An Example from Medicare (continued)

Type of Service	Actual Resource Use per Yr.	Actual/ State Avg.	Actual/ACG Expected
Hospital			
Physician Services	$ 204	1.09	.80
Facility Services	3975	1.17	.87
Total	4179	1.17	.87
Overall	6217	1.20	.89

Summary of Ongoing ACG Research and Development

- Significant portion of royalties and several corporate and government grants are supporting ongoing ACG research and development at The Johns Hopkins University.
- About 60 other academic organizations (in five countries) are applying, validating, and evaluating the ACG system independently. It is becoming a standard research tool.

Summary (continued)

- Peer reviewed ACG literature is growing rapidly. No other ambulatory case-mix or risk adjustment system as well evaluated.
- JHU, in partnership with CSC Healthcare Systems Inc., are committed to updating software annually and developing new support and applications material.

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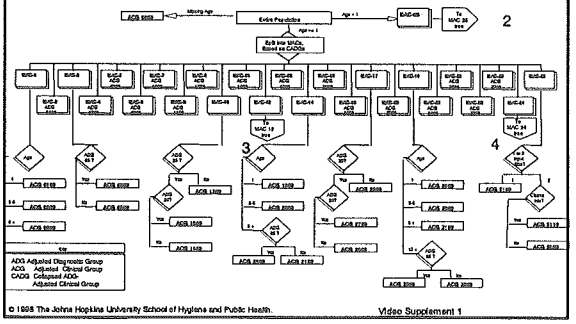
Video Supplement 1-12

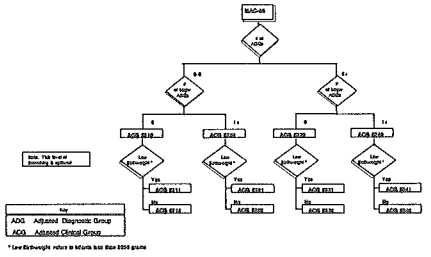
Note: This material does not appear on your screen when viewing the video.

ACG Version 4.x Tree -Part 1 (Initial Branches)



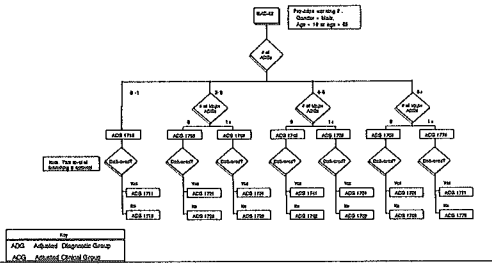
Video Supplement 1

ACG Decision Tree-Part 2 (Infant MAC 26)



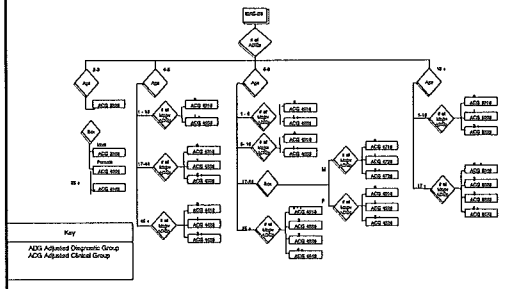
 Video Supplement 2

ACG Decision Tree -Part 3 (Pregnant Women)



 Video Supplement 3

ACG Decision Tree -Part 4 (Multiple Morbidities-MAC24)



 Video Supplement 4

Resource Use In 1994 and 1995 Based on 1994 ACGs: Average Per-member-Per Month Total Charges at HMO

	1994 ACG	Families	1994 Costs PMPM	1994 Costs ACG / Tot	1995 Costs PMPM	1995 Costs ACG/ Tot
	Entire Population (including non-users)	71529	85.42	1	79.73	1
100	Acute Minor, Age 1	122	6.75	0.08	15.41	0.19
200	Acute Minor, Age 2-5	664	4.94	0.06	13.93	0.17
300	Acute Minor, Age 6+	5202	7.93	0.09	33.64	0.42
400	Acute: Major	1940	22.3	0.26	44.36	0.56
500	Likely to Recur, w/o Allergies	3024	11.06	0.13	42.22	0.53
600	Likely to Recur, w/ Allergies	248	10.21	0.12	40.08	0.5
700	Asthma	128	8.13	0.1	18.07	0.23
800	Chronic Medical, Unstable	148	23.16	0.27	70.25	0.88
900	Chronic Medical, Stable	1092	8.85	0.1	49.42	0.62
1000	Chronic Specialty	68	6.23	0.07	46.94	0.59
1100	Ophthalmological/Dental	1696	6.05	0.07	30.78	0.39
1200	Chronic Specialty, Unstable	146	23.7	0.28	63.92	0.8

 Video Supplement 5

Resource Use In 1994 & 1995 (continued)

	1994 ACG	Families	1994 Costs PMPM	1994 Costs ACG / Tot	1995 Costs PMPM	1995 Costs ACG/ Tot
	Entire Population (including non-users)	71529	85.42	1	79.73	1
1300	Psychosocial, w/o Psychoc Unstable	314	4.24	0.05	32.41	0.28
1400	Psychosocial, w/ Psychoc Unstable, w/o Psychoc Stable	20	6.77	0.08	47.43	0.59
1500	Psychosocial, w/ Psychoc Unstable and Psychoc Stable	20	13	0.15	42.06	0.53
1600	Preventive/Administrative	3304	2.78	0.03	24.75	0.31
1711	Pregnancy: 0-1 ADGs, delivered	82	433.67	5.08	77.8	0.98
1712	Pregnancy: 0-1 ADGs, not delivered	78	52.08	0.61	340.26	4.27
1721	Pregnancy: 2-3 ADGs, no major ADGs, delivered	246	438.88	5.14	62.98	0.79
1722	Pregnancy: 2-3 ADGs, no major ADGs, not delivered	286	89.15	1.04	380.05	4.77
1731	Pregnancy: 2-3 ADGs, 1+ major ADGs, delivered	94	501.7	5.87	103.36	1.3
1732	Pregnancy: 2-3 ADGs, 1+ major ADGs, not delivered	24	197.73	2.31	382.11	4.79
1741	Pregnancy: 4-5 ADGs, no major ADGs, delivered	146	569.39	6.67	80.37	1.01

 Video Supplement 6

Resource Use In 1994 & 1995 (continued)

	1994 ACG	Families	1994 Costs PMPM	1994 Costs ACG / Tot	1995 Costs PMPM	1995 Costs ACG/ Tot
1742	Pregnancy: 4-5 ADGs, no major ADGs, not delivered	242	102.14	1.2	394.14	4.94
1751	Pregnancy: 4-5 ADGs, 1+ major ADGs, delivered	92	513.36	6.01	85.35	1.07
1752	Pregnancy: 4-5 ADGs, 1+ major ADGs, not delivered	108	290.7	3.4	264.28	3.31
1761	Pregnancy: 6+ ADGs, no major ADGs, delivered	64	642.6	7.52	172.31	2.16
1762	Pregnancy: 6+ ADGs, no major ADGs, not delivered	140	215.2	2.52	367.7	4.61
1771	Pregnancy: 6+ ADGs, 1+ major ADGs, delivered	206	794.38	9.3	138.99	1.74
1772	Pregnancy: 6+ ADGs, 1+ major ADGs, not delivered	252	387.62	4.54	346.52	4.35
1800	Acute Minor and Acute Major	3112	51.22	0.6	63.82	0.8
1900	Acute Minor and Likely to Recur, Age 1	340	20.46	0.24	20.24	0.25
2000	Acute Minor and Likely to Recur, Age 2-5	1452	16.9	0.2	25.71	0.32
2100	Acute Minor and Likely to Recur, Age > 5, w/o Allergy	3128	19.48	0.23	46.16	0.58
2200	Acute Minor and Likely to Recur, Age > 5, w/ Allergy	340	26.81	0.31	62.32	0.78
2300	Acute Minor and Chronic Medical: Stable	856	16.09	0.19	59.81	0.75

 Video Supplement 7

Resource Use in 1994 & 1995 (continued)

	1994 ACG	Enrollees	1994 Costs PMPM	1994 ACG / Tot	1995 Costs PMPM	1995 ACG/ Tot
2400	Acute Minor and Eye/Dental	954	13.68	0.16	37.37	0.47
2500	Acute Minor & Psychosc w/n Psychosc Unstable	270	15.31	0.18	27.19	0.34
2600	Acute Minor & Psychosc w/ Psychosc Unstable, w/o Psychosc Stable	12	43.49	0.51	16.02	0.2
2700	Acute Minor & Psychosc w/ Psychosc Unstable & Stable	10	26.25	0.31	6.76	0.08
2800	Acute Major and Likely to Recur	1166	51.47	0.6	72.25	0.91
2900	Acute Minor/Acute Major/Likely to Recur, Age 1	264	45.63	0.53	79.43	1
3000	Acute Minor/Acute Major/Likely to Recur, Age 2-5	648	30.31	0.59	35.66	0.45
3100	Acute Minor/Acute Major/Likely to Recur, Age 6-11	596	35.58	0.65	41.36	0.52
3200	Acute Minor/Acute Maj/Likely to Recur, Age >12, w/o Allergy	2134	85.34	1	90.73	1.14
3300	Acute Minor/Acute Maj/Likely to Recur, Age >12, w/ Allergy	210	63.59	0.74	56.59	0.71
3400	Acute Minor/Likely to Recur/Eye & Dental	744	31.03	0.36	46.54	0.58
3500	Acute Minor/Likely to Recur/Psychosocial	306	34.47	0.4	82.58	1.04

Video Supplement 9

Resource Use in 1994 & 1995 (continued)

	1994 ACG	Enrollees	1994 Costs PMPM	1994 ACG / Tot	1995 Costs PMPM	1995 ACG/ Tot
3600	Acute Minor/Acute Major/Likely to Recur/Eye & Dental	1738	158.06	1.85	152.56	1.91
3700	Acute Minor/Acute Major/Likely to Recur/Psychosocial	428	81.21	0.95	99	1.24
3800	2-3 Other ADG Combos, Age < 17	1670	24.37	0.29	33.63	0.42
3900	2-3 Other ADG Combos, Males Age 17-34	754	36.05	0.42	68.91	0.86
4000	2-3 Other ADG Combos, Females Age 17-34	934	32.63	0.38	92.28	1.16
4100	2-3 Other ADG Combos, Age > 34	4368	44.49	0.52	102.11	1.28
4210	4-5 Other ADG Combos, Age < 17, no major ADGs	1008	53.21	0.62	41.08	0.52
4220	4-5 Other ADG Combos, Age < 17, 1+ major ADGs	300	107.59	1.26	84.9	1.06
4310	4-5 Other ADG Combos, Age 17-44, no major ADGs	1752	61	0.71	89.84	1.13
4320	4-5 Other ADG Combos, Age 17-44, 1 major ADG	1192	127.59	1.49	95.18	1.19
4330	4-5 Other ADG Combos, Age 17-44, 2+ major ADGs	228	235.86	2.76	159.02	1.99
4410	4-5 Other ADG Combos, Age > 44, no major ADGs	1000	67.31	0.79	112.86	1.42

Video Supplement 9

Resource Use in 1994 & 1995 (continued)

	1994 ACG	Enrollees	1994 Costs PMPM	1994 ACG / Tot	1995 Costs PMPM	1995 ACG/ Tot
4420	4-5 Other ADG Combos, Age > 44, 1 major ADG	986	118.41	1.39	132.58	1.91
4430	4-5 Other ADG Combos, Age > 44, 2+ major ADGs	260	284.23	3.33	257.25	3.23
4510	6-9 Other ADG Combos, Age < 6, no major ADGs	108	93.95	1.1	30.56	0.38
4520	6-9 Other ADG Combos, Age < 6, 1+ major ADGs	148	250.11	2.93	62.33	0.78
4610	6-9 Other ADG Combos, Age 6-16, no major ADGs	332	101.21	1.18	75.2	0.94
4620	6-9 Other ADG Combos, Age 6-16, 1+ major ADGs	304	307.82	3.6	191.2	2.4
4710	6-9 Other ADG Combos, Males Age 17-34, no major ADGs	80	69.6	0.81	207.98	2.61
4720	6-9 Other ADG Combos, Males Age 17-34, 1 major ADG	136	234.5	2.75	202.45	2.54
4730	6-9 Other ADG Combos, Males Age 17-34, 2+ major ADGs	106	445.65	5.22	175.72	2.2
4810	6-9 Other ADG Combos, Females Age 17-34, no major ADGs	298	114.99	1.35	117.33	1.47
4820	6-9 Other ADG Combos, Females Age 17-34, 1 major ADG	292	180.69	2.12	137.67	1.73

Video Supplement 10

Resource Use in 1994 & 1995 (continued)

	1994 ACG	Enrollees	1994 Costs PMPM	1994 ACG / Tot	1995 Costs PMPM	1995 ACG/ Tot
4830	6-9 Other ADG Combos, Females Age 17-34, 2+ major ADGs	140	333.65	3.91	158.68	1.99
4910	6-9 Other ADG Combos, Age > 34, 0-1 major ADGs	2666	184.17	2.16	177.58	2.23
4920	6-9 Other ADG Combos, Age > 34, 2 major ADGs	844	414.42	4.85	307.42	3.86
4930	6-9 Other ADG Combos, Age > 34, 3 major ADGs	266	831.39	9.74	393.22	4.96
4940	6-9 Other ADG Combos, Age > 34, 4+ major ADGs	46	3068.6	35.92	532.32	6.68
5010	10+ Other ADG Combos, Age 1-16, no major ADGs	6	276.43	3.24	127.03	1.59
5020	10+ Other ADG Combos, Age 1-16, 1 major ADG	28	319.34	3.74	330.08	4.14
5030	10+ Other ADG Combos, Age 1-16, 2+ major ADGs	36	4636.7	54.28	1112.8	13.96
5040	10+ Other ADG Combos, Age >16, 0-1 major ADGs	294	325.12	3.81	266.49	3.34
5050	10+ Other ADG Combos, Age >16, 2 major ADGs	268	694.68	8.13	354.75	4.45
5060	10+ Other ADG Combos, Age >16, 3 major ADGs	244	1508	17.65	458.8	5.75
5070	10+ Other ADG Combos, Age >16, 4+ major ADGs	142	4499.4	52.67	1100.2	13.8

Video Supplement 11

Resource Use in 1994 & 1995 (continued)

	1994 ACG	Enrollees	1994 Costs PMPM	1994 ACG / Tot	1995 Costs PMPM	1995 ACG/ Tot
5110	No Diagnosis or Only Unclassified Diagnosis	152	2.91	0.03	23.88	0.3
5200	Non-Users	10434	0	0	31.66	0.4
5310	Infants: 0-5 ADGs, no major ADGs	392	106.4	1.25	42.45	0.53
5320	Infants: 0-5 ADGs, 1+ major ADGs	66	280.18	3.28	44.3	0.56
5330	Infants: 6+ ADGs, no major ADGs	30	422.64	4.95	135.32	1.7
5340	Infants: 6+ ADGs, 1+ major ADGs	86	1442.1	16.88	193.59	2.43

Video Supplement 12

The Johns Hopkins

ACG® Case-Mix System

Version 6.0 Release Notes

PC (DOS/WIN/NT) and Unix
Version 6.0 – April, 2003
(Revised June 4, 2003)

JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

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Preface

Welcome to ACG Version 6.0

We hope that you will share our excitement about this newest release of the Johns Hopkins ACG System. No previous ACG software update has been more significant in terms of additional features over the prior version. No other version has had as many practical benefits for its users.

Health care risk adjustment and predictive modeling in general are not simple processes, but the goal of these release notes is to help ease your way into these domains and to get you started as quickly as possible in making full use of the array of features in ACG Release Version 6.0.

How to Use This Document

This document, the *ACG Version 6.0 Release Notes,* augments the last comprehensive Johns Hopkins ACG "handbook," the *Release 5.0 Documentation and Application Manual.* The chapters provide existing ACG users with all of the information needed to begin to use the new features and capabilities of this latest release. We recommend that first-time users of ACGs also review the Release 5.0 *Manual* to learn about the core features of the ACG System, including the system's conceptual basis. Both sets of documents are distributed with the Version 6.0 software, but if you need a copy of the Release 5.0 documentation, it is available on our website at http://www.acg.jhsph.edu.

The release notes are organized into six sections as follows:

1. An **overview** of new features in ACG Release 6.0. This will quickly introduce you to both the new areas of functionality and the modifications and updates of previous features.
2. A comprehensive description of the new state-of-the-art **predictive model, the acgPM**, which includes performance data and application suggestions.
3. Details of the additions to and refinements of the expanded diagnosis cluster (EDC) disease-marker methodology, including several new reports that combine EDCs and ACGs.
4. Introduction of the new **"internal" relative value weights** for ACGs that are now included in the software.

5. Suggested guidelines on how to **make the best use of the tools and methodologies** now found in the ACG System. This section will help you quickly get to the bottom line, and thus supports mission-critical clinical and financial management decisions.
6. A detailed technical **software installation guide** that describes all updates and includes operating instructions like those found in the previous ACG version. You will need only this section (and no previous documentation) to run the software.

We hope and expect that you will find the latest ACG software and this accompanying documentation of value to you and your organization. As always, the Johns Hopkins ACG development team welcomes your feedback. Please forward comments, questions, or suggestions for improvement about this release document or our software to askacg@jhsph.edu.

Section 1

Overview of New Features in ACG Version 6.0

The Johns Hopkins University ACG development team is very pleased to distribute version 6.0 of our ACG risk-adjustment/case-mix software. This software includes several enhancements that significantly expand both the breadth and depth of the Johns Hopkins ACG suite of diagnosis-based health care measurement tools.

This version reflects our ongoing commitment to continued improvement and refinement of the ACG System. Now more than ever, the ACG toolkit can serve as the measurement engine for a full array of health care applications, including clinical care management, resource management, health services finance and payment, and applied evaluation and scientific research.

Some of the new features in version 6.0 will advance and expand the clinical grouper and measurement tools available to the experienced user. Other improvements will make the ACG System easier to use for those just starting out. Many changes and enhancements will be of value to both groups. As noted in the Preface, the key enhancements included in Version 6.0 include:

- predictive modeling (including new reports),
- additions and refinements to the expanded diagnosis cluster (EDC) methodology (including new reports),
- updating ICD-9 codes,
- relative risk factors based on nationally representative data, and
- an updated installation guide.

a. AcgPM: Predictive Modeling for High-risk Case Identification and Future Costs

The ACG Predictive Model (acgPM) permits the rapid identification of high-risk patients who may benefit from care management services. The acgPM is the focal point of several notable innovations:

- focus on individualized care management,
- incorporation of a new hospitalization propensity index,
- ability to employ pharmacy use data where available,
- integration of elements of our EDC technology, and
- incorporation of a unique regression modeling strategy.

The acgPM remains grounded in the disease burden perspective unique to the ACG System, one that focuses on commonly occurring patterns of morbidity and assessment of all types of medical need. The model also shares the modest data requirements of the ACG System.

This state-of-the-art predictive modeling risk identification module builds on the many facets of the ACG system and several years of intensive research and development at Johns Hopkins. According to all empirical assessments to date, the accuracy of the risk prediction measures calculated by the acgPM equals or surpasses other available methods.

One of the outputs of the acgPM model is based on a sophisticated logistic regression equation that maximizes the tool's ability to identify your members who will be among the very highest cost users in the next year (or some other future period). With the same data that you use to assign standard ACGs, the acgPM module assigns each individual within your organization a risk Probability Score that can be employed to array the members of your population from the lowest to the highest risk.

As described in the following section, evaluations of the acgPM Probability Score indicate that it is more accurate than case identification derived from prior use/prior (cost) experience. Unlike other case identification methodologies based on extended hospital stays or repeat specialist visits, the acgPM method helps to identify many persons before they actually become expensive.

Another set of outputs is based on linear OLS (ordinary least squares) regression and can be used to provide an estimate of cost for each individual in the subsequent time period. Termed the Predicted Resource Index (PRI), this index can be used to assist clinical administrators, actuaries, and others interested in valuing future expectations of resource use. This index can be used for a wide range of actuarial/financial applications such as setting risk-adjusted capitation payments or setting premiums.

In addition to offering measures of risk related to overall service use, the acgPM includes a special component for predicting an individual's risk of using pharmaceuticals. Moreover, the acgPM can incorporate prior pharmacy use data, when obtainable, to improve the accuracy of its predictions. If prior pharmacy use data are available within an organization, this combination of pharmacy and the typical ACG risk factor information derived from ICD diagnosis information is a powerful means for identifying individuals at risk of high future resource use.

As discussed in more detail in the main body of this document, automatically generated acgPM reports combine the Probability Score and the PRI. This enables users to focus attention quickly on those individuals with case-manageable conditions at greatest risk for future high expenditures and to provide estimates of what these individuals might cost if no intervention is taken.

b. Additions and Refinements to the Johns Hopkins Expanded Diagnosis Clusters

The expanded diagnosis cluster (EDC) "disease marker" system originally emphasized commonly occurring conditions treated primarily in ambulatory settings. For this version, the EDC mapping underwent considerable refinement. To provide a more comprehensive categorization approach for profiling morbidity, EDCs now include less commonly occurring conditions, many of which may require hospitalization. All in all, 40 new EDC categories have been added and affect 16 of the 27 major EDCs (MEDCs), and several existing EDCs have been subdivided to provide additional clinical specificity.

To facilitate quick implementation of the EDC typology, the software print file now incorporates a series of EDC-based "standardized morbidity ratios" (prevalence of EDCs within your population, after controlling for age and sex) as well as a series of combined ACG/EDC tables to help support case-management and disease-management programs.

c. Updating ICD-9 Codes

The ICD-9 mapping tables for both the EDC and ACG/ADG groupers have been updated to include all new codes introduced in the Center for Medicare and Medicaid Services official ICD-9-CM (Version 20). As in years past, old or retired ICD-9 codes have been retained as part of our algorithm because they were once valid and/or their interpretation is reasonably clear.

d. Available Relative Value Weights for ACGs and RUBs

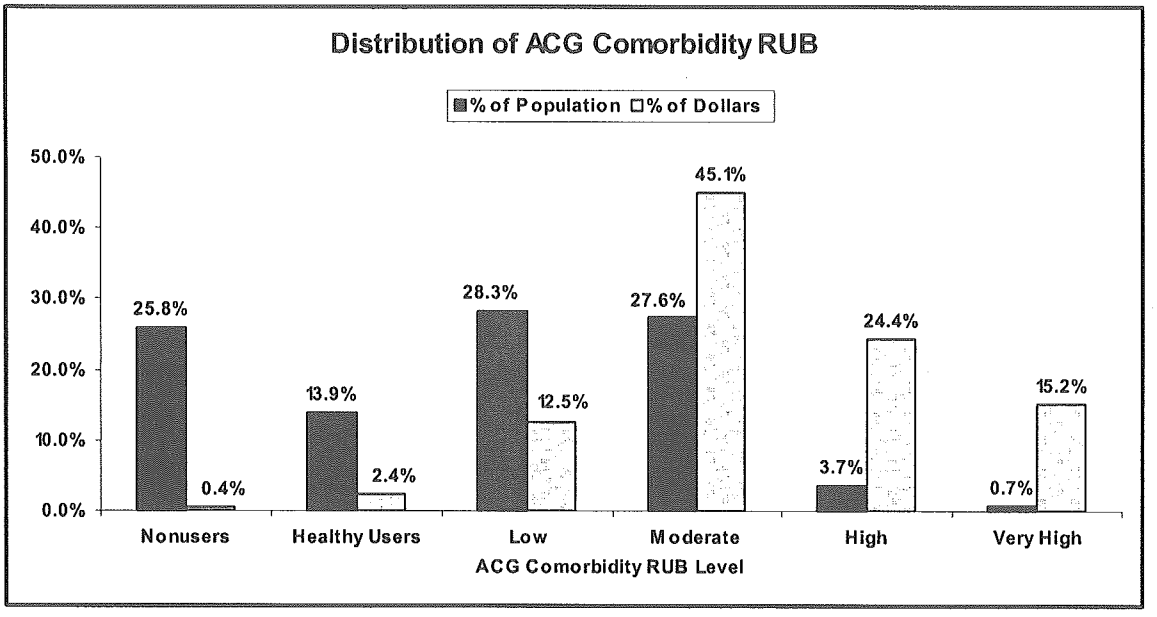
A key strength of the ACG suite of case-mix/risk adjustment measures is that the grouping algorithms and analytic approaches in the software are very accessible to most organizations. The straightforward ACG actuarial cell approach readily allows for the application

of an organization's own information to calibrate "weights" (or coefficients) to fine-tune the analysis to best match the local situation and context. While many users of ACGs have applied actuarial cell-based models, there is a growing body of users who wish to implement risk adjustment and for whom no local cost data are available

To facilitate quick implementation of ACG technologies, Version 6.0 for the first time incorporates concurrent (i.e., same-year resource use) ACG weights based on a large research database (more than 2 million persons) younger than 65 years of age who were enrolled in several U.S. commercial health insurance plans.

Version6.0 also makes available individual assignment to one of six ACG categories (from low to high) termed ACG *Resource Utilization Bands*, or RUBs. Relative value weights for each RUB category can be calculated by using local cost data or by using the concurrent ACG weights built into the software. The supplied RUB categories cover six morbidity levels: non-users, healthy users, low morbidity, moderate morbidity, high morbidity, and very high morbidity. Figure 1 illustrates the percentage of the population and percentage of total dollars associated with each RUB (based on a large research population); the bottom 40% of the population consume less than 3% of all health care dollars while the top 0.7% in the highest RUB category consume over 15%. RUBs can be used in the same fashion as ACG assignments. For many applications, they dramatically simplify risk adjustment computational tasks while retaining considerable ability to explain variations in resource use that are attributable to case-mix.

Figure 1: Distribution by ACG Comorbidity RUB



The relative values and RUB assignments available within the current version of our software are also used to generate tables that combine ACG and EDC information to develop a series of summary reports. These reports are discussed in Section 5 of the Release Notes, *Selecting the Right Tool from the Expanding ACG "Tool Box".*

The software-provided weights may be considered viable "external" or "reference" weights for concurrent ACG or RUB analyses. These weights can be used as substitutes for locally calibrated weights by those organizations with no available resource-use measures, or whenever the population may be too small to produce reliable local weights. (In addition to the section on this topic in the Version 6.0 Release Notes, please see Chapters 6, 8, and 11 of the *Version 5.0 Documentation and Application Manual* for further discussion of the advantages and disadvantages of local versus "software-provided" reference weights).

e. Technical Notes

Although the functionality of Version 6.0 is greater, there are only modest changes from Version 5.0 in terms of how to load and execute the software. Those familiar with the operation of ACG Version 5.0 will find it easy to implement 6.0. All new features follow from the

incorporation of a few new "reserved words" in the ACG control card file (used to pass data to the software and to control what fields are written to the software's output file). Readers should review the *Installation and Usage* section to familiarize themselves with the technical details and new specification requirements for 6.0. The guide included in this document can stand alone, and there should be no need for programmers or analysts running the software to refer to the previous *Version 5.0 Manual.*

Section 2

The ACG Predictive Model: Helping to Manage Care for Persons at Risk for High Future Cost

This section introduces the ACG Predictive Model (acgPM), an advanced tool for projecting future resource use based upon concurrent data captured largely from standard claims files. In addition to background on predictive modeling and on the construction of the acgPM, the text also provides model performance specifications, and concludes with a discussion of output reports and how they may be used to support case and disease management.

a. Introduction

This chapter describes the newest addition to the ACG System's toolkit, the ACG Predictive Model (acgPM). The acgPM uses sophisticated statistical techniques to project the impact of co-morbidity and other factors on an individual's use of health care resources in a subsequent time period. The acgPM is designed for prospective high-risk case identification and will be of real value for assessing both the quality and appropriateness of patient care.

We begin with an overview of the acgPM and then launch into a discussion of our acgPM development effort, the elements of the new models, and model performance assessment. We conclude the chapter by addressing application issues.

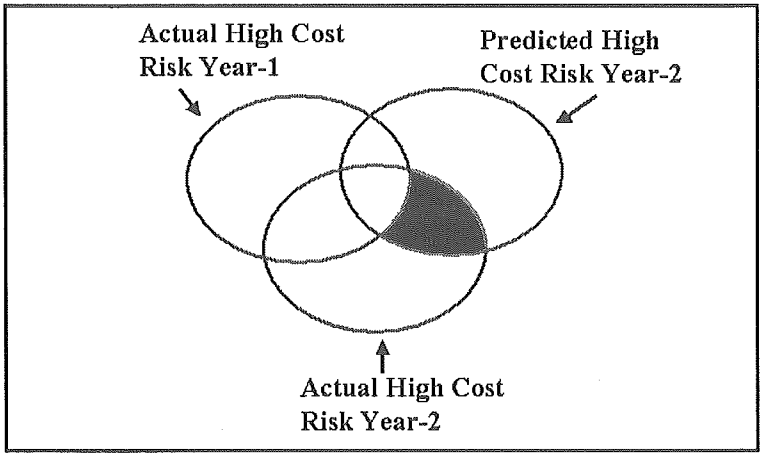
i. Model Offers Fast Identification of High-risk Patients

The acgPM permits the rapid identification of high-risk patients who may benefit from care management services. The acgPM remains grounded in the disease burden perspective unique to the ACG System, which focuses on commonly occurring patterns of morbidity and assessment of all types of medical need. This holistic method has repeatedly proved to have many advantages over comparable case-mix adjustment approaches that include only a limited set of disease or episode categories. Also, our predictive model's straightforward approach to integrating clinically relevant risk factors offers advantages over "black box" strategies based on complex clinical algorithms for data-mining or on artificial intelligence.

The Venn diagram provided in Figure 1 graphically depicts the predictive modeling challenge. Traditionally plans have made use of data on prior experiences (the Actual High-risk

Year 1 ellipse) to project individuals likely to remain costly in the following year. This projection represents an amalgam of patients that includes those who have continuing chronic conditions and also those who go through acute events or injuries that do not recur. The acgPM identifies another group of individuals (the Predicted High Risk ellipse) that overlaps the prior-cost ellipse but also identifies individuals who were NOT high cost in Year 1 (the shaded area). Thus an important attribute of predictive model performance is the size of the shaded area.

Figure 1. Identifying High-cost Persons Who Were Not Previously High Cost



ii. Model Outputs Serve Dual Purposes

The acgPM software produces two types of predictive risk indicators: (1) a probability score representing the likelihood that a member will be among those persons using extraordinary health care resources in the coming year and (2) a predicted resource index that expresses anticipated resource use as a relative value.

Probability scores are used because the clinical decision-making process is often couched in terms of likelihood or odds. When employing the probability score, users can set their own definition of high resource use by setting some minimum threshold. Thus, for the purposes of case management, a health plan might choose to consider only those individuals with a probability of .6 or more of falling within the "high-risk" group during the following year. Our experience suggests this cut-off would identify about one half of 1% of the plan's members. There are performance tradeoffs to be made (e.g., increased positive predicted values with lower sensitivities) when setting minimum thresholds. Setting higher probability thresholds permits

prediction with greater accuracy but with a greater chance of missing potentially high-risk cases. These tradeoffs are discussed later in this chapter. The acgPM probability score has been tailored to case identification and thus will be especially useful to case managers in targeting patients for intervention.

The second acgPM output, the predicted resource index, can be applied to calculate expected resource dollars. Case managers will be able to calculate expected differences between current and projected future costs to prioritize interventions that could have the highest impact. Health plans and others will also find this model output to be a useful tool for rate setting and financially related decisions.

iii. Models Forecast Overall and Pharmacy-specific Expenses

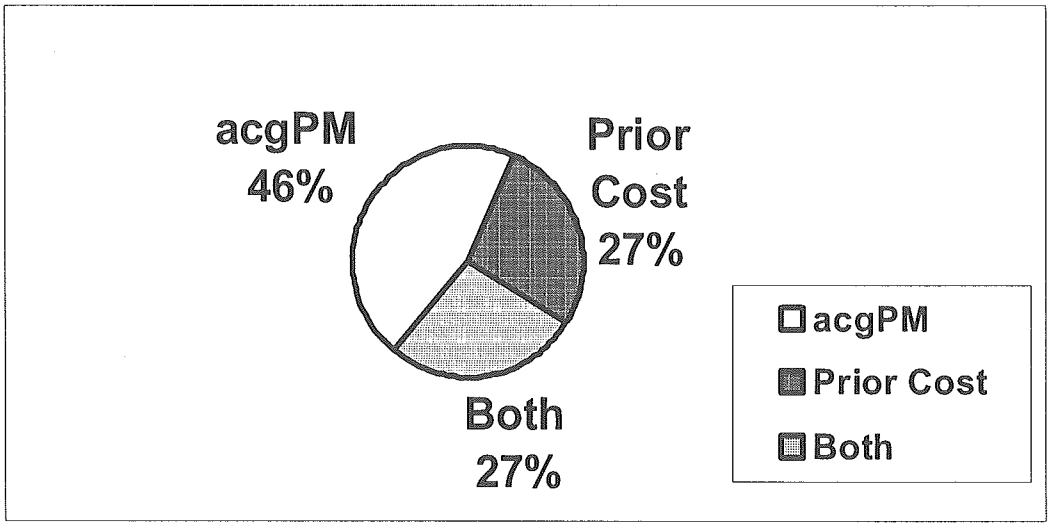
The acgPM output provides two separate sets of probability scores and predictive resource indexes: the first for total cost, and the second for pharmacy-specific cost. The total cost output represents an overall measure of inpatient and outpatient resource use that is the main focus of the prediction model. The model also provides pharmacy resource predictors because pharmacy-specific cost has become a major component of overall expenditures and is currently the focus of many payment and delivery organizations. Although there is a correlation between medical care service use and pharmacy use, the relationship is not one-to-one. Disease management evaluations are showing that total cost savings can be achieved, primarily because of reduced inpatient care, while pharmaceutical use increases.

iv. Identification by Prior Costs Alone Omits Many Cases

Prior cost and other utilization experience (e.g., extended hospitalization) are often used as the basis for identifying individuals for inclusion in intensive case management. Chronically ill individuals who have had significant health care use in the past often do continue these patterns of high care use into the future. Prior use measures also identify patients with a high-cost acute event, which may have no bearing on healthcare use in the future. Still others who had previously been less intensive users of health care resources may enter a high-use phase. For especially high-risk cases, reliance on prior use alone will yield a very incomplete picture. In

Figure 2 we have pooled together those persons within a large health plan data set whom were successfully predicted to be high use (cost) by either the acgPM or by prior cost experience.[1]

Figure 2. Percentage of Cases Correctly Predicted to Be at High-risk for Using Extraordinary Health Care Resources, by Prediction Strategy



Overall, the acgPM identified 73% of the high-risk cases that were successfully captured by either approach. The acgPM uniquely accounted for nearly half of the successfully identified high-risk patients. These cases were not previously high resource users and would be missed if prior cost alone were used in case identification.

v. The acgPM Adds Another Tool to the ACG System Without Increased Data Collection

The acgPM substantially improves high-use case identification and does so without increasing the minimal data collection effort currently required for the ACG software. The acgPM constructs its risk factor information from claims data streams containing only age, sex, and diagnostic information. If a plan has historical pharmacy-cost information for each person (the full drug claims history is not needed), this summary measure of pharmacy use can optionally be added to the input data stream for enhanced model performance. Moreover, the

[1] The high risk group in this comparison included those with an acgPM probability score of 0.6 or more of being among those persons with the top 5% of total costs next year. An equivalent number of the highest prior cost cases in year –1 were then identified for comparison. These two groups each account for about ½ of 1% of the test population.

acgPM is bundled within the current ACG System, and thus the full capabilities of ACGs, including provider profiling and risk-adjusted capitation determination, are available as part of the standard software package.

b. Developing the acgPM

i. What is a Predictive Model?

Predictive modeling in the health care management context is generally defined as a process that applies existing patient data to identify prospectively persons with high medical need who are "at risk" for above-average future medical service utilization. Such future resource use is often, although not always, linked to negative health outcomes.

A predictive model can incorporate information from a wide array of sources and can rely on many statistical approaches—from the very simple to the very complex. As noted, one simple approach is to use contemporary cost data as a predictor of future high cost. For example, a plan could assume that if a person is very high cost this year, he or she is likely also to have a high care-utilization experience in the future. Other models use multivariable statistical analysis and data available from a range of sources for their predictions. The basis for many of these efforts is ordinary least squares regression. Some predictive models are based upon neural networks. These are sometimes termed "artificial intelligence" approaches, given that neural networks represent collections of mathematical models that emulate the processes observed in biological nervous systems, including the capability to "adapt and learn." From the perspective of either empirical accuracy or performance, no modeling method has yet to demonstrate clear superiority.

One of the main challenges facing any modeling strategy is the limited risk factor data on which the models can be based. Currently, the commercially available prediction tools depend largely on standard medical care claims (age, sex, diagnoses, procedures, prescriptions, service dates, and cost). Model coefficients are developed using one year's data to "predict" a second year. With the limited source of risk factor data, model predictive capabilities are limited as well. All predictive models are tools that must be used with good clinical and managerial judgment and other sources of information in making decisions.

ii. Historical Use of ACG for PM

Although a separate predictive model is new to the ACG System as of version 6.0, for years elements of the ACG case-mix grouping algorithms have been successfully adapted by users to apply their own customized predictive models. ACGs work very well for this purpose because, at their core, they focus on the dimensions that help predict high risk, such as:

- persistence of the conditions,
- seriousness/severity of the conditions,
- the co-morbid nature of disease,
- the likelihood of a negative outcome, and
- the need for high levels of medical services.

Prior work by Starfield et al. (Primary Care, Co-morbidity, and Case Management, presented at the Conference on Health Care Risk Adjustment, Minneapolis, MN, May 2, 2001 and available in the virtual ACG library at: http://acg.jhsph.edu) suggests that the components of the ACG System have inherent utility as predictors of high future costs. As is shown in Table 1, the co-occurrence of ADGs and the presence of selected ACGs are superior to prior hospitalizations in predicting high costs in subsequent years.

Table 1. Potential Influence of Prior Co-Morbidity and Hospitalization on Future Cost.

Measure	Percentage of Members	Percentage High Cost in Year 2	Percentage High Cost in Year 3
2+ Hospitalizations	0.7%	53.3%	51.5%
12+ ADGs	0.9%	65.6%	66.1%
4+ Major ADGs	0.4%	72.4%	70.1%
Selected ACGs	1.7%	60.0%	52.0%
Total	<3.7%		

For other successful applications of the ACG System components to predict high-risk cases, see the proceedings of the 2002 International Johns Hopkins ACG Risk Adjustment Conference, Baltimore, MD, April 28, 2002 (available in the virtual ACG library at: http://acg.jhsph.edu).