-75 percentile. • 5 – 76-90 percentile. • 6 – 91-93 percentile. • 7 – 94-95 percentile. • 8 – 96-97 percentile. • 9 – 98-99 percentile.

Column	Definition
Age Band	A banded indicator of patient age. Possible values include: • <0 • 00-04 • 05-11 • 12-17 • 18-34 • 35-44 • 45-54 • 55-69 • 70-74 • 75-79 • 80-84 • 85+ • Unknown
ACG Cd	Adjusted Clinical Groups. The ACG code assigned to this patient. ACGs assign persons to unique, mutually exclusive morbidity categories based on patterns of disease and expected resource requirements.
Resource Utilization Band	Aggregations of ACGs based upon estimates of concurrent resource use providing a way of separating the population into broad co-morbidity groupings as follows: • 0 - No or Only Invalid Dx • 1 - Healthy Users • 2 - Low • 3 - Moderate • 4 -High • 5 -Very High
National Unscaled Weight	An estimate of concurrent resource use associated with a given ACG based on a national reference database and expressed as a relative value. Each patient is assigned a weight based on their ACG Cd.
National Rescaled Weight	National weights that are rescaled so that the mean across the population is 1.0.
Local Weight	A concurrent weight assigned to this patient based upon their ACG Cd using local cost data. The weight for each ACG is calculated as the simple average total cost of all individuals assigned to each category.
ADG Codes	Aggregated Diagnosis Groups. The building blocks of the ACG System. Each ADG is a grouping of diagnosis codes that are similar in terms of severity and likelihood of persistence of the health condition over time. This column contains a listing of all ADG codes assigned to this patient, separated by spaces.
ADG Vector	A vector of zeros and ones to indicate which ADG codes this patient was assigned. A "1" in the fifth position indicates the patient was assigned ADG 5. **Note:** ADG15 and ADG19 are no longer in use and thus should always be zero.
EDC Codes	Expanded Diagnosis Clusters. All of the EDC codes assigned to this patient, separated by spaces. The EDC taxonomy identifies patients with specific diseases or symptoms that are treated in ambulatory and inpatient settings.
MEDC Codes	Major Expanded Diagnoses Clusters. All of the MEDC codes assigned to this patient, separated by spaces. The EDC taxonomy is structured into broad clinical categories, called MEDCs.

Column	Definition
Rx-MG Codes	Pharmacy Morbidity Group Codes – all of the Rx-MG codes assigned to this patient, separated by spaces.
Major Rx-MG Codes	Major Pharmacy Morbidity Group Codes – all of the Major Rx-MG codes assigned to this patient, separated by spaces.
Major ADG Count	The number of major ADGs assigned to this patient. A "major ADG" is an ADG found to have a significant impact on concurrent or future resource consumption. There are separate "major ADGs" for pediatric and adult populations.
Frailty Flag	A flag for any one of 11 diagnostic clusters that represent discrete conditions consistent with frailty (e.g., malnutrition, dementia, incontinence, difficulty in walking).
Hospital Dominant Count	A count of ADGs containing a trigger diagnoses indicating a high probability (typically greater than 50 percent) of future admission.
Chronic Condition Count	A count of EDCs containing trigger diagnoses indicating a chronic condition with significant expected duration and resource requirements.
Asthma	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Arthritis	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Congestive Heart Failure	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
COPD	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Chronic Renal Failure	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Depression	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Diabetes	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.

Column	Definition
Hyperlipidemia	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Hypertension	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Ischemic Heart Disease	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Low Back Pain	A flag indicating the presence of the condition: NP – condition not present. BTH – condition identified by both diagnosis and NDC code. RX – condition identified by NDC code. ICD – condition identified by diagnosis code.
Unscaled Total Cost Resource Index	ACG PM Predicted Resource Index (PRI) for Total Cost. The estimated total costs (including pharmacy costs) for this patient for the year following the observation period. Based upon a national reference database (with a mean of 1.0), the predicted value is expressed as a relative weight. Population or sub-group analyses provide comparisons to national norms.
Rescaled Total Cost Resource Index	The Total Cost Resource Index rescaled so that the local population mean is 1.0. Sub-group analyses provide comparisons to local norms.
Probability High Total Cost	ACG Predictive Probability Score for total cost. The probability that this patient will have high total costs (including pharmacy costs) in the year following the observation period.
Unscaled Pharmacy Cost Resource Index	ACG Predictive Model PRI Score for Pharmacy Costs. The estimated pharmacy costs for this patient for the year following the observation period. Based upon a national reference database (with a mean of 1.0), the predicted value is expressed as a relative weight. Population or sub-group analyses provide comparisons to national norms.
Rescaled Pharmacy Cost Resource Index	The Pharmacy Cost Resource Index rescaled so that the overall population mean is 1.0. Sub-group analyses provide comparisons to local norms.
Probability High Pharmacy Cost	ACG Predictive Model Probability Score for pharmacy cost. The probability that this patient will have high pharmacy costs in the year following the observation period.

Appendix B: Batch Mode Processing

Windows/DOS

During the ACG System Windows installation process, a separate executable file (jhuacg.exe) is loaded for command line use. The **jhuacg.exe** file is initiated at the command prompt in Windows/DOS and utilizes the same input files as the Windows release. The command line version produces an ACG Data File with the extension .acgd. The .adcg file is readable in the Windows version. Click the **File** menu and select **Open**. Type the filename or use the Windows Explorer feature to double click the .acgd file of interest. You can also access the processed data using command line functions explained below in the ACG Command Line Usage section.

UNIX

The UNIX versions of the ACG application support command line use in both the installer and the runtime version. The installer comes in the form of an executable for each target UNIX platform. To install the software:

- Log in as root, move to the directory that the installation is located in, and run in (“./JHUACGSetup4AIX-8.2-20060614.bin”).
- The software will install into “/opt/jhuacg{version}”. The current version should install into “/opt/jhuacg8.2”.

Installation can be confirmed by running the help command: “/opt/jhuacg8.2/jhuacg –h”.

Note: The software requires a Java® 6 Runtime (this is technically Java 1.6, recently marketed as Java 6)

ACG Command Line Usage

Command line usage of the ACG application works the same at the Windows command prompt and at the UNIX command prompt (shell). All examples given are provided in Windows format.

Usage Details

Create a New ACG Data File

jhuacg -new-acg-file <file>

-patient <file> [-patient-format TAB|COMMA|<file>] [-patient-skip]

-diagnosis <file> [-diagnosis-format TAB|COMMA] [diagnosis-skip]

-pharmacy <file> [-pharmacy-format TAB|COMMA] [-pharmacy-skip]

-rav <rav-code> [-ignore-prior-costs] [-all-models]

Export Data from an ACG Data File

jhuacg -export <type> -acg-file <file> [-delim TAB|COMMA] [col-file <file>]

-export-file <file> [-no-headers]

Install a License File

jhuacg -install-license <file>

Install a Mapping File

jhuacg -install-mapping-file <file>

Options

-new-acg-file <file>	Creates a new ACG Data File called <file>
-patient <file>	Uses <file> as patient source data file
-patient-format <file>	Uses <file> as the format definition for the patient data
-patient-skip	Skips first row from patient file
-diagnosis <file>	Uses <file> as diagnosis source data file
-diagnosis-skip	Skips first row from diagnosis file
-pharmacy <file>	Uses <file> as pharmacy source data file
-pharmacy-skip	Skips first row from pharmacy file
-rav <rav-code>	Uses <rav-code> stated RAV for calculations US-ELD = US Elderly US-NONELD = US Non-Elderly (the default if no rav is specified is US-NONELD)
-all-models	Generates all valid predictive models
-ignore-prior-costs	Ignores prior cost data
-export <type>	Exports data from an ACG Data File.

<type> determine what data to export as follows:

PATIENT - exports patient details

ADG – exports ADG assignments

EDC - exports EDC assignments

MEDC - exports MEDC assignments

RXMG - exports Rx-MG assignments

MAJ-RXMG - exports Major Rx-MG assignments

DIAGNOSIS - exports patient diagnoses

PHARMACY - exports patient pharmacy codes

NM-DIAGS - exports non-matched diagnosis codes

NM-PHARMACY - exports non-matched pharmacy codes

WARNINGS - exports warnings

LOCAL-WEIGHTS - exports local weights

MARKERS - exports model markers

MODELS - exports all model outputs

-delim TAB|COMMA	Uses a tab or comma delimiter for export. If not specified, TAB is used
-col-file <file>	Exports only the columns listed in <file>. <file> should contain columns on separate lines. Only valid for PATIENT export.
-acg-file <file>	Uses the acg data file <file> to export from
-export-file <file>	Exports data into <file>
-no-headers	Does not write a row of headers into the export file
-install-license <file>	Installs the license in <file>
-install-mapping-file <file>	Installs the mapping file <file>
-help	Prints this message

Guidelines

- All filenames should be specified with an absolute pathname.
- All input files should be in either comma-delimited or tab-delimited format, using optional quotes, with the platform specific end-of-line character(s) (CR/LF on Windows, LF on UNIX).
- By default export files will be exported as tab-delimited, quote enclosed, using the platform specific end-of-line character(s). Use the delim option to select comma separated files.
- To use a patient file format that is different from the standard file format, the user can either create a format file (*.acgf) in the Windows application and apply it within the command line, or the user can create a custom format file for use with the command line. The user needs to create a text file in the following format:

  property = value

  col name : data type : col desc

  Column formatting rules are

  > column names should not contain spaces.

  > column descriptions may contain spaces.

  > data types are described in the documentation for file formats in the Windows application.

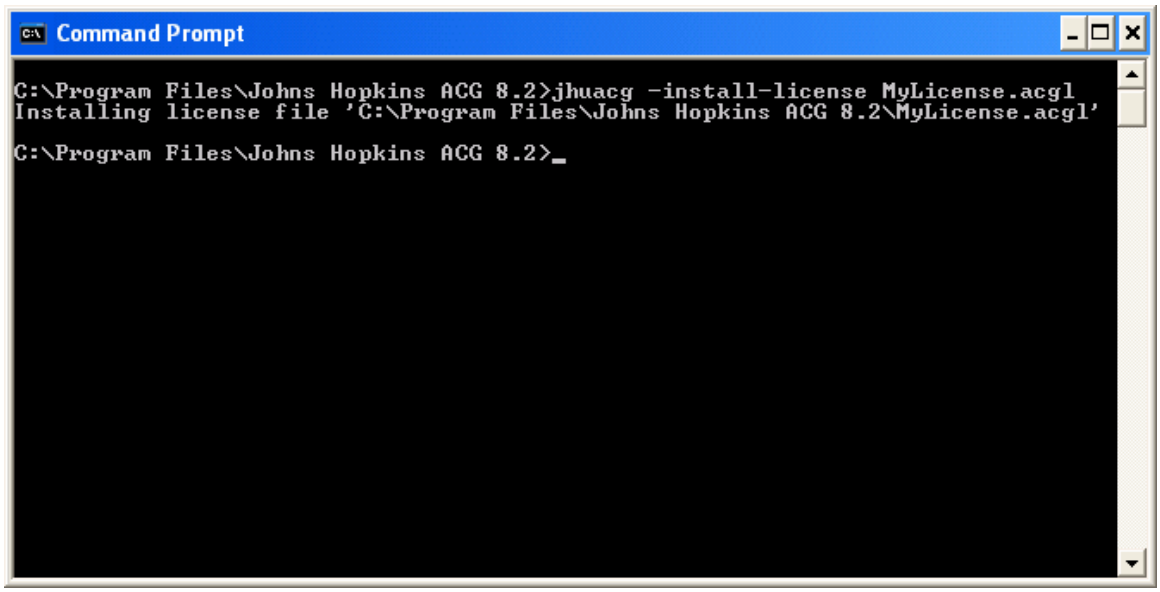
Install a License File

C:\> "\Progam Files\Johns Hopkins ACG 8.2\jhuacg.exe" –install-license c:\acgdata\mylic.acgl

(The command above is typed on a single line)

Note: If the license file was installed under the Windows release prior to using the command line version, then the license file does not need to be re-installed and this step can be skipped.

Figure 46: Use the Command Line Version to Install a License File

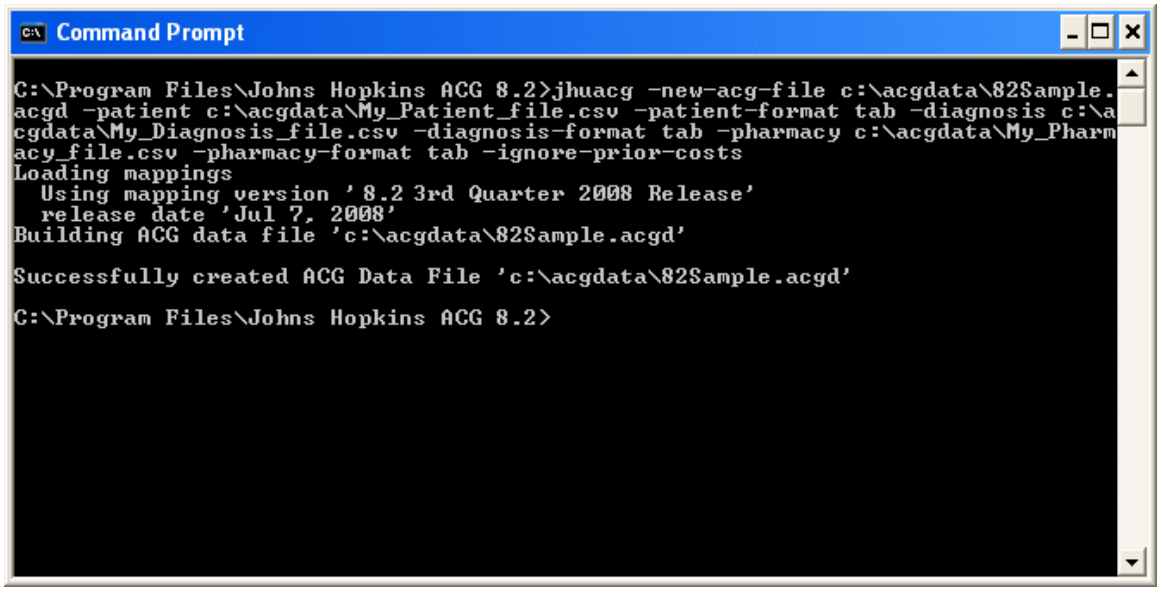


Create a New ACG Data File (.acgd)

C:\> "\Program Files\Johns Hopkins ACG 8.2\jhuacg" –new-acg-file c:\acgdata\82Sample.acgd –patient c:\acgdata\My_Patient_file.csv –patient-format tab –diagnosis c:\acgdata\My_Diagnosis_file.csv –diagnosis-format tab –pharmacy c:\acgdata\My_Pharmacy_File.csv –pharmacy-format tab –ignore-prior-costs

(The command above is typed on a single line)

Figure 47: Use the Command Line Version to Create a New ACG Data File



Example custom format file

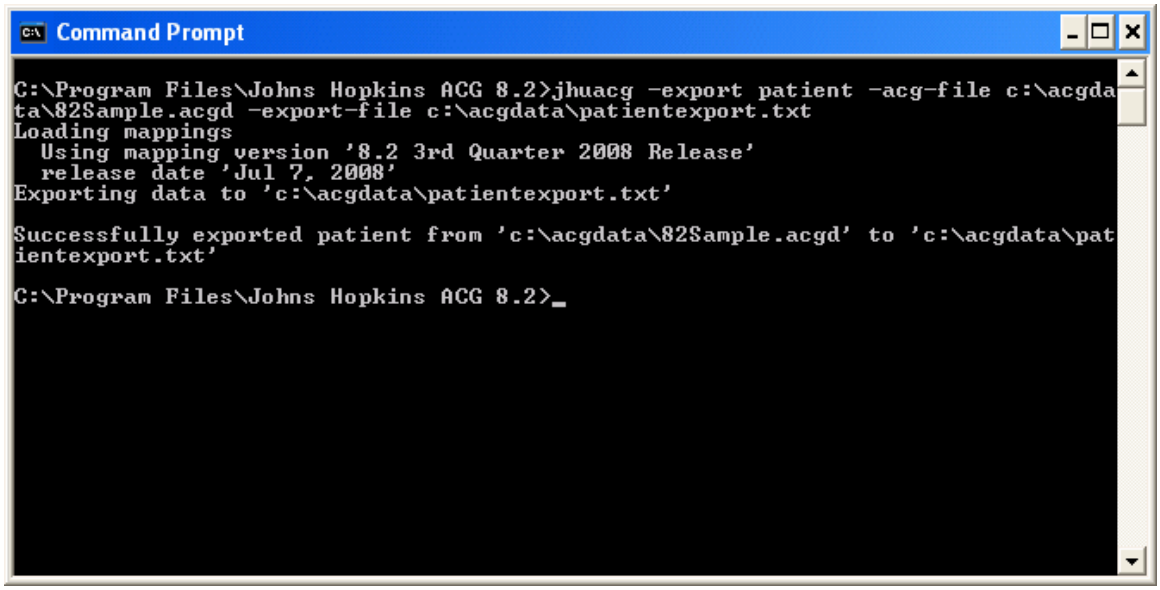
```
# Patient Format File
# Property Definitions
delim          = tab
# Columns Definitions
patient_id     : String     : Patient Id
age            : Integer    : Age
sex            : String     : Sex
pharmacy_cost  : Double     : Pharm Cost
total_cost     : Double     : Total Cost
```

Export Patient Data from the ACG Data File

C:\> "\Program Files\Johns Hopkins ACG 8.2\jhuacg.exe" –export patient –acg-file c:\acgdata\82Sample.acgd –export-file c:\acgdata\patientexport.csv

(The command above is typed on a single line)

Figure 48: Use the Command Line Version to Export Data



Appendix C: Java API

The ACG System includes a Java API which allows clients to process data one member at a time. This may be useful when building applications which provide data to the system interactively; e.g., within a workflow system. The client can utilize this API with a development environment that can interface with Java. Because the API processes a single member at a time, some aggregate processes will not be performed by the API and will be the responsibility of the developer.

In order to use prior cost as an input into the predictive model, the developer will be required to calculate the total and pharmacy cost bands for input into the application. Probability scores will not be calculated by the API, but can be calculated by ranking the scores, determining the percentile and converting to a probability score using a lookup table. Other aggregate variables, such as local weights and rescaled PRIs will not be available in the API.

◢ ***Tip:*** Please contact your software vendor for documentation and certification.

6 Assessing the ACG Grouper's Output

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Introduction

This chapter is intended for the programmer/analyst who will actually be running the ACG Software. This chapter outlines a series of steps that will help you assess the face validity of the grouping process.

ACG Compressed Data File

After processing the input (patient, diagnostic and optional pharmacy files), the ACG Software generates a single output file in a compressed data file format with an .acgd extension. The ACG output file contains all of the input and output variables necessary to produce each of the standard reports as well as the ability to export the data for customized analyses. Please refer to the Installation and Usage Chapter for more detail on each of the ACG Software input and output files. **Note:** UNIX® users must transport the .acgd file created by the software to a Windows™ platform and invoke a Windows version of the software to follow the review steps outlined in this chapter.

Basic Review Process

The first stage in the quality-control process includes an initial review of the reports automatically produced by the software. These include:

1. Review the Summary Statistics tab including verifying the input file(s), person counts, diagnosis code mismatch rate, and that the number of warning messages is reasonable.

2. Review the Patient Sample tab to confirm population of the each field within the .acgd file and confirmation that the input of data matches the patient source file.

3. Review the Local Weights tab to validate the presence of most or all ACGs. Of particular interest is a relationship between the pregnancy and newborn ACGs, as well as the number of non-user and no dx code ACGs.

4. Review the Age-Gender Distribution tab against the known age and gender mix of the population.

5. Review the Predictive Modeling Scores Distribution tab. Users should expect to see a large portion of the population with PM scores below 0.80.

6. Review the Build Options tab. Information on input files (patient, diagnosis and pharmacy) as well as reference weights (e.g., Risk Assessment Variables) and options selected for the ACG predictive model are easily summarized.

The second stage in the quality-control process includes producing and evaluating those reports available in the Analyze Menu (reference the section entitled, "Review of Reports Produced by the Analyze Menu" in this chapter).

Review of Reports Produced Automatically by the Software

Summary Statistics Tab

The first tab the user sees after processing the data or opening an .acgd file is the Summary Statistics tab which provides a summary review of which input file(s) were processed, a summary person count, information on diagnosis code mismatch rate, and information on the number of warning messages generated. The first check is to verify that the number of output records (people) should be consistent with the general knowledge of the input data. Non-Grouped code percentages should generally be 1% or less for ICD codes and 10% or less for NDC codes. Rates higher than this may suggest a coding or data processing problem on the part of the user. It is equally useful to examine the Non-Matched ICD and Non-Matched Pharmacy Code List. There may be codes in this list that cause concern and can be easily deleted or replaced. If you are concerned that the mismatch rate is too high, please contact your primary support person for assistance.

◢ ***Tip:*** If processing ICD-10 data, pay special attention to the non-matched ICD-10 codes. Users are reporting higher than anticipated mismatch rates due to local implementation of ICD-10-CM encouraged by the World Health Organization. Adjustments to the input data to assure conformity to ICD-10 WHO may be necessary to assure that maximal diagnostic information may be extracted from the claims data. Talk to your software vendor about the possibility of including local code sets to accommodate your customization of ICD-10.

Which Predictive Model

The Summary Statistics Tab also provides the user with information on which predictive model was used in selecting the scores (predictions of total cost, pharmacy cost and probability scores for high total cost and high pharmacy costs) in the summary patient file. The descriptions for each model are described in four sections using the following example:

Total Cost Model Selected	DxRx-PM[1] - total cost[2] → total cost[3]
Risk Assessment Variables	US non-elderly[4]

[1] Indicates the type of ACG predictive model. Possible values include

- Dx-PM (for diagnosis based predictive modeling),
- Rx-PM (for pharmacy based predictive modeling), or
- DxRx-PM (for diagnosis plus pharmacy based predictive modeling).

[2] Indicates whether or not and the type of prior cost information included in the calibration of the predictive model. Possible values include

- No cost (for no cost information was incorporated),
- Total cost (for total cost), or
- Rx cost (for Pharmacy cost).

[3] Indicates what is being predicted. Possible values include:

- Total cost (for total cost)
- Rx cost (for pharmacy cost)

[4] Indicates the population to which the model has been calibrated. Possible values include:

- Non-elderly for less than 65 years old and
- Elderly for populations 65 years or older

◢ ***Tip:*** For advanced users wishing to explore the All Models File containing all possible permutations of the Dx-PM, the Rx-PM and the DxRx-PM, a similar, albeit not identical, model identification schema has been implemented.

Patient Sample

The second table produced by the ACG Software is a sample of the first 1,000 output records. The table provides a means of quickly assessing whether data appears to have been loaded and processed correctly. User should use this table to confirm that input data matches the equivalent output information and check the remaining output fields for consistency in column population.

Local Weights

The third table produced by the ACG Software is the Local Weights tab. The table presents patient counts, total cost and concurrent weights by ACG based on local data. A review of this table should help with determining 'holes' or missing ACGs indicative of missing, incomplete or improperly processed data. For example, users should check the relationship between deliveries and newborns, as well as excess patient counts associated with ACGs 5110 and 5200.

Proper ACG assignment depends, in large part, on defining the underlying population appropriately. In some specialized cases, the study population will be defined in such a way that all ACG categories are not utilized. For example, ACG Software runs that are limited to adults should not have persons assigned to ACGs that reflect pediatric patients. More generally, however, anomalies in the distribution of ACGs may suggest either: 1) problems with the definition of the denominator population; or 2) "holes" in the claims used to identify patients' diagnosis codes (e.g., claims for carved-out benefits not being submitted to the plan). Using the ACG distribution displayed in this report, you can assess some of the following potential distribution errors:

- ACGs 0100, 0200, 0300, 1700 series, 1900-2200, 2900-3300, 3800-5070 and the 5300 series incorporate the age of the patient. Are there an appropriate number of infants in ACGs 5310-5332? If these ACGs have an insufficient number of patients or a larger than expected number of patients, the analyst should review the way age was coded on the input data set. A similar review can be performed for other age categories (e.g., 2-5, 6-11, 18-34).

- Is the number of members assigned to ACG 5100 (no valid diagnoses assigned to an ADG) or ACG 5200 (non-users) consistent with the plan's non-user rate? If it is not, and the ICD mismatch rate is within the expected range, a diagnosis coding or record justification problem may exist on the input data file.

Age-Gender Distribution

The fourth table produced by the ACG Software is an Age-Gender Distribution of the local population. This distribution is useful as a comparison between the given population and any external reference data source as a means of validating input data. It can also be used for historical trending.

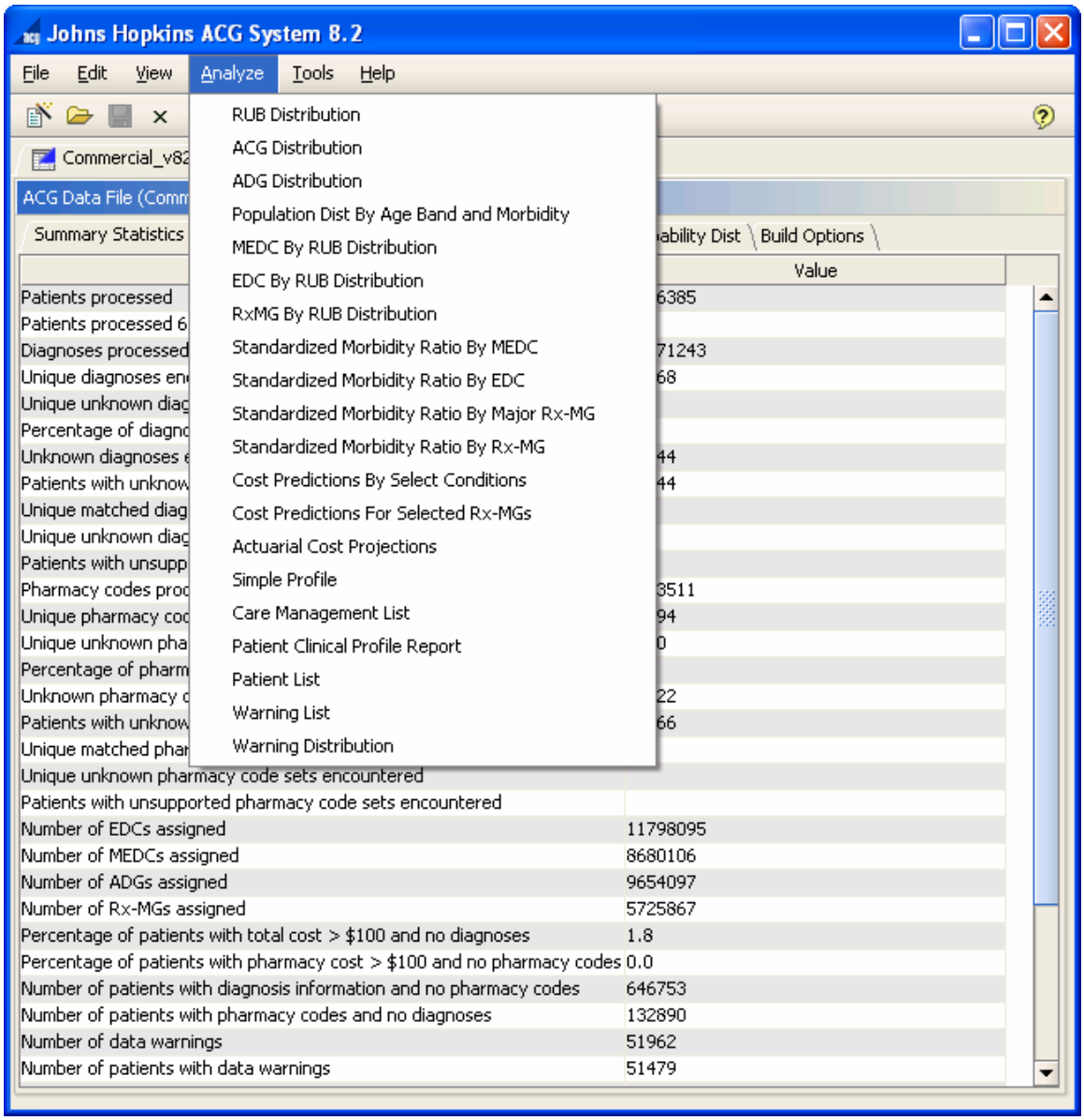
PM Scores Distribution

The fifth table produced by the ACG Software is a Predictive Modeling (PM) Distribution of the local population. For Commercial populations, results should be reviewed and compared against the reference data results below. Users should expect to see a large portion of the population with PM scores below 0.80.

Review of Reports Produced by the Analyze Menu

There are a series of reports available in the Analyze menu (**Figure 1**) of the software each of which may be accessed by 1) selecting Analyze from the Windows task bar and, 2) selecting the desired report from the pull down menu. The Analyze menu may be used not only for assessing data quality but may also, and depending on data input provided to the software, be used for describing differences in morbidity mix across population sub-groupings.

Figure 1: Analyze Menu



◢ ***Tip:*** All of the reports generated in the Analyze menu can be exported as Excel spreadsheets using the 1) selecting the Tools from the Windows Task bar and 2) selecting Export from the pull down menu.

While each of these reports is discussed in additional detail elsewhere in the manual (please see the Installation and Usage chapter in the Technical User Guide), at a fundamental level the review process can be distilled to a few basic elements as follows:

1. Evaluate the distribution of persons by ACG category for face validity.

2. Verify that patients are being assigned to appropriate ACG categories, when delivery status and/or birth weight status is present.

3. Examine the distribution by ADG against known patterns..

4. Compare the EDC, Major EDC, Rx-MG and Major Rx-MG distributions against known patterns. Validate that reports by population variable were run according to the option selected.

5. Review the list and distribution of data warnings.

6. Examine the list of non-matched ICD and pharmacy codes.

The goal of these analyses is to first provide an initial review of the output; the second is to provide a more detailed understanding of the study population's characteristics or texture.

Example: RUB Distribution

Resource Utilization Bands (RUBs) represent a means of collapsing the multiple ACG categories into six iso-resource groupings from very low (or non-users) to very high.

ACG aggregation into RUBs is as follows:

- RUB-0 (No Resource Use): ACG 5200

- RUB-1 (Low Expected Costs) ACGs 0200, 0300, 1600

- RUB-2 (Low/Intermediate Expected Costs) ACGs 0100, 0400-0700, 0900-1300, 1800-2500, 3400, 3800

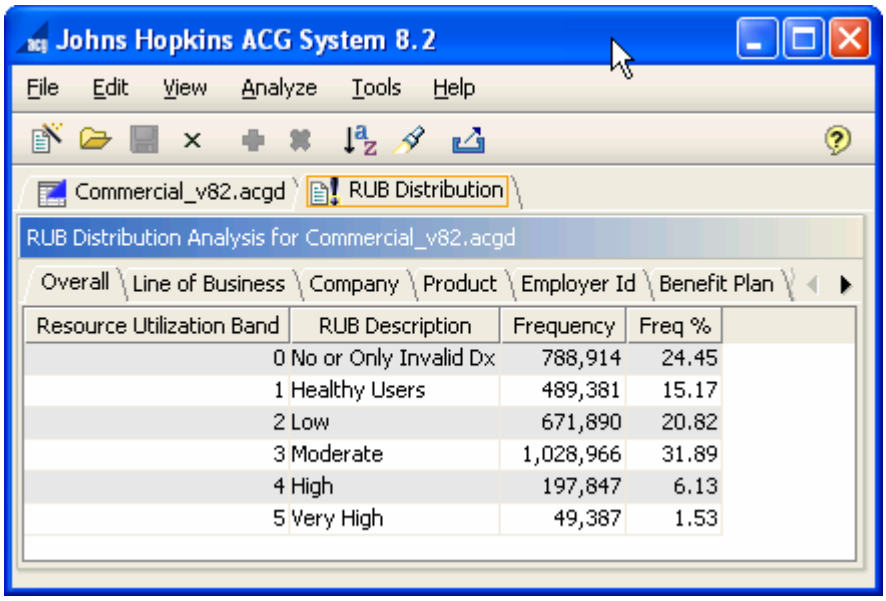
- RUB-3 (Intermediate Expected Costs) ACGs 0800, 1400, 1500, 1712, 1722, 1732, 1742, 1752, 1762, 2600-3300, 3500-3700, 3900-4320, 4410, 4420, 4510, 4610, 4710, 4720, 4910, 5010, 5310, 5330

- RUB-4 (Intermediate/High Expected Costs) ACGs 1711, 1721, 1731, 1741, 1751, 1761, 1771, 1772, 4330, 4430, 4520, 4620, 4730, 4830, 4920, 5020, 5040, 5050, 5320

- RUB-5 (High Expected Costs) ACGs 4930, 4940, 5030, 5060, 5070, 5340

RUBs provide an easy means of summarizing ACG information and are useful for presentation, payment and profiling applications (**Figure 2**).

Figure 2: Population RUB Distribution



Resource Utilization Band	RUB Description	Frequency	Freq %
0	No or Only Invalid Dx	788,914	24.45
1	Healthy Users	489,381	15.17
2	Low	671,890	20.82
3	Moderate	1,028,966	31.89
4	High	197,847	6.13
5	Very High	49,387	1.53

◢ ***Tip:*** For each report, an explanation of each field may be found in Chapter 5 of the Technical Users Guide or the on-line help within the ACG Software.

Comparison to Reference or External Data

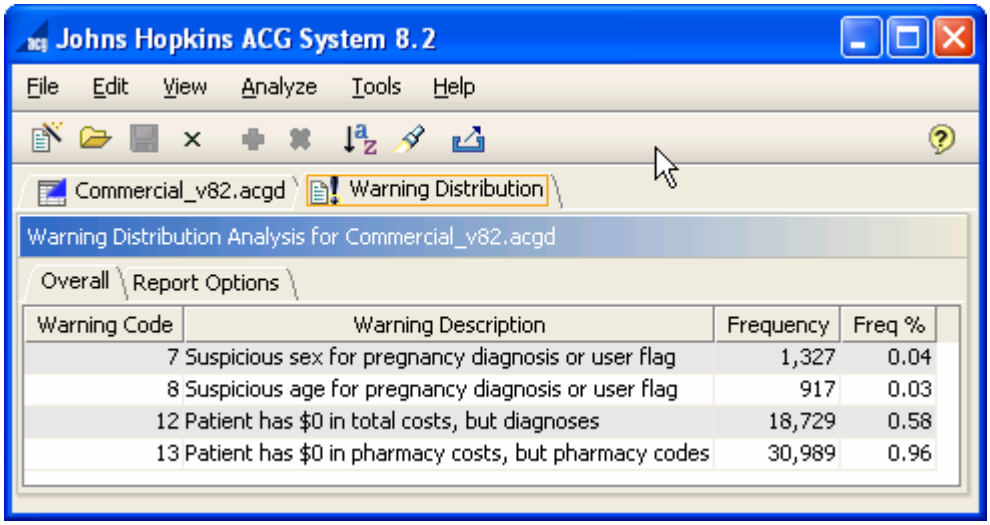
For almost all reports available in the software, results for a Commercial and Medicare reference data set for the under age 65 working age population as well as the over age 65 Medicare eligible population are available electronically as an Excel spreadsheet which may be accessed via the pull down menu of the Johns Hopkins ACG 8.2 start menu. Users are encouraged to produce their own reports and use this reference comparison data as a benchmark. Key is not does your data match the reference data exactly; but rather, does it make sense given the context of your particular application.

Additional Considerations

Evaluate the Warning Distribution

The Warning Distribution Analysis produces a frequency distribution by warning. A sample listing of warnings is presented in **Figure 3**. The frequencies reported should be examined possible data completeness issues. For example, an excessive number of cases receiving Warning 14, "Patient has > $0 in total costs, but no diagnoses," may indicate a problem with how total cost was captured. Alternatively, this may indicate inappropriate exclusion of diagnoses related to rule-out or provisional claims. In either case, a review of the original input data may be necessary. The Software may need to be rerun if problems are found that can be corrected.

Figure 3: Sample Warning Distribution



Examining the List of Non-Matched Diagnosis Codes

All input ICD codes not considered valid are eligible for export to the non-matched ICD file. Each mismatched code is written out one time for each person who has that code (along with a corresponding person ID). In this way, you can use this machine-readable information to generate a listing of codes and/or people who have non-matched codes. A sample of a non-matched ICD file is presented as **Table 1**. The non-matched ICD file contains each patient identifier for whom a non-matched code occurred, the ICD version (9 or 10) and the corresponding ICD code. At the very least, you should scan the list of non-matched codes to determine if any codes that should have been assigned to an ADG are listed frequently. The non-matched ICD codes can be exported and saved as a *CSV* file (either tab or comma delimited), as shown in **Figure 4**. To gain a fuller perspective of the codes that are contained in the non-matched ICD file, you can sort the output file by ICD code only and create a frequency distribution of all rejected (non-matched) ICD codes.

Table 1: Sample of Non-Matched ICD File

patient_id	icd_version	icd_cd
d514AAAAAACAADBN	9	D999
d514AAAAAACAHJZW	9	E888
d514AAAAAACAIYSE	9	E888
d514AAAAAACAOBLE	9	E888
d514AAAAAACAOTGN	9	E888
d514AAAAAACASNTD	9	E888
d514AAAAAACAUAGC	9	E888
d514AAAAAACAWYRK	9	E888
d514AAAAAACBMZYK	9	E888
d514AAAAAACBNDHW	9	7412
d514AAAAAACBPYLW	9	E812
d514AAAAAACBXTBZ	9	E826
d514AAAAAACCCGTY	9	E813
d514AAAAAACCCJSM	9	E888
d514AAAAAACCIKWQ	9	E888
d514AAAAAACCJBSM	9	E888
d514AAAAAACCLIIN	9	E888
d514AAAAAACCMMYB	9	E929
d514AAAAAACCPJOV	9	E888
d514AAAAAACCWVJO	9	E888
d514AAAAAACCWVPW	9	E888

Common Input File Problems

Some common problems with the input file that can lead to high mismatches are as follows:

- Codes that have been padded out to five digits using zeros will not be assigned to an ADG unless the five-digit code is in the mapping. If all codes have been padded on the right with zeroes, mismatch rates will be high and patients may not be assigned the correct risk assessment variables.

- If the same code is rejected repeatedly for multiple members, this may be a home-grown (plan-specific) code. You can usually recode these to a valid ICD code. Before assigning risk assessment variables, all common homegrown codes should be reviewed and re-assigned in this manner. (Please contact your ACG support contact for assistance with this process, if needed.)

If decimal points are included in the input diagnosis codes, are they appropriately placed? Decimals will be stripped from diagnoses that include them (by the ACG Software) before assignments are made. Codes that include decimals can have a maximum of three characters to the left of the decimal and two characters to the right of the decimal. If a non-conventional location of the decimal point seems to be posing a problem, remove them from the diagnoses in the input data file and rerun the ACG software.

Remember, if processing ICD-10 data special attention should be paid to the non-matched ICD-10 codes. A large number of users are reporting higher than anticipated mismatch rates due to local implementation of CM encouraged by the World Health Organization. Adjustments to the input data to assure conformity to ICD-10 WHO may be necessary to assure that maximal diagnostic information may be extracted from the claims data.

Examining the List of Non-Matched Pharmacy Codes

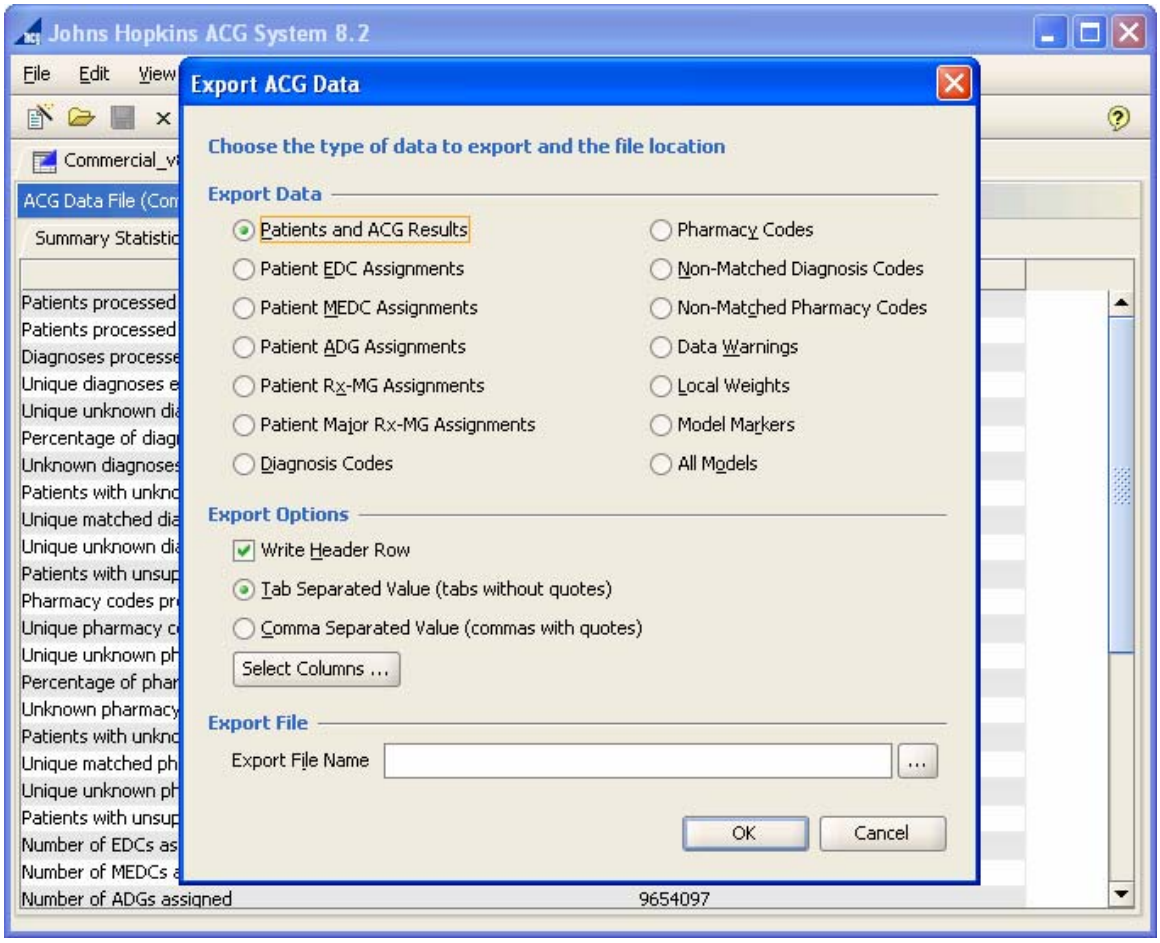
To assist users with understanding potential pharmacy coding issues non-matched pharmacy code file can be generated. All input pharmacy codes that are not considered valid codes are eligible for export to the non-matched pharmacy file. A sample of a non-matched pharmacy file is presented as **Table 2**. The non-matched pharmacy codes can be exported and saved as a CSV file (either tab or comma delimited). This file contains each patient identifier for whom a non-matched code occurred, the pharmacy code type (NDC or ATC) and the corresponding pharmacy code. At the very least, you should scan the list of non-matched codes to determine if any codes that should have been assigned to an Rx-MG are listed frequently. To gain a fuller perspective of the codes that are contained in the non-matched pharmacy file, you can sort the output file by pharmacy code only and create a frequency distribution of all rejected (non-matched) pharmacy codes. See **Table 1** above to perform the export process.

Table 2: Sample of Non-Matched Pharmacy File

patient_id	Rx_code_type	rx_cd
0214AAAAAAAAABWB	N	77777777777
0214AAAAAAAAAFIH	N	49502020701
0214AAAAAAAAATUS	N	53489042405
0214AAAAAAAABLOY	N	51552049810
0214AAAAAAAABUSI	N	08884473000
0214AAAAAAAACTEF	N	08290328438
0214AAAAAAAACTEF	N	53885024510
0214AAAAAAAAEKQL	N	00193361050
0214AAAAAAAAGSNX	N	53885037410
0214AAAAAAAAIWOH	N	66666666666
0214AAAAAAAAMHDY	N	53885004810
0214AAAAAAAAMHDY	N	53885044450
0214AAAAAAAAMPUG	N	49452278001
0214AAAAAAAANEWL	N	53885044450
0214AAAAAAAAPESD	N	53885004810
0214AAAAAAAAQBNK	N	50924038110
0214AAAAAAAAQKIY	N	50924096610
0214AAAAAAAAQYNA	N	00001000101
0214AAAAAAAAQYNA	N	12866101800
0214AAAAAAAAQYNA	N	66666666666
0214AAAAAAAARRIR	N	00193394221

◢ ***Tip*:** Accessing the file export options can also be done by using the **Tools – Export** or the  menu button. Once the Export ACG Data window is opened, simply click the **File Selection** button (…) and choose a filename in which to save the exported data. Click **OK** to begin the export.

Figure 4: Exporting Files



Conclusion

Now that you have successfully run the ACG Software and taken some preliminary steps to validate the output, it is time to begin using the ACG System. The next chapter, "Making Effective Use of Risk Scores," will provide more detail on the built-in scores or weights provided with the software that be used for additional validation purposes and to begin basic report building and profiling.

7 Making Effective Use of Risk Scores

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Introduction

While there are separate chapters that discuss the conceptual and clinical underpinnings of the risk assessment variables produced by the ACG System (please refer to the *Reference Manual* for explanation of the ADG, ACG, EDC, and Rx-MG typologies), the purpose of this chapter is to provide an overview of the risk scores or "weights" produced by the software.

In this chapter the term "weight" is used to represent a relative value for resource use with respect to some population average and is generally expressed as a numeric value with a mean of 1.0 (i.e., where the resource use is the same as that of the reference population). Relative weights can be applied to mean resource use for a population to arrive at expected resource use. Weights can be generated concurrently (i.e., for the current period) or prospectively.

Software-Produced Weights and Their Uses

Table 1 provides a summary of the risk weights and scores produced by the software and briefly summarizes their potential application. The remainder of this chapter discusses custom or local calibration of weights. **Table 1** begins on the next page.

Table 1: Risk Weights and Scores

Metric	Description	Use
Unadjusted Weights		
Reference Unscaled Weight	An estimate of concurrent resource use associated with a given ACG based on a reference database and expressed as a relative value. Each patient is assigned a weight based on his or her ACG. Separate weights for non-elderly and elderly eligible populations will be applied depending on the Risk Assessment Variable selected by the user.	Useful in drawing **external** comparisons between your population morbidity burden and that of the reference database. Generally, scores greater than 1.0 indicated the case-mix or predicted risk of your population is sicker than the reference population while scores less than 1.0 indicate they are healthier. ◢ ***Tip*:** Remember that the ACG predictive model selection is determined by a combination of user specified options (e.g., selection of reference data as specified by the Risk Assessment Variables option and the inclusion/exclusion of prior cost) and available input files (e.g., diagnostic and/or pharmacy). See the Summary Statistics or Build Options Tab(s) for clarification on which model and set of reference weights was implemented by the software (eg, Dx-, Rx- or DxRx-PM).
Unscaled Total Cost Resource Index	ACG PM Predicted Resource Index (PRI) for Total Cost. The estimated total costs (including pharmacy costs) for this patient for the year following the observation period. Based upon a reference database (with a mean of 1.0), the predicted value is expressed as a relative weight. Population or sub-group analyses provide comparisons to reference populations as defined by the selected Risk Assessment Variables.	
Unscaled Pharmacy Cost Resource Index	ACG Predictive Model PRI Score for Pharmacy Costs. The estimated pharmacy costs for this patient for the year following the observation period. Based upon a reference database (with a mean of 1.0), the predicted value is expressed as a relative weight. Population or sub-group analyses provide comparisons to reference populations as defined by the selected Risk Assessment Variables.	
Adjusted Weights		
Reference Rescaled Weight	Reference weights that are rescaled so that the mean across the population is 1.0.	Rescaling facilitates **internal** comparisons of morbidity burden, based on reference population, between different subpopulations.
Rescaled Total Cost Resource Index*	The Total Cost Resource Index rescaled so that the local population mean is 1.0. Sub-group analyses provide comparisons to local norms.	

Metric	Description	Use
Rescaled Pharmacy Cost Resource Index*	The Pharmacy Cost Resource Index rescaled so that the overall population mean is 1.0. Sub-group analyses provide comparisons to local norms.	
Local Weight	A concurrent weight assigned to this patient based upon their ACG Cd using local cost data. The weight for each ACG is calculated as the simple average total cost of all individuals assigned to each category.	Local weights are calibrated to reflect the unique properties of your population and do not make use of national norms.
Probability Scores		
Probability High Total Cost	ACG Predictive Probability Score for total cost. The probability that this patient will have high total costs (including pharmacy costs) in the year following the observation period.	Probability scores can be used as the initial selection criteria for identifying members for early intervention.. Only a small percentage of individuals (typically less than two percent) have probability scores greater than 0.5. Roughly 10 percent of the population have scores greater than 0.10.
Probability High Pharmacy Cost	ACG Predictive Model Probability Score for pharmacy cost. The probability that this patient will have high pharmacy costs in the year following the observation period.	
Resource Bands		
Resource Utilization Band	Aggregations of ACGs based upon estimates of concurrent resource use providing a way of separating the population into broad co-morbidity groupings as follows: • 0 – No or Only Invalid Dx • 1 – Healthy Users • 2 – Low • 3 – Moderate • 4 – High • 5 – Very High	RUBs provide a way of separating the population into broad co-morbidity groupings. Also useful when individual ACG cell counts fall below minimum thresholds.

Metric	Description	Use
Total Cost Band	A banded indicator of historic total costs based upon total cost percentiles. Possible values include: • 0 – 0 pharmacy costs • 1 – 1-10 percentile • 2 – 11-25 percentile • 3 – 26-50 percentile • 4 – 51-75 percentile • 5 – 76-90 percentile • 6 – 91-93 percentile • 7 – 94-95 percentile • 8 – 96-97 percentile • 9 – 98-99 percentile	Strictly prior cost markers, these bands are used (optionally) by the ACG predictive models and may prove a useful adjunct to analysts wishing to stratify their populations.
Pharmacy Cost Band	A banded indicator of historic pharmacy costs based upon pharmacy cost percentiles. Possible values include: • 0 – 0 pharmacy costs • 1 – 1-10 percentile • 2 – 11-25 percentile • 3 – 26-50 percentile • 4 – 51-75 percentile • 5 – 76-90 percentile • 6 – 91-93 percentile • 7 – 94-95 percentile • 8 – 96-97 percentile • 9 – 98-99 percentile	

Concurrent ACG-Weights

A fixed set of concurrent ACG-weights based upon the Risk Assessment Variables selection is available as part of the software output file (see the chapter entitled, "Installing and Using ACG Software," in this document for instructions on how to turn this option on). Separate sets of weights exist for under age 65 working age populations and for over 65 Medicare eligible populations. Which set of weights is applied is dependent upon the user-specified options selected about which population the user is working on (i.e., under or 65 and over). The weights produced by the software are relative weights, i.e., relative to a population mean, and are standardized to a mean of 1.0. An individual weight is associated with each ACG. The software-supplied weights may be considered a national reference or benchmark for comparisons with locally calibrated ACG-weights. In some instances (e.g., for those with limited or no cost data), these weights may also be used as a reasonable proxy for local cost data. **Table 6** at the end of this chapter provides a complete listing of ACGs and their corresponding nationally representative concurrent ACG-weight from the US Non-elderly Risk Assessment Variables. (See the following discussion regarding the importance of rescaling so that dollars are not over predicted or under predicted.)

The software-supplied national ACG-weights are supplied in two forms: unadjusted and adjusted. Unadjusted ACG-weights are simply the values of the national ACG-weights applied to a population of interest. The mean value of the unadjusted ACG-weights provides a rudimentary profiling statistic. If the mean of the unadjusted ACG-weight is greater than 1.0 it indicates the rating population (the population to which the weights are being applied) is sicker than the reference population (the national reference database). If the mean is less than 1.0, it indicates the rating population is healthier. To ensure that dollars in the system are not over or under-estimated, we have also made available an adjusted or standardized ACG-weight that mathematically manipulates the unadjusted ACG-weight to have a mean of 1.0 in the local population. The steps for performing this manually are discussed in more detail subsequently.

Our experience indicates that concurrent (also referred to as retrospective) ACG-weights, especially when expressed as relative values, have remarkable stability. Where differences in ACG-weights across plans are present, it is almost universally attributable to differences in covered services reflected by different benefit levels. The software-provided concurrent weights associated with the US Non-elderly Risk Assessment Variables which were developed from a nationally representative database comprising approximately two million lives with comprehensive benefit coverage.

If local cost data are available, the ACG Software also calculates local ACG-weights. These local weights more accurately reflect local benefit levels and area practice patterns. In general it is recommended that the reference population (on which the weights are developed) should be as similar as possible to the assessment population to which the weights are applied. However in the absence of local cost data, the national weights may prove useful for calculating reasonably representative profiling statistics (reference the chapter entitled, "Provider Performance Assessment" in the *Reference Manual*).

Prospective Risk Scores

With the advent of the ACG PM, it is also possible to generate prospective risk scores within the ACG Software. This prospective risk score or "weight" is called the Predictive Resource Index, or PRI. Unlike the concurrent ACG-weights which are linked to specific ACGs, the PRI is individualized and thus, conceivably, every member could have a distinct PRI score. Two PRI scores are produced--one for total cost and one for pharmacy cost. The PRI is interpreted in the same manner as a concurrent ACG weight, i.e., as a relative value. The software produces both an unadjusted and adjusted form of the PRI. The adjustment process is identical to that used to produce the adjusted concurrent weights.

All Model File

Optionally, the user may select the "All Models" option when importing their data. The "All Models" selection will produce the full set of predictive modeling variables for Dx-PM, Rx-PM and DxRx-PM . We recommend contacting your software vendor for additional support in interpreting and using the All Model File. The intent is to allow users a means of easily comparing and contrasting each of the predictive modeling approaches. Upon contacting your software vendor, an appendix will be made available that describes the columns in more detail. As a bit of a preview, the variable naming convention is in shorthand form and describes the type of score, what is being predicted as well as what model was applied, the reference or comparison population on which the model was developed, and whether or not prior cost information was incorporated into the forecasts. We strongly encourage users wishing to take advantage of this option to contact their software vendor.

◢ ***Tip*:** Utilizing the All Model File feature may consume significant PC resources and require longer processing times.

Converting Scores to Dollars

As noted above, both the ACG-weights and the ACG PM's PRI are expressed as relative values, where the mean is centered at 1.0 (assuming the scores have been appropriately rescaled). The interpretation then is that individuals with scores higher than 1.0 are more expensive than average, whereas those with scores less than 1.0 are less expensive than average. Such relative indices can easily be converted to dollar amounts by multiplying by the underlying mean of the population to which the risk adjustment values will be applied. These dollars can be used as the expected cost values for profiling and other risk adjustment applications.

Before converting scores to dollar amounts, it is important to rescale the data (one option is to just use the "adjusted" weights described above) to account for differences between the reference population (in this case, the US Non-Elderly Risk Assessment Variables from Johns Hopkins nationally representative database) and the population to which the weights are applied (e.g., your population of interest). Rescaling is necessary to assure that the underlying mean of the weights is 1.0. A similar process is undertaken when you use your own reference population and it has somewhat different characteristics (e.g., it is from a previous time period, or benefit coverage is somewhat different). Unless rescaling is done, resource use (or payments) may be over or under-predicted. **Table 2** and the accompanying discussion provide a simplified example for a population with only twelve members.

How to Rescale and Assign Dollar Values

The rescaling process consists of the following steps:

Step 1: Compute population mean weight. Compute a separate grand mean for each of the weights (either concurrent ACG weights or the ACG PM PRI) generated for your population (the observations represent individuals). The mean for this example is shown in **Table 2** at the bottom of Column B.

Step 2: Apply weighting factor. Divide each individual weight by the rescaling factor (i.e., the mean) that you computed in Step 1. The result is the rescaled relative weight (Column C).

Step 3: Compute population mean cost. For the same population on which the weights were based, compute the mean cost for the current data year. For this example, the mean cost was $1,265.11.

Step 4: Compute cost. Multiply the rescaled relative weights generated for each member of the population (Column C) by the average population cost generated from Step 3 to calculate an estimated individual cost (Column D).

Table 2: Estimating Costs in a Sample of Cases

A Member	B Relative Weight	C Rescaled Weight	D Estimated Cost
1	0.185	0.171	$216.36
2	0.291	0.268	$339.61
3	0.387	0.357	$451.64
4	0.457	0.422	$533.33
5	0.541	0.499	$631.33
6	0.609	0.562	$711.58
7	0.696	0.642	$812.58
8	0.842	0.777	$982.84
9	1.025	0.946	$1,196.68
10	1.293	1.194	$1,510.19
11	1.892	1.746	$2,209.38
12	4.783	4.415	$5,585.78
Mean	1.083	1.000	$1,265.11

The rescaling factor functions as a summary case-mix index for understanding how the rating population (e.g., your local population) compares to the development data (the US Non-Elderly Risk Assessment Variables from JHU's nationally representative database). The interpretation of this factor is analogous to how one interprets both relative weights and profiling indicators. If the rescaling factor is greater than 1.0 (as it was in the example), then your population is sicker; if the factor is less than 1.0, then your population is healthier than the reference population.

Adjustments for Inflation

If you are going to use the scores for predicting future expenditures it may be appropriate to inflation-adjust these values. Based on Bureau of Labor Statistics results for the calendar year 2004, medical care costs rose by approximately 5% over the previous year (see http://data.bls.gov). In the preceding example, if you were going to apply this inflation adjustment, you would multiply the mean cost computed in Step 3 by 1.05 to reflect inflation. For this example, the inflation-adjusted mean cost for the next year would have been $1,328.37 instead of $1,265.11. Depending on the local situation, it may also be appropriate to modify future cost expectations for other actuarial factors such as changes in benefit structure of cost-sharing provisions.

Note: The above discussion was meant to offer general instructional guidance on the rescaling of relative weights and inflation adjustment. Given that no two analytic or actuarial applications are exactly alike, and given the potentially major impact that such a process may have on the management or financial applications within your organization, it is essential that you seek and follow advice from experienced statistical or actuarial specialists before finalizing the general processes described above.

Customizing Risk Scores Using Local Cost Data

Two approaches for calculating ACG weights from local data are:

- PMPM (per member per month)
- PMPY (per member per year or other extended period of time)

The calculations for these two approaches are:

1. $PMPM_{(ACG)} = R_{(ACG)} / Months_{(ACG)}$
   (per member per month)

2. $PMPY_{(ACG)} = R_{(ACG)} / N_{(ACG)}$
   (per member or other extended period of time)

Where $R_{(ACG)}$ is calculated as the sum of resource use across all members assigned to a particular ACG and $Months_{(ACG)}$ is calculated as the total number of member months of eligibility for this cohort. $N_{(ACG)}$ is the number of individuals in this cohort. Weights are calculated separately for each ACG category. The primary difference between these two methodologies hinges on whether or not costs are annualized to account for part-year enrollment (more on this issue later in the chapter).

The default calculation for local calibration of ACG-weights within the software is the PMPY approach. Compared to the more widely-used PMPM, the PMPY approach represents a new way of actuarial thinking, which is only feasible because of the use of ICD-based adjusters such as ACGs. (**Note:** The per-member per-year notation or PMPY will be used generally to reflect a per member per period approach where the extended period may be other than a 12 month year (e.g., 10 months or 18 months)). Since PMPY can be considered a paradigm shift in the manner by which such expected values are usually calculated, we have attempted to provide extensive background information on why the PMPY is preferred over the traditional PMPM approach for many risk adjustment applications.

Including Part-Year Enrollees

The primary reason PMPY is preferred for risk adjustment is because of the way it handles part-year enrollees.

Past work using data from multiple sites has demonstrated that persons who are enrolled for fewer than 12 months in a health plan during a given year tend to use more resources on a PMPM or annualized basis than those who are continuously enrolled for the entire period. New, previously uninsured enrollees may have higher costs as a result of previously unmet needs or they could be switching plans in the midst of a special healthcare episode (e.g., they could be responding to a newly diagnosed condition).

Shorter-term enrollees as a group also exhibit higher costs in part because they include those who leave a plan either because they have special medical circumstances or, at the extreme, die. In addition to these circumstances, as the following tables will illustrate, shorter-term enrollees have seemingly higher PMPM costs in large part because the denominator of the PMPM calculation is relatively smaller for those enrollees. By contrast, the average cost of 12-month enrollees tends to be more stable. The following analysis illustrates the implications of this within the context of diagnosis-based risk adjustment such as ACGs.

Table 3 presents a side-by-side comparison of the PMPM and PMPY costs of enrollee sub-groups defined in terms of months enrolled during a given recent year at a large commercial HMO. The table is limited to those who used services because retrospective analyses (e.g. provider profiling) are typically limited to those who actually used services. The average PMPM costs for the enrollee cohorts decrease as the length of enrollment increases. Those who were enrolled for 12 months used $86.95 PMPM while those enrolled for only one month used $768.92 PMPM, illustrating almost a nine-fold difference between twelve-month and one-month enrollees. Viewed from this perspective, it would appear that it is important to account for months enrolled when examining the pattern of costs over a given time period. In contrast, there is less than a two-fold difference between those enrolled for 1 and 12 months on a (non-annualized) PMPY basis. As would be expected, those enrolled for very few months tend to have lower within-plan annual average costs, but this effect is less marked than the differential found when PMPM values are compared.

Table 3: Comparison of PMPM and PMPY Average Costs by Months Enrolled Within a HMO Population

Months Enrolled	Persons	Months	% Months	$ PMPM	$ PMPY
1	488	488	0.1	768.92	768.92
2	934	1,868	0.2	438.65	877.29
3	1,517	4,551	0.5	212.53	637.59
4	1,411	5,644	0.6	198.55	794.21
5	1,601	8,005	0.8	157.91	789.55
6	1,701	10,206	1.1	144.00	863.99
7	2,027	14,189	1.5	136.47	955.27
8	1,550	12,400	1.3	140.35	1,122.80
9	1,781	16,029	1.7	125.45	1,129.09
10	1,941	19,410	2.0	105.65	1,056.46
11	1,355	14,905	1.6	105.22	1,157.43
12	70,786	849,432	88.7	86.95	1,043.40
Total	87,092	957,127	100	93.18	1,023.99

Notes:
- Cost includes total paid claims truncated at $35,000.
- The population was limited to service users in a large commercial HMO population for 1996.

PMPM = Per member per month
PMPY = Per member per year. (**Note:** Although 12 months were used here, other extended periods could also be used to calculate per-member-per-period weights.)

When diagnoses are assigned on a concurrent basis and partial year enrollees are included in the analysis, the denominator in the PMPM calculation tends to skew the relationship between actual and expected costs, particularly when performing retrospective analyses such as provider performance profiles. As previously described, PMPM ACG weights are calculated by determining the costs associated with each ACG divided by the total member months associated with that ACG. The total expected costs associated with any given individual, in this case, would be the PMPM ACG weight times the number of months enrolled. Alternately, ACG weights derived on a PMPY basis are calculated as the costs associated with each ACG for the analysis period divided by the number of persons associated with that ACG. Therefore, total expected costs associated with any given individual would be independent of the time enrolled during the analysis period.

Based on total paid costs truncated at $35,000 (to mimic stop-loss reinsurance levels in this plan), ACG weights were calculated using both the PMPM and PMPY alternative approaches for the population shown in **Table 3**. Based on each of these approaches, actual costs were compared to expected ACG costs within that population. Sections A and B of **Table 4** present a series of measures comparing actual to expected costs for cohorts of enrollees defined in terms of the months they were enrolled during a 12-month period. This table, as does the previous one, represents a retrospective cohort analysis of users as appropriate for a provider profiling assessment.

Section A of **Table 4** presents the results using a PMPM calculation. The column labeled "% deviation" reflects expected costs divided by actual costs minus one. For persons enrolled for one month, the (85.1) figure indicates that when the actual (1996) costs of these 488 single month enrollees are compared to their ACG expected costs (calculated on a PMPM basis), the cohort would have been underpaid by 85.1 percent, on average. In contrast, persons who were enrolled for the full 12 months of the year were overpaid, on average, by 5.3 percent. The "% deviation" column is expressed in absolute dollars in the column labeled over (under) $000. Section A of Table 4 illustrates a shift of expected dollars from part-year enrollees to 12-month enrollees. The net result of this for profiling applications is that subpopulations that include a disproportionate number of shorter-term enrollees will look inefficient because the associated expected dollars calculated on a PMPM basis will tend to be lower than their actual costs. Conversely, a population comprised exclusively of 12-month enrollees will be overpaid and appear to be efficient because of the shift of expected dollars embedded in the PMPM calculation.

Table 4: Comparison of Actual and ACG Expected Costs: Months of Member Enrollment (PMPM) versus (PMPY) Weight Calculation Approaches

		(A) Using A PMPM Calculation			(B) Using a PMPY Calculation		
Months Enrolled	**Months**	**% Deviation**	**Over (Under) $000**	**Adjusted R-squared**	**% Deviation**	**Over (Under) $000**	**Adjusted R-squared**
1	488	(85.1)	(319)	0.013	8.6	32	0.327
2	1,868	(73.5)	(603)	0.109	(0.5)	(4)	0.408
3	4,551	(57.5)	(556)	0.156	14.3	139	0.369
4	5,644	(52.5)	(589)	0.226	0.9	10	0.386
5	8,005	(39.1)	(495)	0.326	8.0	102	0.442
6	10,206	(33.9)	(498)	0.375	0.5	8	0.509
7	14,189	(27.7)	(537)	0.312	(3.0)	(59)	0.392
8	12,400	(18.1)	(314)	0.446	(3.8)	(67)	0.545
9	16,029	(12.2)	(245)	0.382	(3.2)	(64)	0.411
10	19,410	(0.1)	(3)	0.371	(0.5)	(11)	0.385
11	14,905	13.7	214	0.465	3.1	48	0.553
12	849,432	5.3	3,943	0.380	(0.2)	(134)	0.385
Total	957,127	(0.0)	(0)	0.338	(0.0)	(0)	0.395

Notes:

- Costs include total paid claims truncated at $35,000.
- The population was limited to service users in a large commercial HMO population for 1996.
- Total absolute error was $8.3 million using a PMPM calculation and $677,000 PMPY calculation. See text for a description of these calculations.

PMPM = Per member per month

PMPY = Per member per year. (**Note:** Although 12 months were used here, other extended periods could also be used to calculate per-member-per-period weights.)

Section B of **Table 4** shows the results using a PMPY calculation. While there is a slight overpayment associated with shorter-term enrollees (e.g., one month enrollees are overpaid by 8.6 percent on average), the extent of the deviation between actual and expected costs is markedly lower for each subgroup (i.e., each row) as a result of using the PMPY orientation. The sum of the absolute error of each enrollment cohort reflected in section B of the table is less than $700,000 while the comparable figure is $8.3 million reflected in section A.

R-squared (R^2) is a measure of the extent to which expected values explain variation in actual costs. The R^2 for the population as a whole using a PMPM calculation is .338 (shown in the row labeled Total in Section A of the table), and this measure decreases with shorter-term enrollment, particularly for those with less than five months of enrollment. The R^2 is higher using a PMPY calculation (.395 in section B of the table) and remains largely stable regardless of the length of time a patient has been enrolled.

The modest tendency of the PMPY approach to overpay or inflate expected costs associated with very short-term eligibility (e.g., one to three months of enrollment) reaffirms that time has some effect on the calculation of diagnosis specific expected values. To examine the nature of this effect in more detail within this case-study population, **Table 5** presents the average costs per-person and the number of persons by three-month enrollment windows for selected ACGs. Some ACGs have relatively low mean costs given shorter-term enrollment, as opposed to costs for all cases during the full period (a year). At the same time, many ACGs are quite stable regardless of time enrolled, particularly for persons enrolled more than three months. The highest morbidity/highest cost ACGs (e.g. ACGs 4940-5070) tend to be uncommon for those enrolled for the shortest periods, but nonetheless are fairly consistent (in terms of average costs per period) across the enrollment windows, even given the small numbers of cases for shorter periods of time. Generally, much of the variability in average costs probably can be attributed to the very small sample size in the shorter enrollment columns. Again, while enrollment time has an influence on costs associated with some ACGs, the general consistency of costs across the columns in **Table 5** and the relatively limited number of persons with less than 12 months enrollment tend to limit the overall plan-wide effect of time on risk adjusted concurrent analyses. However, analyses where some sub-cohorts include a disproportionate number of short-term enrollees are likely to undervalue expected costs for those groups. In any event, such analyses should be approached cautiously because of the instability associated with the shorter-term enrollment.

In summary, when performing concurrent (or retrospective) risk-based adjustment, a PMPM calculation of ACG weights for a population that includes some number of part-time enrollees tends to over-represent the expected costs associated with 12 month enrollees and under-represent the expected costs associated with shorter-term enrollees. A PMPY calculation of concurrent ACG weights appears to provide a more accurate measure of the expected weight. As noted earlier, we believe this empirical observation represents a relatively new paradigm, and we encourage analysts performing profiling

and other concurrent analyses to test whether and how such an approach could replace the PMPM approach within their organization. The Johns Hopkins ACG Development Team expects to continue providing empirical findings and support material regarding this innovation.

Table 5: Effect of Enrollment Period on Selected ACG-Specific Weights

	1-3 Months		4-6 Months		7-9 Months		10-12 Months		All Enrollees (users)	
ACG All	Avg$ 736	Cases 2,939	Avg$ 818	Cases 4,713	Avg$ 1,062	Cases 5,358	Avg$ 1,046	Cases 74,082	Avg$ 1,024	Cases 87,092
200	66	62	111	95	115	71	153	969	143	1,197
400	275	163	300	192	287	202	353	2,222	340	2,779
500	137	264	131	335	169	316	182	3,743	175	4,658
800	510	27	322	15	973	18	785	166	736	226
1300	173	58	217	65	232	57	265	599	252	779
1600	97	272	110	395	119	382	119	4,195	117	5,244
1711	3,186	12	3,412	27	3,791	22	4,155	193	3,998	254
1712	241	35	390	35	890	26	782	149	660	245
1752	422	2	1,129	7	4,212	13	3,552	95	3,427	117
1800	316	106	498	207	654	225	584	3,417	576	3,955
2400	267	15	225	46	206	55	223	1,268	223	1,384
2500	268	20	259	40	256	35	402	571	381	666
3200	865	35	858	106	1,012	141	1,028	2,300	1,018	2,582
3500	493	10	390	27	607	29	793	686	767	752
3600	2,111	17	1,656	29	1,406	66	1,876	1,506	1,855	1,618
3900	702	43	457	63	474	86	590	803	577	995
4100	610	116	838	206	702	228	692	4,986	696	5,536
4220	1,796	3	1,344	28	1,017	21	1,328	553	1,320	605
4320	1,498	23	2,274	54	1,811	82	1,709	1,192	1,735	1,351
4330	5,787	8	5,360	7	1,754	19	2,515	252	2,625	286
4410	553	7	742	30	1,450	37	1,037	1,476	1,039	1,550
4420	1,805	13	1,535	24	2,485	35	1,741	1,108	1,760	1,180
4430	12,039	6	10,454	8	7,145	16	5,803	260	6,134	290
4510	297	1	666	1	1,600	15	1,818	186	1,789	203
4910	6,071	4	1,938	42	2,795	77	2,372	2,824	2,382	2,947
4940	18,946	4	19,979	5	25,181	5	16,363	60	17,343	74
5030	0	0	0	0	0	0	13,554	41	13,554	41
5040	0	0	1,234	2	4,317	11	4,165	336	4,153	349
5050	0	0	5,430	2	7,330	5	7,245	261	7,218	268
5060	0	0	11,243	4	16,426	4	11,887	222	11,954	230
5070	0	0	24,892	5	27,790	11	20,766	140	21,393	156
5110	64	67	40	53	54	33	46	541	48	694
5310	1,195	413	1,253	483	1,563	369	1,563	200	1,357	1,465
5320	4,416	70	5,553	40	5,036	41	5,811	18	4,984	169
5340	11,121	12	12,454	29	9,936	40	8,316	39	10,136	120

	1-3 Months	4-6 Months	7-9 Months	10-12 Months	All Enrollees (users)

Notes:

- Average mean costs include total 1996 paid claims truncated at $35,000 for users in a large commercial HMO population.
- These figures reflect a retrospective/concurrent analysis.

Addressing the Impact of Age on the Calculation of ACG-Weights

Age is incorporated as a control variable in the sorting algorithm that determines final ACG assignment. At the same time, there are some ACGs that include both pediatric and adult populations because splitting on age was not consistently found to contribute to variation explained within those categories. Despite this, pediatric populations (those younger than 18) tend to generate fewer costs than adult populations within broadly defined commercial populations.

Where ACG-based applications are stratified by pediatric versus adult populations, risk-adjusted resource weights derived from the population as a whole may over- or under-represent expected values associated with these groups. For example, in profiling primary care providers, weights derived from a broadly defined population may over-represent expected values for physicians whose practice is limited to pediatric cases. Those providers will, on average, tend to look more efficient than providers for the health plan as a whole.

One common way to address this issue is to calculate ACG weights separately for pediatric and adult cohorts within a health plan. For example, two weights could be calculated for ACG0500, Likely to Recur, without Allergies. One ACG weight would be based on the resource used by adults who were assigned to ACG0500. The second ACG weight would be based on similar data but restricted to those under age 18. **Note:** Only those ACGs not automatically split by age are affected.

Concurrent versus Prospective Calculations

In theory there is no difference in the basic methodological approach for calculating concurrent (also called retrospective) or prospective weights. The primary difference hinges on the timeframe from which resource measures are drawn ($R_{(ACG)}$, m_i, and M as outlined in the preceding sections). For concurrent analyses, diagnoses used to assign ACGs come from the same period for which the resource use variable is calculated. In contrast, for prospective analyses, resource use is calculated based on concurrent data for some future time period, typically year 2. The special challenge of prospective analysis hinges on sample selection or whom to include in the population for the calculation of $R_{(ACG)}$, m_i, and M. For calculation of prospective weights, the sample is typically limited to those enrolled during both time periods. Last, the PMPM calculation of ACG weights is the preferred method for prospective applications.

Local Calibration of ACG Predictive Modeling Scores

The prospective scores provided in the Dx-PM, Rx-PM and DxRx-PM are based upon multivariate linear regression models. To develop a locally-based PRI score would involve fitting a regression to local data using the variables included within the ACG predictive models. A listing of the predictor variables (the "independent" variables) is provided as an appendix to the chapter on predictive modeling in the *Reference Manual*. Using these variables and local cost data, an experienced analyst could develop a new set of PRI scores that are customized for the local enrollee population. Custom models should be based on populations of no fewer than 100,000 individuals.

◢ ***Tip:*** In the Export ACG Data Menu there is a Model Markers file that contains two columns, a member ID and a string of Boolean (0/1) flags representing the right-hand side of the regression equation. Local calibration can be performed by merging this file with cost information. We **strongly** recommend you talk to your ACG support analyst for technical support in implementing this application, at least the first time. The Model Marker file contains all necessary flags for the DxRx-PM model.

Resource Bands

The software incorporates both prior total cost and prior pharmacy cost bands into the ACG predictive models. They are a useful adjunct to analysts wishing to stratify their populations.

Possible values include:

- 0 – 0 or no pharmacy costs
- 1 – 1-10 percentile
- 2 – 11-25 percentile
- 3 – 26-50 percentile
- 4 – 51-75 percentile
- 5 – 76-90 percentile
- 6 – 91-93 percentile
- 7 – 94-95 percentile
- 8 – 96-97 percentile
- 9 – 98-99 percentile

Resource Utilization Bands (RUBs)

ACGs were designed to represent clinically logical categories for persons expected to require similar levels of healthcare resources. However, enrollees with similar predicted (or expected) overall utilization may be assigned different ACGs because they have different epidemiological patterns of morbidity. For example, a pregnant woman with significant morbidity, an individual with a serious psychological condition, or someone with two chronic medical conditions may all be expected to use approximately the same level of resources even though they each fall into different ACG categories. In many instances users may find it useful to collapse the full set of ACGs into fewer categories, particularly where resource use similarity and not clinical cogency is a desired objective. Often a fewer number of combined categories will be easier to handle from an administrative perspective. ACGs can be combined into what we term Resources Utilization Bands (RUBs).

The software automatically assigns 6 RUB classes:

- 0 - No or Only Invalid Dx
- 1 - Healthy Users
- 2 - Low
- 3 - Moderate
- 4 - High
- 5 - Very High

Table 6: Relative Concurrent PMPY Weights and RUB Categories

ACG	ACG Label	Relative Weight	RUB
0100	Acute Minor, Age 1	0.449	2
0200	Acute Minor, Age 2 to 5	0.179	1
0300	Acute Minor, Age > 5	0.147	1
0400	Acute Major	0.345	2
0500	Likely to Recur, w/o Allergies	0.184	1
0600	Likely to Recur, with Allergies	0.201	2
0700	Asthma	0.144	1
0800	Chronic Medical, Unstable	0.629	3
0900	Chronic Medical, Stable	0.186	1
1000	Chronic Specialty	0.198	1
1100	Eye/Dental	0.116	1
1200	Chronic Specialty, Unstable	0.211	2
1300	Psychosocial, w/o Psych Unstable	0.531	2
1400	Psychosocial, with Psych Unstable, w/o Psych Stable	1.278	3
1500	Psychosocial, with Psych Unstable, w/ Psych Stable	3.093	3
1600	Preventive/Administrative	0.099	1
1710	Pregnancy: 0-1 ADGs	3.390	3
1711	Pregnancy: 0-1 ADGs, delivered	3.551	3
1712	Pregnancy: 0-1 ADGs, not delivered	0.437	2
1720	Pregnancy: 2-3 ADGs, no Major ADGs	3.922	4
1721	Pregnancy: 2-3 ADGs, no Major ADGs, delivered	4.099	4
1722	Pregnancy: 2-3 ADGs, no Major ADGs, not delivered	0.839	3
1730	Pregnancy: 2-3 ADGs, 1+ Major ADGs	5.667	4
1731	Pregnancy: 2-3 ADGs, 1+ Major ADGs, delivered	4.326	4
1732	Pregnancy: 2-3 ADGs, 1+ Major ADGs, not delivered	1.483	3
1740	Pregnancy: 4-5 ADGs, no Major ADGs	4.240	4
1741	Pregnancy: 4-5 ADGs, no Major ADGs, delivered	4.709	4
1742	Pregnancy: 4-5 ADGs, no Major ADGs, not delivered	1.277	3
1750	Pregnancy: 4-5 ADGs, 1+ Major ADGs	5.997	4
1751	Pregnancy: 4-5 ADGs, 1+ Major ADGs, delivered	5.277	4
1752	Pregnancy: 4-5 ADGs, 1+ Major ADGs, not delivered	2.298	3
1760	Pregnancy: 6+ ADGs, no Major ADGs	4.616	4
1761	Pregnancy: 6+ ADGs, no Major ADGs, delivered	5.477	4
1762	Pregnancy: 6+ ADGs, no Major ADGs, not delivered	2.177	3
1770	Pregnancy: 6+ ADGs, 1+ Major ADGs	7.411	4
1771	Pregnancy: 6+ ADGs, 1+ Major ADGs, delivered	7.169	4
1772	Pregnancy: 6+ ADGs, 1+ Major ADGs, not delivered	4.422	4
1800	Acute Minor and Acute Major	0.572	2
1900	Acute Minor and Likely to Recur, Age 1	0.710	3
2000	Acute Minor and Likely to Recur, Age 2 to 5	0.352	2

ACG	ACG Label	Relative Weight	RUB
2100	Acute Minor and Likely to Recur, Age > 5, w/o Allergy	0.310	2
2200	Acute Minor and Likely to Recur, Age > 5, with Allergy	0.364	2
2300	Acute Minor and Chronic Medical: Stable	0.323	2
2400	Acute Minor and Eye/Dental	0.250	2
2500	Acute Minor and Psychosocial, w/o Psych Unstable	0.495	2
2600	Acute Minor and Psychosocial, with Psych Unstable, w/o Psych Stable	1.025	3
2700	Acute Minor and Psychosocial, with Psych Unstable and Psych Stable	2.696	3
2800	Acute Minor and Likely to Recur	0.658	3
2900	Acute Minor/Acute Major/Likely to Recur, Age 1	1.334	3
3000	Acute Minor/Acute Major/Likely to Recur, Age 2 to 5	0.795	3
3100	Acute Minor/Acute Major/Likely to Recur, Age 6 to 11	0.686	3
3200	Acute Minor/Acute Major/Likely to Recur, Age > 11, w/o Allergy	0.963	3
3300	Acute Minor/Acute Major/Likely to Recur, Age > 11, with Allergy	0.914	3
3400	Acute Minor/Likely to Recur/Eye & Dental	0.468	2
3500	Acute Minor/Likely to Recur/Psychosocial	0.819	3
3600	Acute Minor/Acute Major/Likely Recur/Eye & Dental	1.719	3
3700	Acute Minor/Acute Major/Likely Recur/Psychosocial	1.835	3
3800	2-3 Other ADG Combinations, Age < 18	0.590	2
3900	2-3 Other ADG Combinations, Males Age 18 to 34	0.655	3
4000	2-3 Other ADG Combinations, Females Age 18 to 34	0.545	2
4100	2-3 Other ADG Combinations, Age > 34	0.665	3
4210	4-5 Other ADG Combinations, Age < 18, no Major ADGs	0.810	3
4220	4-5 Other ADG Combinations, Age < 18, 1+ Major ADGs	1.676	3
4310	4-5 Other ADG Combinations, Age 18 to 44, no Major ADGs	0.839	3
4320	4-5 Other ADG Combinations, Age 18 to 44, 1+ Major ADGs	1.581	3
4330	4-5 Other ADG Combinations, Age 18 to 44, 2+ Major ADGs	2.949	3
4410	4-5 Other ADG Combinations, Age > 44, no Major ADGs	0.961	3
4420	4-5 Other ADG Combinations, Age > 44, 1+ Major ADGs	1.661	3
4430	4-5 Other ADG Combinations, Age > 44, 2+ Major ADGs	3.490	3
4510	6-9 Other ADG Combinations, Age < 6, no Major ADGs	1.603	3
4520	6-9 Other ADG Combinations, Age < 6, 1+ Major ADGs	3.618	4
4610	6-9 Other ADG Combinations, Age 6 to 17, no Major ADGs	1.499	3
4620	6-9 Other ADG Combinations, Age 6 to 17, 1+ Major ADGs	3.686	3
4710	6-9 Other ADG Combinations, Males, Age 18 to 34, no Major ADGs	1.412	3
4720	6-9 Other ADG Combinations, Males, Age 18 to 34, 1+ Major ADGs	2.487	3
4730	6-9 Other ADG Combinations, Males, Age 18 to 34, 2+ Major ADGs	5.959	4

ACG	ACG Label	Relative Weight	RUB
4810	6-9 Other ADG Combinations, Females, Age 18 to 34, no Major ADGs	1.467	3
4820	6-9 Other ADG Combinations, Females, Age 18 to 34, 1+ Major ADGs	2.271	3
4830	6-9 Other ADG Combinations, Females, Age 18 to 34, 2+ Major ADGs	5.015	4
4910	6-9 Other ADG Combinations, Age > 34, 0-1 Major ADGs	2.276	3
4920	6-9 Other ADG Combinations, Age > 34, 2 Major ADGs	4.613	4
4930	6-9 Other ADG Combinations, Age > 34, 3 Major ADGs	8.582	5
4940	6-9 Other ADG Combinations, Age > 34, 4+ Major ADGs	16.864	5
5010	10+ Other ADG Combinations, Age 1 to 17, no Major ADGs	3.450	3
5020	10+ Other ADG Combinations, Age 1 to 17, 1 Major ADGs	6.352	4
5030	10+ Other ADG Combinations, Age 1 to 17, 2 Major ADGs	27.640	5
5040	10+ Other ADG Combinations, Age > 17, 0-1 Major ADGs	3.863	3
5050	10+ Other ADG Combinations, Age > 17, 2 Major ADGs	6.237	4
5060	10+ Other ADG Combinations, Age > 17, 3 Major ADGs	10.876	5
5070	10+ Other ADG Combinations, Age > 17, 4+ Major ADGs	27.508	5
5110	No Diagnosis or Only Unclassified Diagnosis (2 input files)	0.107	1
5200	Non-Users (2 input files)	0.000	0
5310	Infants: 0-5 ADGs, no Major ADGs	1.358	3
5311	Infants: 0-5 ADGs, no Major ADGs, low birth weight	7.987	4
5312	Infants: 0-5 ADGs, no Major ADGs, normal birth weight	1.053	3
5320	Infants: 0-5 ADGs, 1+ Major ADGs	4.217	4
5321	Infants: 0-5 ADGs, 1+ Major ADGs, low birth weight	23.145	5
5322	Infants: 0-5 ADGs, 1+ Major ADGs, normal birth weight	2.658	3
5330	Infants: 6+ ADGs, no Major ADGs	2.709	3
5331	Infants: 6+ ADGs, no Major ADGs, low birth weight	8.387	4
5332	Infants: 6+ ADGs, no Major ADGs, normal birth weight	2.206	3
5340	Infants: 6+ ADGs, 1+ Major ADGs	16.780	5
5341	Infants: 6+ ADGs, 1+ Major ADGs, low birth weight	42.535	5
5342	Infants: 6+ ADGs, 1+ Major ADGs, normal birth weight	8.729	4
9900	Invalid Age or Date of Birth	0.000	0

The source data comes from PharMetrics, a unit of IMS in Watertown, MA, and would be shown when the user selects the US Non-Elderly Risk Assessment Variables. The data is comprised of paid claims from a number of managed healthcare plans. The database is nationally representative of commercially-insured populations with respect to region, age-gender and health plan type. The database also includes populations that are insured by government payers. The database combines medical and prescription drug data with enrollment data across multiple years and only plans that submit data for all enrolled members are included in the database. All plan data are quality-controlled before they become part of the database and the data is HIPAA compliant.

8 Final Considerations

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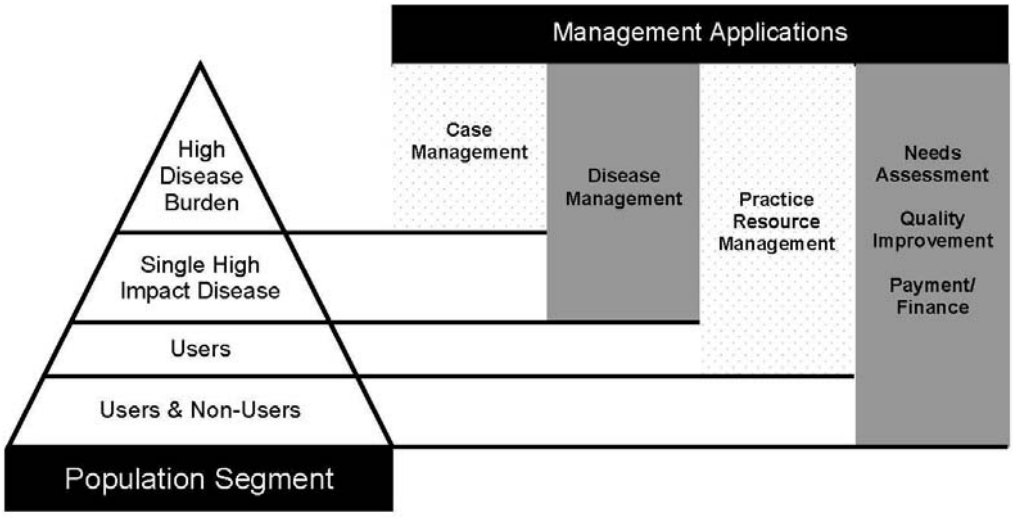
Introduction

The purpose of this chapter is to highlight and discuss some of the key analytical and technical issues associated with the application of diagnosis-based risk adjustment in populations. These issues affect both the framing and interpretation of analyses. Much of this discussion relates to forming a population for risk adjustment, determining which members to include and to exclude, and circumstances where sampling is appropriate.

Art of Risk Adjustment

Figure 1: Risk Adjustment Pyramid



While the essential methodological underpinnings of risk adjustment are straightforward, technical challenges may be experienced when putting health-based risk adjustment in place within an organization. **Figure 1** is intended to help graphically illustrate the variety of ways in which risk adjustment is most commonly applied within healthcare organizations today. Some implementations, such as needs assessment or payment/finance applications apply to the entire population base. Other implementations, such as care-management or disease-management interventions, focus only on targeted population subgroups. Depending on the application or the question being asked, it is important to appropriately define the denominator or the population of interest. Another key consideration is time frame—is the analysis retrospective or concurrent in nature involving a comparison of morbidity across or between population subgroupings or is the application prospective or predictive in nature? Each of these issues will be discussed in more detail subsequently.

Time Frames and Basic Population Perspectives

For profiling, the population's health characteristics (i.e., diagnoses used to adjust the profiles) typically come from the same time period as the resource use being profiled. Thus, the process is designated retrospective or concurrent. For example, to understand the differences in per person pharmacy use across two provider panels in a given year, you would assign risk assessment variables using diagnosis codes derived from patient physician contacts during that same year.

In contrast, the most common approach for risk adjusting capitation payments is to prospectively set rates in the following years for a cohort of enrollees based on the diagnosis codes documented in data derived from the prior year(s). For administrative reasons, there is usually a lag period (often of about three months' duration) between the risk assessment period and the target payment period. Additionally, some patients may be enrolled during the first period but not the second, and vice versa. Others may be enrolled during the entire period but use no services. Therefore, they do not have diagnosis assignments during the first 12-month risk assessment period. These are a few of the challenges that the prospective capitation process faces. The prototypical time line for this process and the concurrent profiling process are outlined in **Figure 2**.

Figure 2: Typical Timeline for Risk Adjustment

12 Months	3 Months	3 Months	12 Months
Risk measurement period (also assessment period for retrospective profiling)	Data lag period	Analysis/rating process	Risk measurement period (also assessment period for retrospective profiling)

There are numerous technical approaches for dealing with the data lag problem for prospective applications. The simplest approach is to take the predictions provided by the ACG PM model. This, of course, means that the prediction is already aged by the period of the lag. An alternative is to use an historical database to determine trended resource use for successive years. For example, at Plan Z, by going back to a time period 24 months before the target year (the target year being months 25-36), it would be possible to associate future resource use based on risk scores assigned during the previous time period. In this simulation, months 1-12 would be used to predict months 13-24. Results from this model could then be applied to months 13-24 to yield predictions for months 25-36. In essence, modeling would occur across the lag period. These longer term models could serve as provisional models for a period of interest and could be replaced once a potentially more predictive annual model becomes available. Yet a third approach is that implemented by Minnesota Medicaid and the Buyers Health Care Action Group (BHCAG) and several other tiered network applications where group-level predictions are based on historical group-level concurrent profiles with a trend factor applied to generate an estimate of future resource expectations at the group level. The assumption behind using group-level concurrent profiles to predict future costs is that the case-mix of a group (at least of sufficient size) will not change much over time and that projections based on concurrent profiles provide more accurate projections than individual level predictions. In such an application the concurrent ACG-based profiles are generally recalibrated approximately every three months and new "targets" are set, thus mitigating the data lag problem.

Handling New or Part-Year Enrollees

Most ACG applications involve the analyst viewing a snapshot of the utilization history of plan members during a particular period of time. If any members of the risk pool have been eligible to use services for a period of time that is shorter than the in-scope period, both their diagnosis history and their resource consumption profile may differ from members who were enrolled for the entire period. For the most part, and so long as these new enrollees are randomly distributed across the population (and population sub-groupings), their impact is minimal. If, however, large numbers of enrollees are concentrated in one provider group being profiled or one employer group for which rates are being set, concentration of new enrollees may bias results to make this group look "healthier" than they otherwise might have if complete diagnoses and claims information had been available for them.

In general, when including individuals who are not eligible for the entire enrollment period, it is recommended that results be scrutinized closely. One approach would be to compare results excluding and including these individuals to help assess whether their inclusion has introduced any systematic bias. Another strategy for assessing their impact would be to examine ACG distribution across the various units of analysis, such as by provider. A disproportionate number of persons assigned to ACGs 5100 or 5110 and 5200 (i.e., no diagnoses and non-user ACGs) may indicate the enrollee cohort entered the plan near the end of the analysis period and may lack sufficient contact with the provider

to allow accurate overall ACG assignment. Such groups can, and perhaps should, be eliminated from the analysis or be reported with appropriate caveats. The specific approach used will vary for each analysis/organization based on the quality of the alternatives. Although new enrollees' ICD codes may be incomplete, risk adjustment based on a limited pool of diagnoses generally provides more accurate risk adjustment than do alternative demographic adjustments.

Non-Users Who are Eligible to Use Services

Most grouping methods and case-mix measurement tools that focus on episodes of care restrict their attention to the subset of a population that actually consumes resources (e.g., those visiting a provider or being admitted to the hospital). The most common applications of these tools, provider profiling and other retrospective applications, are concerned exclusively with users of services since only for these members can a meaningful profile be developed. However, for capitation rate development and other prospective applications, non-users are of great importance since many, if not most, of the enrollees who do not use services in the current period will consume services, to at least some degree, in the future period. Since capitation payments are made regardless of whether the member interacts with the capitated provider, the characteristics of non-users are important. For profiling, consideration of the percentage of enrollees assigned to a physician who are non-users may provide information on access issues or illustrate differences in provider practice patterns. In general, population-oriented analysis will have more flexibility and be more comprehensive if both users and non-users are included.

Sample Size

The question of what is an appropriate minimum enrollee/patient sample size arises at many levels of the risk adjustment process. As a general rule, the larger the sample size, the better. Ideally, the total population used to perform ACG-based analysis should be larger than 20,000 individuals. Also, ideally, there should be a minimum of 30-50 cases in each ACG cell. Smaller sample sizes may be applied but users should be cautious of instability created by small cell size.

Sample size plays an important role in profiling provider practice patterns. Even when the underlying ACG weights are calculated using a large reference population, providers treating relatively few patients may be unfairly skewed simply because of the effects of random error resulting from sample size.

Handling High Cost or Outlier Cases

How high cost or outlier cases are included affects many risk adjustment applications. If untruncated cost weights of very high cost individuals are included in the calculation of either concurrent or prospective risk scores, there will be a tendency for the variability of all cost estimates or risk scores to increase. Similarly, high cost cases can create problems for physician profiling analyses where the inclusion of one patient my falsely identify a provider as an outlier physician. Yet, at the same time, it is these very high cost or "outlier" patients that the ACG PM high risk case identification tool is designed to identify. Thus, the use of truncation depends upon the application. For applications that relate to rate setting or profiling, a conservative strategy would be to top code (set a ceiling) for per person costs to $50,000.

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