The Johns Hopkins ACG® System

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3 Adjusted Clinical Groups (ACGs)

A Brief Overview

The Johns Hopkins ACG Case-Mix System ("the ACG System") is a statistically valid, diagnosis-based, case-mix methodology that allows healthcare providers, health plans, and public-sector agencies to describe or predict a population's past or future healthcare utilization and costs. The ACG System is also widely used by researchers and analysts to compare various patient populations' prior health resource use, while taking into account morbidity or illness burden.

Adjusted **C**linical **G**roup actuarial cells, or **ACGs**, are the building blocks of the Johns Hopkins ACG Case-Mix System ("the ACG System") methodology. ACGs are a series of mutually exclusive, health status categories defined by morbidity, age, and sex. They are based on the premise that the level of resources necessary for delivering appropriate healthcare to a population is correlated with the illness burden of that population.

ACGs are used to determine the morbidity profile of patient populations to more fairly assess provider performance, to reimburse providers based on the health needs of their patients, and to allow for more equitable comparisons of utilization or outcomes across two or more patient or enrollee aggregations.

The Development of the ACGs

The concept of ACG actuarial cells grew out of research by Dr. Barbara Starfield and her colleagues in the late 1970s when they examined the relationship between morbidity or illness burden and healthcare services utilization among children in managed care settings. The research team theorized that the children using the most healthcare resources were not those with a single chronic illness, but rather were those with multiple, seemingly unrelated conditions. To test their original hypothesis, illnesses found within pediatric HMO populations were grouped into five discrete categories:

1. Minor illnesses that are self-limited if treated appropriately, e.g., the flu, or chicken pox.

2. Illnesses that are more severe but also time-limited if treated appropriately, e.g., a broken leg or pneumonia.

3. Medical illnesses that are generally chronic and which remain incurable even with medical therapy, e.g., diabetes or cystic fibrosis.

4. Illnesses resulting from structural problems that are generally not curable even with adequate and appropriate intervention, e.g., cerebral palsy or scoliosis.

5. Psychosocial conditions, e.g., behavior problems or depression.

The Johns Hopkins team's findings supported the hypothesis that clustering of morbidity is a better predictor of health services resource use than the presence of specific diseases. This

finding forms the basis of the current ACG System and remains the fundamental concept that differentiates ACGs from other case-mix adjustment methodologies.

Since this early research more than two decades ago, the Johns Hopkins ACG Case-Mix System has been refined and expanded based on years of extensive research and development in collaboration with over 25 private and public health plans. The peer reviewed research literature on the ACG System by the Johns Hopkins team and others is quite extensive and we encourage you to study it. (See Bibliography at the end of this guide for a complete listing of ACG-related publications.)

How ACGs Work

ACGs are a person-focused method of categorizing patients' illnesses. Over time, each person develops numerous conditions. Based on the pattern of these morbidities, the ACG approach assigns each individual to a single ACG category. Thus, an ACG captures the specific clustering of morbidities experienced by a person over a given period of time, such as a year.

The ACG System assigns all ICD (-9,-9-CM,-10) codes to one of 32 diagnosis clusters known as Aggregated Diagnosis Groups, or ADGs. Individual diseases or conditions are placed into a single ADG cluster based on five clinical dimensions:

- **Duration of the condition** (acute, recurrent, or chronic): How long will healthcare resources be required for the management of this condition?

- **Severity of the condition** (e.g., minor and stable versus major and unstable): How intensely must healthcare resources be applied to manage the condition?

- **Diagnostic certainty** (symptoms versus documented disease): Will a diagnostic evaluation be needed or will services for treatment be the primary focus?

- **Etiology of the condition** (infectious, injury, or other): What types of healthcare services will likely be used?

- **Specialty care involvement** (e.g., medical, surgical, obstetric, hematology): To what degree will specialty care services be required?

All diseases--even those yet to be discovered--can be classified along these dimensions and categorized into one of these 32 ADG clusters[1].

Because most management applications for population-based case-mix adjustment systems require that patients be grouped into single, mutually exclusive categories, the ACG methodology uses a branching algorithm to place people into one of 93[2] discrete categories based

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[1] Please note that originally when the ACG System was termed the Ambulatory Care Group System, ADG stood for Ambulatory Diagnostic Groups. Today, we retain the ADG acronym and call them Aggregated Diagnosis Groups.

[2] There are 82 default categories and 93 if all optional branchings are turned on.

on their assigned ADGs, their age and their sex. The result is that individuals within a given ACG have experienced a similar pattern of morbidity and resource consumption over the course of a given year.

ACGs can be assigned to individuals using readily available diagnostic information derived from outpatient or ambulatory physician visit claims records, encounter records, inpatient hospital claims, and computerized discharge abstracts. A patient/enrollee is assigned to a single ACG based on the diagnoses assigned by all clinicians seeing them during all contacts, regardless of setting. Thus ACGs are truly person-oriented and are not based on visits or episodes.

Typically, ACGs perform up to ten times better than age and sex adjustment, the traditional risk-adjustment mechanism used within the health insurance industry.

Overview of the ACG Assignment Process

The ACG System relies on automated claims or encounter data derived from healthcare settings to characterize the degree of overall morbidity in patients and populations. ACGs are designed to be conceptually simple, accessible, and practical to both clinicians and managers. A significant advantage of the ACG System is its open architecture. Unlike other case-mix, severity, and profiling systems' decision rules, those used for ACGs are not housed in a "black box." The ACG grouping logic is easily accessible to the user.

This chapter provides a detailed description of the ACG grouping logic. There is a section in this chapter entitled, "Clinical Aspects of ACGs" that expands this discussion by providing a clinical discussion of the ACG System.

Step 1: Mapping ICD Codes to a Parsimonious Set of Aggregated Diagnosis Groups (ADGs)

There are roughly 25,000 ICD (-9 or -10) diagnosis codes that clinicians can use to describe patients' health conditions. The first step of the ACG grouping logic is to assign each of these codes to one of 32 diagnosis groups referred to as **A**ggregated **D**iagnosis **G**roups, or **ADGs**. The ICD-to-ADG mapping embedded in the ACG Software includes an ADG assignment for all[3] ICD codes in the Center for Medicare and Medicaid Services list of ICD-9 codes[4]. ICD-10 codes are sourced from the *Official ICD-10 Updates* published by the World Health Organization.

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[3] Because they indicate the cause of injury rather than an underlying morbidity, E-codes have generally been excluded from the ICD-9 to ADG mapping. Some E-codes representing iatrogenic conditions and adverse effects are included in the mapping.

[4] Available for download at http://www.cms.gov.

Each ADG is a grouping of diagnosis codes that are similar in terms of severity and likelihood of persistence of the health condition treated over a relevant period of time (such as a year of HMO enrollment). ICD codes within the same ADG are similar in terms of both clinical criteria and expected need for healthcare resources. Just as individuals may have multiple ICD diagnosis codes, they may have multiple ADGs (up to 32). **Table 1** lists the 32 ADGs and exemplary diagnosis codes.

ADGs are distinguished by several clinical characteristics (time limited or not, medical/specialty/pregnancy, physical health/psycho-social), and degree of refinement of the problem (diagnosis or symptom/sign). They are not categorized by organ system or disease. Instead, they are based on clinical dimensions that help explain or predict the need for healthcare resources over time. The need for healthcare resources is primarily determined by the likelihood of persistence of problems and their level of severity rather than organ system involvement. See the section entitled, "Clinical Aspects of ACGs," in this manual for further discussion of these clinical criteria.

Table 1: ADGs and Common ICD-9-CM Codes Assigned to Them

ADG	ICD-9-CM Diagnosis Code	
1. Time Limited: Minor	558.9	Noninfectious Gastroententris
	691.0	Diaper or Napkin Rash
2. Time Limited: Minor-Primary Infections	079.9	Unspecified Viral Infection
	464.4	Croup
3. Time Limited: Major	451.2	Phlebitis of Lower Extremities
	560.3	Impaction of Intestine
4. Time Limited: Major-Primary Infections	573.3	Hepatitis, Unspecified
	711.0	Pyogenic Arthritis
5. Allergies	477.9	Allergic Rhinitis, Cause Unspecified
	708.9	Unspecified Urticaria
6. Asthma	493.0	Extrinsic Asthma
	493.1	Intrinsic Asthma
7. Likely to Recur: Discrete	274.9	Gout, Unspecified
	724.5	Backache, Unspecified
8. Likely to Recur: Discrete-Infections	474.0	Chronic Tonsillitus
	599.0	Urinary Tract Infection
9. Likely to Recur: Progressive	250.10	Adult Onset Type II Diabetes w/ Ketoacidosis
	434.0	Cerebral Thrombosis
10. Chronic Medical: Stable	250.00	Adult-Onset Type 1 Diabetes
	401.9	Essential Hypertension
11. Chronic Medical: Unstable	282.6	Sickle-Cell Anemia
	277.0	Cystic Fibrosis
12. Chronic Specialty: Stable-Orthopedic	721.0	Cervical Spondylosis Without Myelopathy
	718.8	Other Joint Derangement
13. Chronic Specialty: Stable-Ear, Nose, Throat	389.14	Central Hearing Loss
	385.3	Cholesteatoma
14. Chronic Specialty: Stable-Eye	367.1	Myopia
	372.9	Unspecified Disorder of Conjunctiva
15. No Longer in Use*		
16. Chronic Specialty: Unstable-Orthopedic	724.02	Spinal Stenosis of Lumbar Region
	732.7	Osteochondritis Dissecans

ADG	ICD-9-CM Diagnosis Code	
17. Chronic Specialty: Unstable-Ear, Nose, Throat	386.0 383.1	Meniere's Disease Chronic Mastoiditis
18. Chronic Specialty: Unstable-Eye	365.9 379.0	Unspecified Glaucoma Scleritis/Episcleritis
19. No Longer in Use*		
20. Dermatologic	078.1 448.1	Viral Warts Nevus, Non-Neoplastic
21. Injuries/Adverse Effects: Minor	847.0 959.1	Neck Sprain Injury to Trunk
22. Injuries/Adverse Effects: Major	854.0 972.1	Intracranial Injury Poisoning by Cardiotonic Glycosides and Similar Drugs
23. Psychosocial: Time Limited, Minor	305.2 309.0	Cannabis Abuse, Unspecified Brief Depressive Reaction
24. Psychosocial: Recurrent or Persistent, Stable	300.01 307.51	Panic Disorder Bulimia
25. Psychosocial: Recurrent or Persistent, Unstable	295.2 291.0	Catatonic Schizophrenia Alcohol Withdrawal Delirium Tremens
26. Signs/Symptoms: Minor	784.0 729.5	Headache Pain in Limb
27. Signs/Symptoms: Uncertain	719.06 780.7	Effusion of Lower Leg Joint Malaise and Fatigue
28. Signs/Symptoms: Major	429.3 780.2	Cardiomegaly Syncope and Collaspe
29. Discretionary	550.9 706.2	Inguinal Hernia (NOS) Sebaceous Cyst
30. See and Reassure	611.1 278.1	Hypertrophy of Breast Localized Adiposity
31. Prevention/Administrative	V20.2 V72.3	Routine Infant or Child Health Check Gynecological Examination
32. Malignancy	174.9 201.9	Malignant Neoplasm of Breast (NOS) Hodgkin's Disease, Unspecified Type
33. Pregnancy	V22.2 650.0	Pregnant State Delivery in a Completely Normal Case
34. Dental	521.0 523.1	Dental Caries Chronic Gingivitis

*Note: Only 32 of the 34 markers are currently in use.

When the user applies the *lenient* diagnostic certainty option, any single diagnosis qualifying for an ADG marker will turn the marker on. However, the user may also apply a *stringent* diagnostic certainty option. For a subset of diagnoses, there must be more than one diagnosis qualifying for the marker in order for the ADG to be assigned. This was designed to provide greater confidence in the ADGs assigned to a patient. For more information, refer to the *Installation and Usage Guide, Chapter 4.*

Major ADGs

Some ADGs have very high expected resource use and are labeled "Major ADGs." **Table 2** presents major ADGs for adult and pediatric populations.

Table 2: Major ADGs for Adult and Pediatric Populations

Pediatric Major ADGs (ages 0-17 years)	Adult Major ADGs (ages 18 and up)
3 Time Limited: Major	3 Time Limited: Major
9 Likely to Recur: Progressive	4 Time Limited: Major-Primary Infections
11 Chronic Medical: Unstable	9 Likely to Recur: Progressive
12 Chronic Specialty: Stable-Orthopedic	11 Chronic Medical: Unstable
13 Chronic Specialty: Stable-Ear, Nose, Throat	16 Chronic Specialty: Unstable-Orthopedic
18 Chronic Specialty: Unstable-Eye	22 Injuries/Adverse Effects: Major
25 Psychosocial: Recurrent or Persistent, Unstable	25 Psychosocial: Recurrent or Persistent, Unstable
32 Malignancy	32 Malignancy

Step 2: Creating a Manageable Number of ADG Subgroups (CADGs)

The ultimate goal of the ACG algorithm is to assign each person to a single morbidity group (i.e., an ACG). There are 4.3 billion possible combinations of ADGs, so to create a more manageable number of unique combinations of morbidity groupings, the 32 ADGs are collapsed into 12 CADGs or Collapsed ADGs (**Table 3)**. Like ADGs, CADGs are not mutually exclusive in that an individual can be assigned to as few as none or as many as 12.

Although numerous analytic techniques could be used to form CADGs from ADGs, the ACG Case-Mix System has placed the emphasis on clinical cogency. Three clinical criteria are used:

- the similarity of **likelihood of persistence or recurrence** of diagnoses within the ADG, i.e., time-limited, likely to recur, or chronic groupings;

- the **severity** of the condition, i.e., minor versus major and stable versus unstable; and

- the **types of healthcare services required** for patient management--medical versus specialty, eye/dental, psychosocial, prevention/administrative, and pregnancy.

ADGs and CADGs can be used for various analytic and research applications that do not require mutually exclusive categories such as multivariate predictive or explanatory models. See the ACG publication list in Appendix A for additional examples of these approaches.

Table 3: The Collapsed ADG Clusters and the ADGs That They Comprise

Collapsed ADG (CADG)	ADGs in Each
1. Acute Minor	1 Time Limited: Minor 2 Time Limited: Minor-Primary Infections 21 Injuries/Adverse Events: Minor 26 Signs/Symptoms: Minor
2. Acute Major	3 Time Limited: Major 4 Time Limited: Major-Primary Infections 22 Injuries/Adverse Events: Major 27 Signs/Symptoms: Uncertain 28 Signs/Symptoms: Major
3. Likely to Recur	5 Allergies 7 Likely to Recur: Discrete 8 Likely to Recur: Discrete-Infections 20 Dermatologic 29 Discretionary
4. Asthma	6 Asthma
5. Chronic Medical: Unstable	9 Likely to Recur: Progressive 11 Chronic Medical: Unstable 32 Malignancy
6. Chronic Medical: Stable	10 Chronic Medical: Stable 30 See and Reassure
7. Chronic Specialty: Stable	12 Chronic Specialty: Stable-Orthopedic 13 Chronic Specialty: Stable-Ear, Nose, Throat
8. Eye/Dental	14 Chronic Specialty: Stable-Eye 34 Dental
9. Chronic Specialty: Unstable	16 Chronic Specialty: Unstable-Orthopedic 17 Chronic Specialty: Unstable-Ear, Nose, Throat 18 Chronic Specialty: Unstable-Eye
10. Psychosocial	23 Psycho-social: Time Limited, Minor 24 Psycho-social: Recurrent or Persistent, Stable 25 Psycho-social: Recurrent or Persistent, Unstable
11. Preventive/Administrative	31 Prevention/Administrative
12. Pregnancy	33 Pregnancy

Step 3: Frequently Occurring Combinations of CADGs (MACs)

The third step in the ACG categorization methodology assigns individuals into a single, mutually exclusive category, called a MAC. This grouping algorithm is based primarily on the pattern of CADGs. **Table 4**, below, shows the MACs and the Collapsed ADGs which comprise them.

There are twenty-three commonly occurring combinations of CADGs which form MACs 1 through 23:

- The first 11 MACs correspond to presence of a single CADG.

- MAC-12 includes all pregnant women, regardless of their pattern of CADGs.

- MACs 13 through 23 are commonly occurring combinations of CADGs.

- MAC-24 includes all other combinations of CADGs.

- MAC-25 is used for enrollees with no service use or invalid diagnosis input data.

- MAC-26 includes all infants (age<12 months), regardless of the pattern of CADGs.

Table 4: MACs and the Collapsed ADGs Assigned to Them

MACs	CADGs
1. Acute: Minor	1
2. Acute: Major	2
3. Likely to Recur	3
4. Asthma	4
5. Chronic Medical: Unstable	5
6. Chronic Medical: Stable	6
7. Chronic Specialty: Stable	7
8. Eye/Dental	8
9. Chronic Specialty: Unstable	9
10. Psychosocial	10
11. Prevention/Administrative	11
12. Pregnancy	All CADG combinations that include CADG 12
13. Acute: Minor and Acute: Major	1 and 2
14. Acute: Minor and Likely to Recur	1 and 3
15. Acute: Minor and Chronic Medical: Stable	1 and 6
16. Acute: Minor and Eye/Dental	1 and 8
17. Acute: Minor and Psychosocial	1 and 10
18. Acute: Major and Likely to Recur	2 and 3
19. Acute: Minor and Acute: Major and Likely to Recur	1, 2 and 3
20. Acute: Minor and Likely to Recur and Eye and Dental	1, 3 and 8
21. Acute: Minor and Likely to Recur and Psychosocial	1, 3, and 10
22. Acute: Minor and Major and Likely to Recur and Chronic Medical: Stable	1, 2, 3, and 6
23. Acute: Minor and Major and Likely to Recur and Psychosocial	1, 2, 3, and 10

MACs	CADGs
24. All Other Combinations Not Listed Above	All Other Combinations
25. No Diagnosis or Only Unclassified Diagnosis	No CADGs
26. Infants (age less than 1 year)	Any CADGs combinations and less than 1 year old

Step 4: Forming the Terminal Groups (ACGs)

MACs form the major branches of the ACG decision tree. The final step in the grouping algorithm divides the MAC branches into terminal groups, the actuarial cells known as ACGs. The logic used to split MACs into ACGs includes a combination of statistical considerations and clinical insight. During the ACG development process, the overarching goal for ACG assignment was to identify groups of individuals with similar needs for healthcare resources who also share similar clinical characteristics. Yale University's AUTOGRP Software (which performs recursive partitioning) was used to identify subdivisions of patients within a MAC who had similar needs for healthcare resources based on their overall expenditures. The variables taken into consideration included: age, sex, presence of specific ADGs, number of major ADGs, and total number of ADGs. (**Note:** Because prevention/administrative needs do not reflect morbidity, we do not include ADG31 in the count of total ADGs[5]).

See **Table 5**, below, for a complete listing and description of all ACGs.

Concurrent ACG-Weights

A concurrent ACG weight is an assessment of the relative resource use for individuals in the ACG. The concurrent weight is calculated as the mean cost of all patients in an ACG divided by the mean cost of all patients in the population. A fixed set of concurrent ACG-weights derived from external reference data is available as part of the software output file. Separate sets of weights exist for under age 65 working age populations and for over 65 Medicare eligible populations and determined by the Risk Assessment Variables selected during processing. 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. In the case of an elderly reference set, the weights of some ACGs (e.g., those associated with pediatrics, pregnancy or newborns) may be extrapolated from an under 65 population. 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 5** provides a complete listing of ACGs and their corresponding nationally representative concurrent ACG-weight from the US Non-elderly and US Elderly Risk Assessment Variables. (See the following

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[5] Readers are referred to Weiner (91) and Starfield (91) for more detail on the historical origins of the current system including the original Version 1.0 development process.

discussion regarding the importance of rescaling so that dollars are not over predicted or under predicted.)

The software-supplied reference ACG-weights are supplied in two forms: unscaled and rescaled. Unscaled ACG-weights are simply the values of the reference ACG-weights applied to a population of interest. The mean value of the unscaled ACG-weights provides a rudimentary profiling statistic. If the mean of the unscaled 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 a rescaled or standardized ACG-weight that mathematically manipulates the unscaled ACG-weight to have a mean of 1.0 in the local population. The steps for performing this manually are discussed in *Applications Guide*, Chapter 3.

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 were developed from a nationally representative database comprising approximately 4.7 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 reference weights may prove useful for calculating reasonably representative profiling statistics (reference *Applications Guide,* Chapter 3).

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 Resource 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 relationship between ACG categories and RUBs is defined in **Table 5** below.

Table 5: The Final ACG Categories, Reference Concurrent Weights and RUBs

| ACG | DESCRIPTION | Reference Concurrent Weight | | RUB |
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
0100	Acute Minor, Age 1	0.31	0.09	2
0200	Acute Minor, Age 2 to 5	0.14	0.04	1
0300	Acute Minor, Age 6+	0.16	0.10	1
0400	Acute Major	0.33	0.18	2
0500	Likely to Recur, w/o Allergies	0.21	0.12	2
0600	Likely to Recur, w/ Allergies	0.23	0.12	2
0700	Asthma	0.25	0.16	2
0800	Chronic Medical: Unstable	1.38	0.47	3
0900	Chronic Medical: Stable	0.35	0.15	2
1000	Chronic Specialty: Stable	0.25	0.25	2
1100	Eye & Dental	0.13	0.12	1
1200	Chronic Specialty: Unstable	0.23	0.13	2
1300	Psychosocial, w/o Psychosocial Unstable	0.32	0.14	2
1400	Psychosocial, w/ Psychosocial Unstable, w/o Psychosocial Stable	0.73	0.36	3
1500	Psychosocial, w/ Psychosocial Unstable, w/ Psychosocial Stable	1.24	0.43	3
1600	Preventive/Administrative	0.13	0.09	1
1710*	Pregnancy, 0-1 ADGs	1.89	0.56	3
1711	Pregnancy, 0-1 ADGs, Delivered	2.34	0.70	4
1712	Pregnancy, 0-1 ADGs, Not Delivered	1.65	0.49	3
1720*	Pregnancy, 2-3 ADGs, no Major ADGs	2.17	0.65	3
1721	Pregnancy, 2-3 ADGs, no Major ADGs, Delivered	2.81	0.84	4

ACG	DESCRIPTION	Reference Concurrent Weight		RUB
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
1722	Pregnancy, 2-3 ADGs, no Major ADGs, Not Delivered	1.84	0.55	3
1730*	Pregnancy, 2-3 ADGs, 1+ Major ADGs	2.64	0.79	4
1731	Pregnancy, 2-3 ADGs, 1+ Major ADGs, Delivered	3.07	0.92	4
1732	Pregnancy, 2-3 ADGs, 1+ Major ADGs, Not Delivered	2.26	0.67	3
1740*	Pregnancy, 4-5 ADGs, no Major ADGs	2.44	0.73	4
1741	Pregnancy, 4-5 ADGs, no Major ADGs, Delivered	3.25	0.97	4
1742	Pregnancy, 4-5 ADGs, no Major ADGs, Not Delivered	2.10	0.63	3
1750*	Pregnancy, 4-5 ADGs, 1+ Major ADGs	3.06	0.91	4
1751	Pregnancy, 4-5 ADGs, 1+ Major ADGs, Delivered	3.70	1.10	4
1752	Pregnancy, 4-5 ADGs, 1+ Major ADGs, Not Delivered	2.60	0.78	4
1760*	Pregnancy, 6+ ADGs, no Major ADGs	2.84	0.85	4
1761	Pregnancy, 6+ ADGs, no Major ADGs, Delivered	3.82	1.14	4
1762	Pregnancy, 6+ ADGs, no Major ADGs, Not Delivered	2.48	0.74	4
1770*	Pregnancy, 6+ ADGs, 1+ Major ADGs	4.45	1.33	4
1771	Pregnancy, 6+ ADGs, 1+ Major ADGs, Delivered	5.45	1.63	4
1772	Pregnancy, 6+ ADGs, 1+ Major ADGs, Not Delivered	3.91	1.17	4
1800	Acute Minor/Acute Major	0.49	0.23	2
1900	Acute Minor/Likely to Recur, Age 1	0.50	0.15	2
2000	Acute Minor/Likely to Recur, Age 2 to 5	0.27	0.08	2
2100	Acute Minor/Likely to Recur, Age 6+, w/o Allergy	0.29	0.18	2

ACG	DESCRIPTION	Reference Concurrent Weight		RUB
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
2200	Acute Minor/Likely to Recur, Age 6+, w/ Allergy	0.34	0.11	2
2300	Acute Minor/Chronic Medical: Stable	0.42	0.17	2
2400	Acute Minor/Eye & Dental	0.24	0.12	2
2500	Acute Minor/Psychosocial, w/o Psychosocial Unstable	0.40	0.14	2
2600	Acute Minor/Psychosocial, w/ Psychosocial Unstable, w/o Psychosocial Stable	0.88	0.28	3
2700	Acute Minor/Psychosocial, w/ Psychosocial Unstable, w/ Psychosocial Stable	1.40	0.49	3
2800	Acute Major/Likely to Recur	0.53	0.24	3
2900	Acute Minor/Acute Major/Likely to Recur, Age 1	0.94	0.28	3
3000	Acute Minor/Acute Major/Likely to Recur, Age 2 to 5	0.57	0.17	3
3100	Acute Minor/Acute Major/Likely to Recur, Age 6 to 11	0.51	0.15	3
3200	Acute Minor/Acute Major/Likely to Recur, Age 12+, w/o Allergy	0.79	0.30	3
3300	Acute Minor/Acute Major/Likely to Recur, Age 12+, w/ Allergy	0.82	0.21	3
3400	Acute Minor/Likely to Recur/Eye & Dental	0.42	0.19	2
3500	Acute Minor/Likely to Recur/Psychosocial	0.65	0.18	3
3600	Acute Minor/Acute Major/Likely to Recur/Chronic Medical: Stable	1.41	0.46	3
3700	Acute Minor/Acute Major/Likely to Recur/Psychosocial	1.28	0.55	3

ACG	DESCRIPTION	Reference Concurrent Weight		RUB
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
3800	2-3 Other ADG Combinations, Age 1 to 17	0.50	0.15	2
3900	2-3 Other ADG Combinations, Males Age 18 to 34	0.59	0.18	3
4000	2-3 Other ADG Combinations, Females Age 18 to 34	0.55	0.16	3
4100	2-3 Other ADG Combinations, Age 35+	0.76	0.31	3
4210	4-5 Other ADG Combinations, Age 1 to 17, no Major ADGs	0.66	0.20	3
4220	4-5 Other ADG Combinations, Age 1 to 17, 1+ Major ADGs	1.29	0.39	3
4310	4-5 Other ADG Combinations, Age 18 to 44, no Major ADGs	0.72	0.22	3
4320	4-5 Other ADG Combinations, Age 18 to 44, 1 Major ADGs	1.39	0.41	3
4330	4-5 Other ADG Combinations, Age 18 to 44, 2+ Major ADGs	2.36	0.70	4
4410	4-5 Other ADG Combinations, Age 45+, no Major ADGs	0.97	0.32	3
4420	4-5 Other ADG Combinations, Age 45+, 1 Major ADGs	1.71	0.56	3
4430	4-5 Other ADG Combinations, Age 45+, 2+ Major ADGs	2.95	0.88	4
4510	6-9 Other ADG Combinations, Age 1 to 5, no Major ADGs	1.20	0.36	3
4520	6-9 Other ADG Combinations, Age 1 to 5, 1+ Major ADGs	2.27	0.68	4
4610	6-9 Other ADG Combinations, Age 6 to 17, no Major ADGs	1.11	0.33	3
4620	6-9 Other ADG Combinations, Age 6 to 17, 1+ Major ADGs	2.50	0.75	4

ACG	DESCRIPTION	Reference Concurrent Weight		RUB
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
4710	6-9 Other ADG Combinations, Males, Age 18 to 34, no Major ADGs	1.13	0.34	3
4720	6-9 Other ADG Combinations, Males, Age 18 to 34, 1 Major ADGs	1.99	0.59	3
4730	6-9 Other ADG Combinations, Males, Age 18 to 34, 2+ Major ADGs	3.93	1.17	4
4810	6-9 Other ADG Combinations, Females, Age 18 to 34, no Major ADGs	1.22	0.36	3
4820	6-9 Other ADG Combinations, Females, Age 18 to 34, 1 Major ADGs	1.93	0.58	3
4830	6-9 Other ADG Combinations, Females, Age 18 to 34, 2+ Major ADGs	3.48	1.04	4
4910	6-9 Other ADG Combinations, Age 35+, 0-1 Major ADGs	2.09	0.70	3
4920	6-9 Other ADG Combinations, Age 35+, 2 Major ADGs	4.05	1.21	4
4930	6-9 Other ADG Combinations, Age 35+, 3 Major ADGs	6.89	1.87	5
4940	6-9 Other ADG Combinations, Age 35+, 4+ Major ADGs	12.59	2.89	5
5010	10+ Other ADG Combinations, Age 1 to 17, no Major ADGs	2.25	0.67	3
5020	10+ Other ADG Combinations, Age 1 to 17, 1 Major ADGs	3.95	1.18	4
5030	10+ Other ADG Combinations, Age 1 to 17, 2+ Major ADGs	12.72	3.80	5

ACG	DESCRIPTION	Reference Concurrent Weight		RUB
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
5040	10+ Other ADG Combinations, Age 18+, 0-1 Major ADGs	3.32	1.06	4
5050	10+ Other ADG Combinations, Age 18+, 2 Major ADGs	5.28	1.60	4
5060	10+ Other ADG Combinations, Age 18+, 3 Major ADGs	8.28	2.40	5
5070	10+ Other ADG Combinations, Age 18+, 4+ Major ADGs	18.85	4.60	5
5110	No Diagnosis or Only Unclassified Diagnosis (2 input files)	0.00	0.00	1
5200	Non-Users (2 input files)	0.90	0.27	0
5310*	Infants: 0-5 ADGs, no Major ADGs	7.45	2.22	3
5311	Infants: 0-5 ADGs, no Major ADGs, Low Birth Weight	0.85	0.25	4
5312	Infants: 0-5 ADGs, no Major ADGs, Normal Birth Weight	3.66	1.09	3
5320*	Infants: 0-5 ADGs, 1+ Major ADGs	15.66	4.67	4
5321	Infants: 0-5 ADGs, 1+ Major ADGs, Low Birth Weight	2.39	0.71	5
5322	Infants: 0-5 ADGs, 1+ Major ADGs, Normal Birth Weight	1.69	0.50	4
5330*	Infants: 6+ ADGs, no Major ADGs	5.34	1.59	3
5331	Infants: 6+ ADGs, no Major ADGs, Low Birth Weight	1.63	0.49	4
5332	Infants: 6+ ADGs, no Major ADGs, Normal Birth Weight	10.15	3.03	3
5340*	Infants: 6+ ADGs, 1+ Major ADGs	28.35	8.46	5
5341	Infants: 6+ ADGs, 1+ Major ADGs, Low Birth Weight	6.14	1.83	5

ACG	DESCRIPTION	Reference Concurrent Weight		RUB
		Commercially Insured (0 to 64 Years)	Medicare Beneficiaries (65 Years and Older)	
5342	Infants: 6+ ADGs, 1+ Major ADGs, Normal Birth Weight	0.86	0.26	4
9900	Invalid Age or Date of Birth	0.31	0.09	0

Source: PharMetrics, Inc., a unit of IMS, Watertown, MA; national cross-section of managed care plans; population of 4,740,000 commercially insured lives (less than 65 years old) and population of 257,404 Medicare beneficiaries (65 years and older), 2007.

*Note: The default is to subdivide these groups on delivery or low birth weight status. Grouping the ACGs without these divisions is optional and must be turned on by the user in order to be used.

Figure 1, on the following page, illustrates the main branches of the ACG decision tree. Some MACs are not subdivided by the characteristics listed above because doing so did not increase the explanatory power of the ACG model. Some include only a single CADG: for instance, MAC-02 is composed of individuals with only acute major conditions. Others, such as MAC-01, acute conditions only, are subdivided into three age groups: ACG 0100 (Age=1 year), ACG 0200 (Age=2-5 years), and ACG 0300 (6 or more years) because resource use differs by age for individuals with this pattern of morbidity. MAC-10, including individuals with psychosocial morbidity only and MAC-17, including individuals with psychosocial and acute minor conditions, are further split by the presence of ADG-24 (recurrent or chronic stable psychosocial conditions) and ADG-25 (recurrent or chronic unstable psychosocial conditions).

Figure 1: ACG Decision Tree
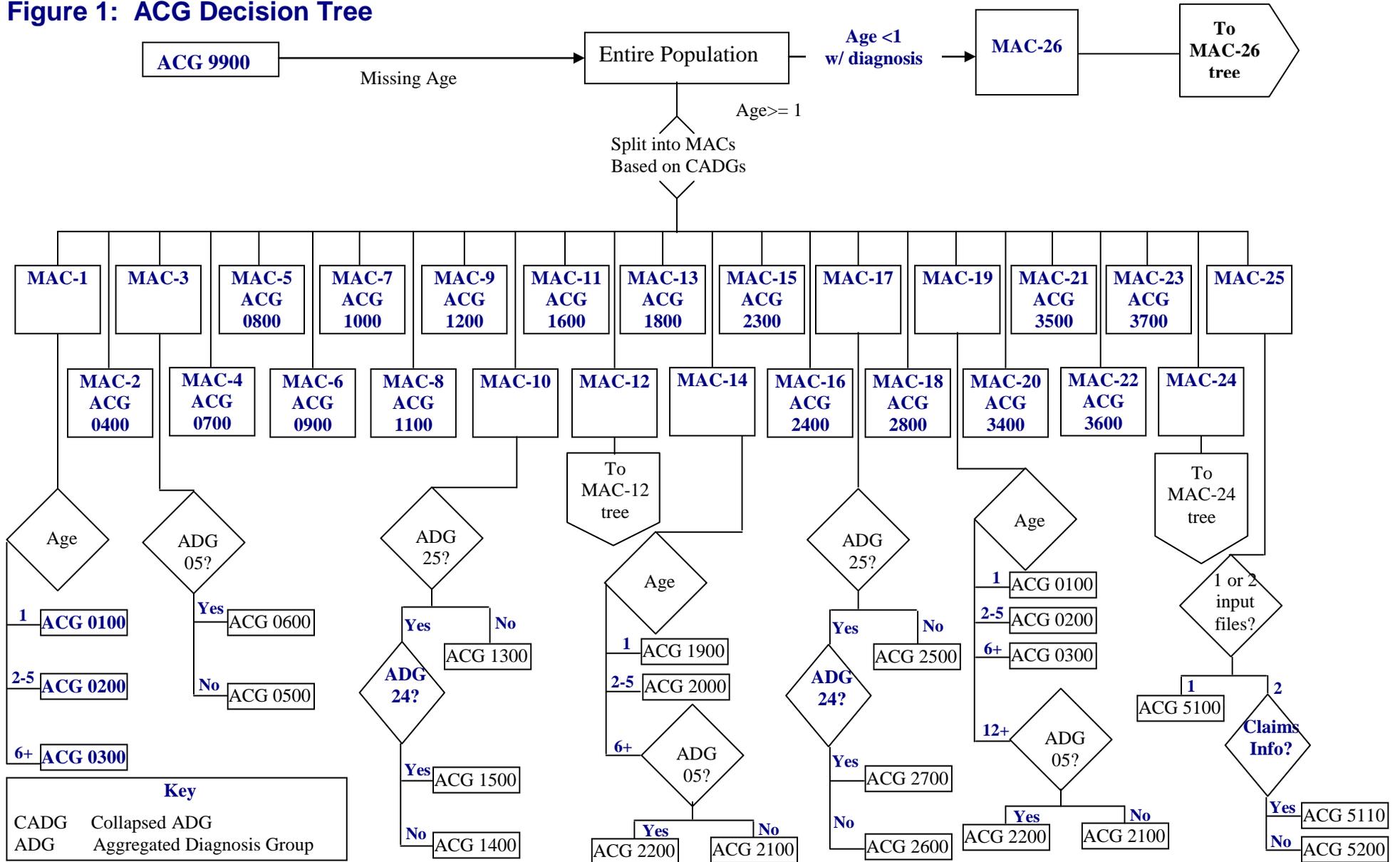
Figure 2, on the following page, illustrates the grouping logic for pregnant women. All women with at least one diagnosis code indicating pregnancy are assigned to MAC-12. The ACGs for pregnant women are formed with subdivisions first on total number of ADGs (0-1, 2-3, 4-5, 6+) and second, for individuals with two or more ADGs, a split on none versus one or more major ADGs. These two splits yield seven ACGs for pregnant women.

Users may want to further subdivide the standard seven ACGs for pregnant women according to whether delivery has occurred during the time period of interest, yielding a total of 14 ACGs for women with a diagnosis of pregnancy. Either diagnosis codes for delivery or user-supplied information on delivery (e.g., CPT-4 codes for delivery) can be used to separate pregnant women according to delivery status. Because of the marked differences in resource consumption for women with and without delivery and generally adequate validity of diagnoses associated with delivery, most users will find this option desirable to use. By default, the software will use diagnosis codes to subdivide based on delivery status

Refer to the chapter entitled, "Basic Data Requirements" in the *Installation and Usage Guide* for a more detailed discussion of appropriate means of identifying delivery status using user-defined flags.

## Figure 2: Decision Tree for MAC-12—Pregnant Women
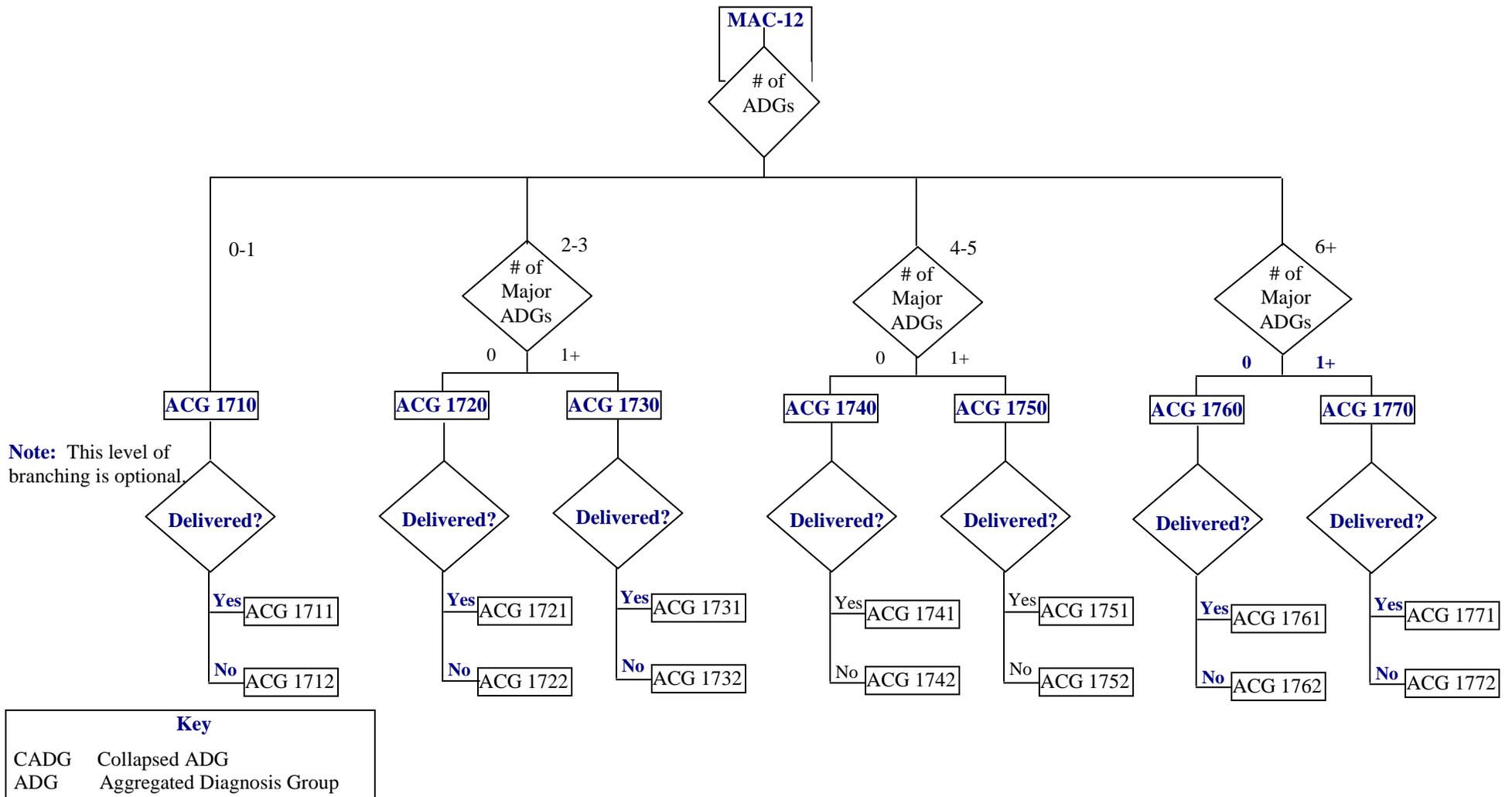
Figure 3, on the following page, illustrates the branching algorithm for MAC-26, which includes all infants, regardless of their pattern of CADGs. The first bifurcation is made on the total number of ADGs. Each group is further subdivided by presence of the number of major ADGs. These two splits yield four ACG groups.

For the infant ACGs, there is an optional additional split on birth weight. If a user has accurate birth weight information that can be linked with claims and enrollment files, the four standard infant ACGs can be further split into low birth weight (<2,500 grams) and normal birth weight (>2,500 grams). Our developmental work suggests that this additional split improves the explanatory power of the ACG System. However, two caveats are important to consider before using this ACG option. First, our research indicates poor validity for existing ICD-9-CM birth weight codes in some administrative data sets. Second, some populations may have such low rates of low birth weight infants that the number of infants grouped into an ACG may be too small for accurate estimates. In general, we recommend that at least 30 individuals per ACG are needed to obtain stable estimates of average resource use for that ACG. By default, the ACG System will divide infants based upon the presence or absence of a diagnosis code indicating low birth weight.

Refer to the chapter entitled, "Basic Data Requirements" in the *Installation and Usage Guide* for a more detailed discussion of appropriate means of identifying low birth weight status using user-defined flags.

Figure 3: Decision Tree for MAC-26—Infants
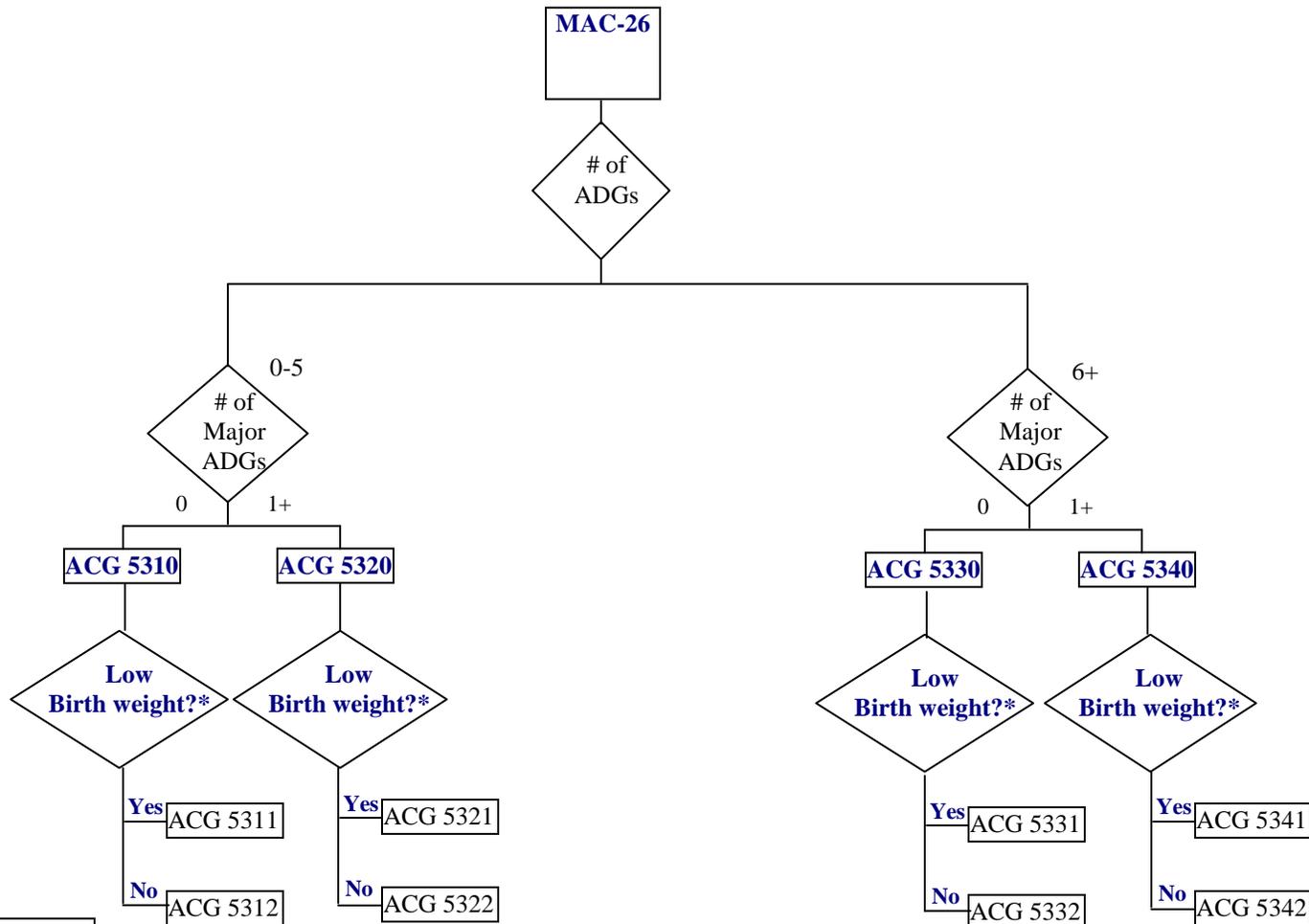
Note: This level of branching is optional.

*Low birth weight refers to infants weighing less than 2500 grams.

Key	
CADG	Collapsed ADG
ADG	Aggregated Diagnosis Group

Figure 4, on the following page, illustrates the last branch of the ACG tree, MAC-24, which includes less frequently occurring combinations of CADGs. There are 33 ACGs within MAC-24. With MAC-24, the first two splits are total number of ADGs (2-3, 4-5, 6-9, and 10+) and then, within each of these four groups, by age. The age splits separate children (1-17 years) from adults (18+), and in some cases further subdivides within these groups. Additional divisions are made on sex and number of major ADGs.

Figure 4: Decision Tree for MAC-24—Multiple ADG Categories

Key

CADG   Collapsed ADG
ADG   Aggregated Diagnosis Group
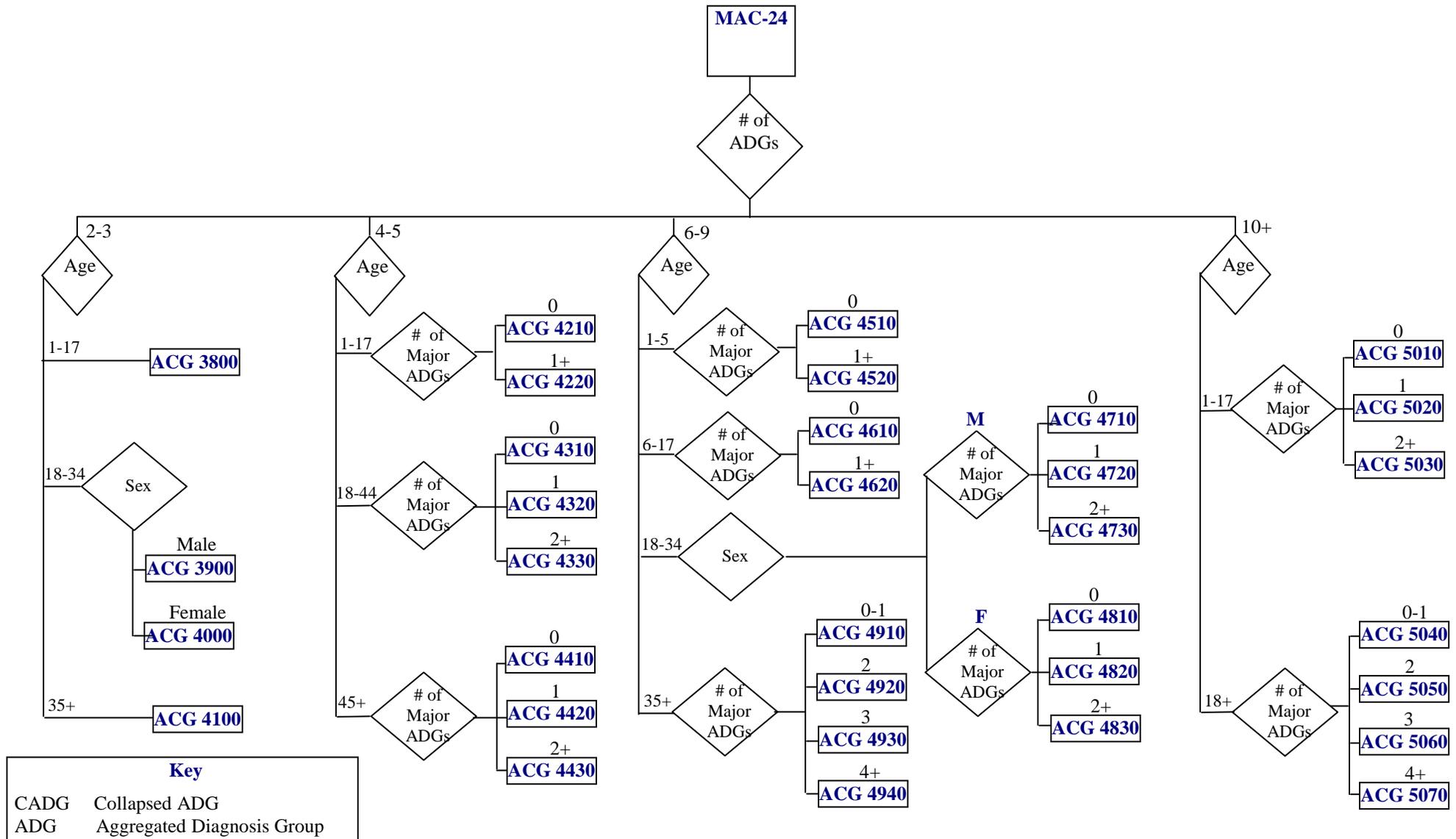
Clinical Aspects of ACGs

An ACG, the 'building block' of the ACG System, is assigned based on all diagnosis codes assigned to a person by providers during a predetermined period of time. This makes ACGs different from most other case-mix measures (e.g., Diagnosis-Related Groups--DRGs, Ambulatory Patient Categories--APCs, or Episode Treatment Groups--ETGs). In these other systems, the case-mix unit of analysis is based on a designated service period and usually a single distinct clinical condition. For example, the service period may be defined based on a single procedure or an episode of care. In contrast, ACGs are based on all morbidities for which a person receives services over a defined period of time.

The first step in the ACG assignment process is to categorize every ICD diagnosis code given to a patient into a unique morbidity grouping known as an "ADG." Each ADG is a group of ICD diagnosis codes that are homogenous with respect to specific clinical criteria and their demand on healthcare services. 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), while 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.

ADGs represent a shift from standard methods for categorizing diagnosis codes. A class of diagnoses, such as all those for diabetes or bacterial pneumonia, may indicate a process that affects a specific organ system or pathophysiologic process. The criteria for ADG assignment depends on those features of a condition that are most helpful in understanding and predicting the duration and intensity of healthcare. Five clinical criteria guide the assignment of each diagnosis code into an ADG: duration, severity, diagnostic certainty, type of etiology, and expected need for specialty care. **Table 6** shows how each of these five clinical criteria is applied to the 32 ADGs.

Duration

What is the expected length of time the health condition will last? Acute conditions are time limited and expected to resolve completely. Recurrent conditions occur episodically with inter-current disease-free intervals. Chronic conditions persist and are expected to require long-term management generally longer than one year.

Severity

What is the expected prognosis? How likely is the condition to worsen or lead to impairment, death, or an altered physiologic state? The ADG taxonomy divides acute conditions into minor and major categories corresponding to low and high severity, respectively. The system divides chronic conditions into stable and unstable based on the expected severity over time. Unstable conditions are more likely to have complications (related co-morbidities) than stable conditions and are expected to require more resources on an ongoing basis (e.g., more likely to need specialty care).

Diagnostic Certainty

Some diagnosis codes are given for signs/symptoms and are associated with diagnostic uncertainty. As such, they may require watchful waiting only or substantial work-up. The three ADGs for signs/symptoms are arrayed by expected intensity of diagnostic work-up, from low to intermediate to high.

Etiology

What is the cause of the health condition? Specific causes suggest the likelihood of different treatments. Infectious diseases usually require anti-microbial therapy; injuries may need emergency medical services, surgical management, or rehabilitation; anatomic problems may require surgical intervention; neoplastic diseases could involve surgical care, radiotherapy, chemotherapy; psychosocial problems require mental health services; pregnancy involves obstetric services; and, medical problems may require pharmacologic, rehabilitative, or supportive management.

Expected Need for Specialty Care

Would the majority of patients with this condition be expected to require specialty care management from one of the following types of specialized providers: orthopedic surgeon, otolaryngologist, ophthalmologist, dermatologist? In addition to these sub-specialties, certain other ADG categories imply that specialty care is more likely.

Table 6: Duration, Severity, Etiology, and Certainty of the Aggregated Diagnosis Groups (ADGs)

Note: ADGs 15 and 19 are no longer used.

ADG	Duration	Severity	Etiology	Diagnostic Certainty	Expected Need for Specialty Care
1. Time Limited: Minor	Acute	Low	Medical, non-infectious	High	Unlikely
2. Time Limited: Minor-Primary Infections	Acute	Low	Medical, infectious	High	Unlikely
3. Time Limited: Major	Acute	High	Medical, non-infectious	High	Likely
4. Time Limited: Major-Primary Infections	Acute	High	Medical, infectious	High	Likely
5. Allergies	Recurrent	Low	Allergy	High	Possibly
6. Asthma	Recurrent or Chronic	Low	Mixed	High	Possibly
7. Likely to Recur: Discrete	Recurrent	Low	Medical, non-infectious	High	Unlikely
8. Likely to Recur: Discrete-Infections	Recurrent	Low	Medical, infectious	High	Unlikely
9. Likely to Recur: Progressive	Recurrent	High	Medical, non-infectious	High	Likely
10. Chronic Medical: Stable	Chronic	Low	Medical, non-infectious	High	Unlikely
11. Chronic Medical: Unstable	Chronic	High	Medical, non-infectious	High	Likely
12. Chronic Specialty: Stable-Orthopedic	Chronic	Low	Anatomic/Musculoskeletal	High	Likely: orthopedics
13. Chronic Specialty: Stable-Ear, Nose, Throat	Chronic	Low	Anatomic/Ears, Nose, Throat	High	Likely: ENT
14. Chronic Specialty: Stable-Ophthalmology	Chronic	Low	Anatomic/Eye	High	Likely: ophthalmology

ADG	Duration	Severity	Etiology	Diagnostic Certainty	Expected Need for Specialty Care
16. Chronic Specialty: Unstable-Orthopedics	Chronic	High	Anatomic/ Musculoskeletal	High	Likely: orthopedics
15. Chronic Specialty: Unstable-Ear, Nose, Throat	Chronic	High	Anatomic/Ears, Nose, Throat	High	Likely: ENT
16. Chronic Specialty: Unstable-Ophthalmology	Chronic	High	Anatomic/Eye	High	Likely: ophthalmology
20. Dermatologic	Acute, recurrent	Low to High	Mixed	High	Likely: dermatology
17. Injuries/Adverse Effects: Minor	Acute	Low	Injury	High	Unlikely
18. Injuries/Adverse Effects: Major	Acute	High	Injury	High	Likely
19. Psychosocial: Time Limited, Minor	Acute	Low	Psychosocial	High	Unlikely
20. Psychosocial: Recurrent or Chronic, Stable	Recurrent or Chronic	Low	Psychosocial	High	Likely: mental health
21. Psychosocial: Recurrent or Persistent, Unstable	Recurrent or Chronic	High	Psychosocial	High	Likely: mental health
22. Signs/Symptoms: Minor	Uncertain	Low	Mixed	Low	Unlikely
23. Signs/Symptoms: Uncertain	Uncertain	Uncertain	Mixed	Low	Uncertain
24. Signs/Symptoms: Major	Uncertain	High	Mixed	Low	Likely
25. Discretionary	Acute	Low or High	Anatomic	High	Likely: surgical specialties
26. See and Reassure	Acute	Low	Anatomic	High	Unlikely
27. Prevention/Administrative	N/A	N/A	N/A	N/A	Unlikely
28. Malignancy	Chronic	High	Neoplastic	High	Likely: oncology
29. Pregnancy	Acute	Low	Pregnancy	High	Likely: obstetrics
30. Dental	Acute, recurrent, chronic	Low to High	Mixed	High	Likely: dental

Clinically Oriented Examples of ACGs

Patients are categorized into an ACG based on the pattern of ADGs experienced over a predetermined interval and, in some cases, their age and sex. This approach focuses on the totality of diseases experienced by a person rather than any specific disease. Because this method diverges from the traditional biomedical, categorical method of examining morbidity, we show how ACGs classify patients with specific types of diseases.

In the examples that follow, we categorize patients by choosing a specific clinical feature that they have, such as a disease, pregnancy, or by their age. These examples show how the presence of other diseases or total number of ADGs changes ACG assignment.

Chronic Illnesses

On the following pages, Example 1 presents three patients with hypertension and Example 2 presents three patients with diabetes. These individuals were actual patients selected from a private health plan database. The input data used by the ACG grouping software, the output produced by the software, and the associated resource consumption variables are presented. As these patients demonstrate, there is substantial variability in patterns of morbidity and need for healthcare for different patients classified by a specific condition such as hypertension or diabetes. Thus, knowing only that a patient has a particular medical problem, even if it is a chronic condition, provides little information about the need for medical services. In general, as the number of different types of morbidities increases, the total number of ambulatory visits increases as does total expenditures. However, the total burden of morbidity as represented by the ACG – that is, the constellation of ADGs and presence of major ADGs is the most important determinant of resource consumption.

In Example 2, for diabetes, during the assessment period Patient 1 had diagnosis codes given only for uncomplicated diabetes mellitus and a routine medical exam and is therefore classified into the ACG for patients with stable, chronic medical conditions (ACG-0900). In contrast, all three of the patients with hypertension as well as Patients 2 and 3 with diabetes are in ACGs that branch from MAC-24 (combinations of ADGs not otherwise classified). This occurs because their combinations of ADGs occur too infrequently to merit a separate ACG. Patients in MAC-24 have both high levels of morbidity and high levels of health need. There is a strong link between the total number of ADGs/major ADGs and resource consumption.

Although not shown in the examples, there are two additional ACGs that describe commonly occurring combinations of morbidity for individuals with stable, chronic medical conditions. ACG-2300 (Chronic Medical--Stable and Acute Minor) is assigned to patients with uncomplicated diabetes, hypertension, or other stable chronic conditions and a minor illness, injury, or symptom. Individuals in ACG-3600 have four types of morbidities: stable chronic medical conditions (which includes the diagnosis of

hypertension), acute minor conditions, conditions of low severity likely to reoccur, and acute major conditions.

Example 1: Hypertension

The following patient types demonstrate the levels of hypertension, ADGs, and associated costs.

Patient 1: Low Cost Patient with Hypertension

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 56/Male	ACG-4100: 2-3 Other ADG Combinations, age > 35	Total Cost: $318 Ambulatory visits: 2 >1 Hospitalization: N
Conditions: Hypertension, Disorders of lipid metabolism, Glaucoma, and Bursitis/synovitis	ADGs: 07, 10, and 18. Likely to Recur: Discrete, Chronic Medical: Stable, and Chronic Specialty: Unstable Eye	

Patient 2: High Cost Patient with Hypertension

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 53/Male	ACG-4430: 4-5 Other ADG Combinations, Age >45, 2 +Majors	Total Cost: $1,968 Ambulatory visits: 7 >1 Hospitalization: N
Conditions: Hypertension, General medical exam, Cardiovascular symptoms; Ischemic heart disease, Disorders of lipid metabolism, Debility/fatigue, Cerobrovascular disease, Arthralgia, and Bursitis/synovitis	ADGS: 01, 09*, 10, 11*, 27, and 31. Time Limited: Minor, Likely to Recur: Progressive, Chronic Medical: Stable, Chronic Medical: Unstable, Signs/Symptoms: Uncertain and Prevention/Administrative	

*Major ADG, all ages

Patient 3: Very High Cost Patient with Hypertension

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 47/Male	ACG- 4920: 6-9 Other ADGs Combination, Age >35, 2 Majors	Total Cost: $16,960 Ambulatory visits: 22 >1 Hospitalization: Y
Conditions: Hypertension, General medical exam, Ischemic heart disease, Congenital heart disease, Cardiac valve disorders, Gastrointestinal signs/ symptoms, Diverticular disease of colon, Chest pain, and Lower back pain	ADGs: 07, 09*, 11*, 27, 28, and 31. Likely to Recur: Discrete, Likely to Recur: Progressive, Chronic Medical: Stable, Chronic Medical: Unstable, Signs/Symptoms: Uncertain, Signs/Symptoms: Major, and Prevention/Administrative	

*Major ADG, all ages

Example 2: Diabetes Mellitus

The following patient types demonstrate the levels of diabetes mellitus, ADGs, and associated costs.

Patient 1: Low Cost Patient with Diabetes

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 57/Female	ACG-0900: Chronic Medical, Stable	Total Cost: $418 Ambulatory visits: 3 >1 Hospitalization: N
Conditions: Diabetes mellitus and General medical exam	ADGs: 10 and 32. Chronic Medical: Stable and Prevention/Administrative	

3-36

3-36

Patient 2: High Cost Patient with Diabetes

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 54/Female	ACG-4930: 6-9 Other ADG Combinations, age >35, 3 Major	Total Cost: $2,122 Ambulatory visits: 16 >1 Hospitalization: N
Conditions: Diabetes mellitus, General medical exam, Congestive heart failure, Thrombophlebitis, contusions and abrasions, Non-fungal infections of skin, disease of nail, Chest pain, Vertiginous syndromes, Fibrositismyalgia, Respiratory signs/symptoms, and cough	ADGs: 01, 04*, 09*, 10, 11*, 21, 27, 28, and 31. Time Limited: Minor, Time Limited: Major Primary Infection, Likely to Recur: Progressive, Chronic Medical: Stable, Chronic Medical: Unstable, Injuries/Adverse	

*Major ADG, all ages

Patient 3: Very High Cost Patient with Diabetes

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 38/Female	ACG-5060: 10 + Other ADG Combination, age >17, 3 Majors	Total Cost: $12,944 Ambulatory visits: 14 >1 Hospitalization: Y
Conditions: Diabetes mellitus, General medical exam, Cardiovascular symptoms, Cardiac arrhythmia, Sinusitis, Abdominal pain, Anorectal conditions, Benign/unspecified neoplasm, Otitis media, Cholelithiasis, Cholecystitis, Acute lower respiratory	ADGs: 01, 02, 03*, 06, 07, 08, 09*, 10, 11*, 27, 28, 29, 30, and 31. Time Limited: Minor, Time Limited: Minor- Primary Infections, Time Limited: Major, Asthma, Likely to Recur: Discrete, Likely to Recur: Discrete-Infections, Likely to Recur: Progressive, Chronic Medical: Stable, Chronic Medical: Unstable, Signs/Symptoms: Uncertain, Signs/ Symptoms: Major, Discretionary, See/ Reassure, and Prevention/Administrative	

*Major ADG, all ages

Pregnancy

Using diagnosis codes for pregnancy, the ACG system identifies all women who were pregnant during the assessment period and places them into the pregnancy MAC. ACGs are formed based on (1) total number of ADGs, (2) presence of "complications" (i.e., presence of a major ADG), and (3) whether the woman delivered (the user may override this default level of assignment).

Example 3 shows how the ACG System groups women with a complicated pregnancy/delivery. Both women in the example had ICD-9-CM codes that map to ADG-03 (an acute major morbidity). The salient difference between the two that explains the difference in resource consumption is that Patient #2 had a greater number of ADGs and more major ADGs and thus fits into a more resource intensive ACG. That is, Patient #2 had a higher level of morbidity than #1, even though both women experienced a complicated pregnancy/delivery.

Table 7 presents an alternative clinical categorization of the pregnancy/delivery ACGs. Three dimensions are used to classify the ACGs – number of ADGs, presence of major ADGs, and whether the women delivered during the assessment period. Resource consumption increases along each of the three axes: presence of delivery, presence of a major ADG, and number of ADGs. Using various combinations of these ACGs, a clinician or manager can determine the proportion of women with complicated pregnancies and deliveries overall, and with different levels of morbidity. The need for specialty services will be greatest for those women with higher levels of morbidity and complications as defined by presence of a major ADG.

Example 3: Pregnancy/Delivery with Complications

The following patient types demonstrate the levels of pregnancy and delivery with complications, ADGs, and associated costs.

Patient 1: Pregnancy/Delivery with Complications, Low Morbidity

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 32/Female	ACG-1731: 2-3 ADGs, 1+ Major ADGs, Delivered	Total Cost: $8,109 Ambulatory visits: N/A >1 Hospitalization: Y
Conditions: General medical exam, Pregnancy and delivery - uncomplicated and Pregnancy and delivery - with complications.	ADGs: 03*, 28, 31, and 33. Time Limited: Major, Signs/Symptoms: Major, Prevention/ Administrative, and Pregnancy	

*Major ADG, all ages

Patient 2: Pregnancy/Delivery with Complications, High Morbidity

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 36/Female	ACG-1771: 6+ ADGs, 1+ Major ADGs, Delivered	Total Cost: $10,859 Ambulatory visits: N/A >1 Hospitalization: Y
Conditions: General medical exam, Dermatitis and eczema, Benign and unspecified neoplasm, Urinary tract infection, Multiple sclerosis, Pregnancy & delivery-uncomplicated, and Pregancy & delivery-with complications.	ADGs: 01, 03*, 08, 10, 11, 26, 28, 31, and 33. Time Limited: Minor, Time Limited: Major, Likely to recur: discrete-infections, Chronic Medical: Stable, Chronic Medical: Unstable, Signs/Symptoms: Major, Prevention/ Administrative, and Pregnancy	

*Major ADG, all ages

Table 7: Clinical Classification of Pregnancy/Delivery ACGs

ACG Levels	Pregnancy Only		Delivered	
Morbidity Level	Uncomplicated (No Major ADGs)	Complicated (1+ Major ADGs)	Uncomplicated (No Major ADGs)	Complicated (1+ Major ADGs)
Low (1-3 ADGs)	1712, 1722	1732	1711, 1721	1731
Mid (4-5 ADGs)	1742	1752	1741	1751
High (6+ ADGs)	1762	1772	1761	1771

Infants

The ACG System places all infants into an infant MAC. By definition, all had at least one hospitalization (at time of delivery). ACG groups are formed based on total number of ADGs and the presence of a complication or major ADG. **Table 8** provides a clinical classification of the four infant ACGs. Example 4 compares an infant in the low morbidity/no complications ACG (5310, the most frequent infant ACG) with an infant in the higher morbidity/with complications ACG (5340, the most resource intensive infant ACG). Infant #1 had a typical course: a hospitalization at birth, routine check-ups, and illness management for upper respiratory tract infection and otitis media. Infant 2 presents a completely different picture in terms of pattern of morbidity and resource consumption, both of which are substantially greater in comparison with Infant 1.

Example 4: Infants

The following patient types demonstrate the levels of infants with complications, ADGs, and associated costs.

Patient 1: Infant With Low Morbidity, No Complications

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 0/Female	ACG 5310: 0-5 ADGs, No Major ADGs	Total Cost: $1,842 Ambulatory visits: 4
Conditions: General medical exam, Otitis media and Acute upper respiratory tract infection.	ADGs: 02, 08 and 31 Time Limited: Minor, Likely to Recur: Discrete-Infections, And Prevention/Administration	>1 Hospitalization: Y

Patient 2: Infant With High Morbidity, No Complications

Input Data/Patient Characteristics	ACG Output	Resource Consumption Variables
Age/Sex: 0/Male	ACG 5340: 6+ ADGs, 1+ Major ADGs	Total Cost: $18,703 Ambulatory visits: 19
Conditions: General medical exam, Cardiovascular symptoms, Dermatitis and eczema, Otitis media, Fluid/ electrolyte disturbance, Diarrhea, Abdominal pain, Nausea, vomiting, Acute upper respiratory tract infection, and Acute lower respiratory tract infection	ADGs: 01, 02, 03*, 08, 11*, 13, 26, 27, 28, 29, and 31 Time Limited: Minor, Time Limited: Minor - Primary Infections, Time Limited: Major, Likely to Recur: Discrete- Infections, Chronic Medical: Unstable, Chronic Specialty: Stable - ENT, Signs/Symptoms: Minor, Signs/Symptoms: Uncertain, Signs/Symptoms: Major, Discretionary, and Prevention/Administrative	>1 Hospitalization: Y

*Major ADG, all ages

Table 8: Clinical Classification of Infant ACGs

Morbidity Level	No Complications (No Major ADGs)	Complication (1+ Major ADGs)
Low (0-5 ADGs)	5310	5320
Mid (6+ ADGs)	5330	5340

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