VIReC

INSIGHTS

Vol. 4 | Number 1 | Spring 2003

VIReC Insights is intended to provide VA researchers with a starting point for understanding concepts in data management and basic information about health related databases.

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HIPPA: Implications for Health Services Research

Vol. 4 | Number 2 | Summer 2003

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The Johns Hopkins Adjusted Clinical Groups (ACGs) Case-Mix System: A Risk-Adjustment Methodology Currently Available at the VA Austin Automation Center

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Introduction

The Johns Hopkins Case-Mix System, Adjusted Clinical Groups (ACGs), is a computerized grouper software system that uses age, gender, and diagnoses generated from patient encounters over a one-year time period to describe the medical problems of patients and their likely effect on health care resource consumption.[1] Thus, the ACGs are a series of mutually exclusive, health status categories that are defined by age, gender, and morbidity. The basic premise behind the ACG approach is that the level of resources necessary for delivering appropriate health care to a population is correlated with the "illness burden" of the population. The ACG case-mix system is currently used by over 200 organizations worldwide for a range of applications, including concurrent and prospective payments, provider profiling, resource allocation, utilization review/case management, and quality improvement.[2-4]

A recently reported study[5] examined the validity and feasibility of applying the ACG case-mix system to the veteran population. Findings suggested that the ACGs provide a significant opportunity to implement a risk-adjustment method that is adequate in capturing the illness burden of the VA population. The investigators concluded that ACGs hold much promise for researchers and administrators interested in using clinical and administrative databases for describing the case-mix across VA populations. Based on these results, the VA initiated a workgroup that was charged with the task of implementing the ACG case-mix system for use in the VA. Subsequently, the workgroup constructed two SAS datasets using the most current ACG software (version 5.0) for patients with records in the VHA Medical SAS Inpatient and Outpatient Datasets for fiscal years (FY) 2000 and 2001. One of the new datasets contains both ACGs and Aggregated Diagnostic Groups (ADGs) (a set of smaller diagnostic groupings), while the second new dataset contains a disease-based grouping called Expanded Diagnosis Clusters (EDCs). These datasets are warehoused at the Austin Automation Center (AAC) and are now available to authorized AAC users.

In this issue of *VIReC Insights*, we describe the importance of risk adjustment in the VA, provide an overview of the ACG system, introduce the EDCs, and provide examples from VA research studies that have applied ACGs. We conclude with a detailed overview of the two SAS datasets currently available at the AAC.

Risk Adjustment and Its Importance to the VA

Risk adjustment is a way of "leveling the playing field," or accounting for factors that patients bring to health care encounters that can affect their outcomes.[6] Risk-adjustment methods are considered fundamental tools for measuring patient/population illness severity and disease burden. Risk adjustment establishes a starting point for comparing resource needs, provider performance, treatment effectiveness, or provider payments. Without risk adjustment, it would be impossible to determine how effective a specific treatment is, because it would not be clear if an observed improvement in outcomes reflects better treatment or simply healthier patients.

The VA population contains a high proportion of patients with multiple medical and psychiatric comorbidities (i.e., VA patients have a higher case-mix than the average population). Risk adjustment is particularly critical for the VA because it helps eliminate underlying differences in population case-mix that may affect comparisons of providers, resource allocation, or quality of care assessments. For example, risk-adjusted outcomes (e.g., volume, cost, length of stay) are necessary in comparing performance across VA facilities or VISNs. Accounting for the disease burden of a population helps ensure that providers who manage patients with a higher disease burden than average receive adequate payment for the care of these patients. Applying risk-adjustment methods will allow the VA to establish more equitable and accurate performance measures for providers, VISNs, and facilities.[7]

Development History and Applications of the ACG Case-Mix System

The ACG Case-Mix System is a diagnosis-based risk-adjustment methodology that was initially developed in the 1980s by Dr. Barbara Starfield and Dr. Jonathan Weiner at Johns Hopkins University (JHU) to examine the relationship between morbidity or "illness burden" and health care services utilization among children in managed care settings.[8-9] This research was useful in supporting the ACG team's hypothesis that a patient's illness burden, or "clustering of morbidity," is better than the presence of specific diseases as a predictor of health services resource use.[8] Although ACGs were originally designed to predict the number of ambulatory care visits in a one-year period in selected health maintenance organizations (HMOs) and the Maryland Medicaid population, their use has expanded considerably since their introduction in 1991. ACGs are currently used to explain and predict total resource use over a specific period of time, generally one year, based on both inpatient and outpatient diagnosis codes in all populations.[6, 10] ACGs require readily available information derived from inpatient and outpatient claims records or encounter data.

Typical applications of the ACG methodology include provider profiling (comparing the utilization and services of health care providers), quality improvement analysis (evaluating disease-specific process or outcome measures), capitation payment (setting payments based on patient case-mix), and outcomes management (comparing clinical outcomes across providers). The most recent application of ACGs is prospective identification of patients with special needs so that these patients, who typically suffer from multiple chronic conditions, can be placed in case management programs, which will help to ensure the quality of their care and promote better coordination of care. More information about these applications is available on the Johns Hopkins University ACG Case-Mix System Web site.[2]

Diagnostic Grouping Methodology

The ACG methodology allows health care providers, insurers, and HMOs to describe or predict a population's past or future health care utilization and cost. The ACG case-mix system is "person-focused," capturing the multidimensional nature of an individual's health over time. Unlike other systems, ACGs categorize individuals, rather than procedures, visits, or discrete episodes, as a unit of analysis.

Four steps are necessary in constructing ACGs, and these are summarized in Figure 1 on the following page and explained below.

The current ACG system (Version 5.0) first assigns all inpatient and outpatient ICD-9-CM diagnostic codes to one of 32 diagnosis groups, known as ADGs, based on five clinical dimensions:

- **Duration** of the condition (acute, recurrent, or chronic)
- **Severity** of the condition (minor/stable versus major/unstable)
- **Diagnostic certainty** (symptoms versus diseases)
- **Etiology** of the condition (infectious, injury, or other)
- **Specialty care** (medical, surgical, obstetrics, hematology, etc.)

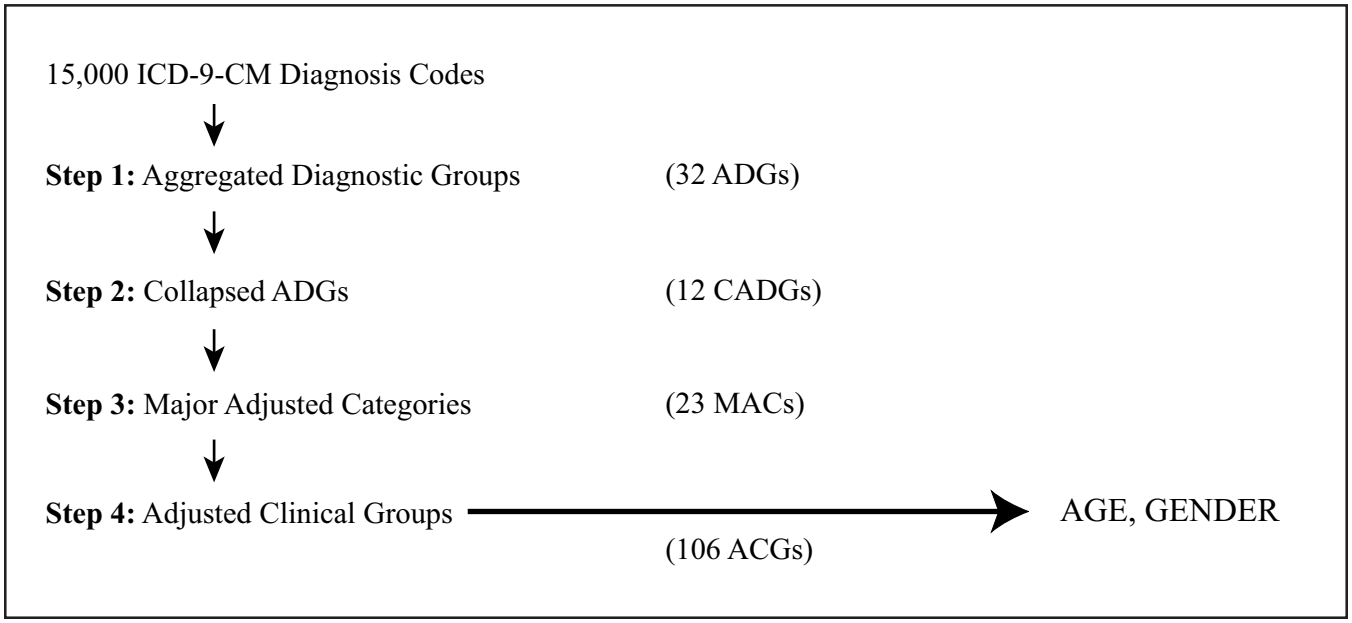

FIG. 1. ACG assignment process.

All diseases can be classified along these dimensions and categorized into one of these 32 groups. Each ADG, therefore, contains diagnoses that are similar with respect to severity and likelihood of persistence of the condition over a certain period of time. An individual will be assigned to all ADGs associated with his or her diagnoses. Examples of ADGs include "Time Limited: Minor," including conditions such as dermatitis, and "Chronic Medical: Stable," including conditions such as hypertension and diabetes. Some ADGs, such as "Time Limited: Major" and Chronic Medical Unstable," are considered "Major ADGs" because they have expected high resource use. Table 1 (below) presents a complete list of the ADGs with examples of ICD-9-CM codes that are included in them.

TABLE 1. ADGs and Common ICD-9-CM Codes Assigned to Each ADG

ADG		ICD-9-CM Diagnostic Code	
1	Time Limited: Minor	558.9 691.0	Noninfectious Gastroententris Diaper or Napkin Rash
2	Time Limited: Minor-Primary Infections	079.9 464.4	Unspecified Viral Infection Croup
3	Time Limited: Major*	451.2 560.3	Phlebitis of Lower Extremeties Impaction of Intestine
4	Time Limited: Major-Primary Infections*	573.3 711.0	Hepatitis, Unspecified Pyogenic Arthritis
5	Allergies	477.9 708.9	Allergic Rhinitis, Cause Unspecified Unspecified Urticaria
6	Asthma	493.0 493.1	Extrinsic Asthma Intrinsic Asthma

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TABLE 1 *cont.*

ADG	ICD-9-CM Diagnostic Code	
7 Likely to Recur: Discrete	274.9 724.5	Gout, Unspecified Backache, Unspecified
8 Likely to Recur: Discrete-Infections	474.0 599.0	Chronic Tonsillitis Urinary Tract Infection
9 Likely to Recur: Progressive*	250.10 434.0	Adult Onset Type II Diabetes w/ Ketoacidosis Cerebral Thrombosis
10 Chronic Medical: Stable	250.0 401.9	Adult Onset Type I Diabetes Essential Hypertension
11 Chronic Medical: Unstable*	282.6 277.0	Sickle-Cell Anemia Cystic Fibrosis
12 Chronic Specialty: Stable-Orthopedic	721.0 718.8	Cervical Sponsylosis Without Myelopathy Other joint Derangement
13 Chronic Specialty: Stable-Ear, Nose, Throat	389.4 385.3	Central Hearing loss Cholesteatoma
14 Specialty: Stable-Eye	367.1 372.9	Myopia Unspecified Disorder of Conjunctiva
15 No Longer in Use		
16 Chronic Specialty: Unstable-Ear, Nose, Throat*	724.02 732.7	Spinal Stenosis of Lumbar Region Osteochodritis Dissecans
17 Chronic Specialty: Unstable-Ear, Nose, Throat	383.1 386.0	Chronic Mastoiditis Meniere's Disease
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	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, Unstable	300.01 307.51	Panic Disorder Bulimia
25 Psychological: Recurrent or Persistent, Unstable*	295.2 291.0	Catatonic Schizophrenia Alcohol Withdrawal Delirium Tremens

cont. page 5

TABLE 1 *cont.*

ADG	ICD-9-CM Diagnostic Code
26 Signs/Symptoms: Minor	784.0 Headache 729.5 Pain in Limb
27 Signs/Symptoms: Uncertain	719.06 Effusion of Lower Leg Joint 780.7 Malaise and Fatigue
28 Signs/Symptoms: Major	429.3 Cardiomegaly 780.2 Syncope and Collapse
29 Discretionary	550.9 Inguinal Hernia (NOS) 706.2 Sebaceous Cyst
30 See and Reassure	611.1 Hypertrophy of Breast 278.1 Localized Adiposity
31 Prevention/Administrative	V20.0 Routine Infant or Child Health Check V72.3 Gynecological Examination
32 Malignancy*	174.9 Malignant Neoplasm of Breast (NOS) 201.9 Hodgkin's Disease, Unspecified Type
33 Pregnancy	V22.2 Pregnant State 650.0 Delivery in a Completely Normal Case
34 Dental	521.0 Dental Caries 523.1 Chronic Gingivitis

Note: only 32 of the 34 markers are currently in use (ACG Manual 2001, p. 24). ADGs that are starred are considered major ADGS.

Similar ADGs are grouped into 12 Collapsed ADGs (CADGs) that are analogous with regard to the likelihood of persistence or occurrence of diagnoses within each ADG, severity of the condition, and type of health care needed. This is done to create a more manageable number of groupings. Then, combinations of the most frequently occurring CADGs are combined into 1 of 23 Major Adjusted Categories (MACs). Finally, MACs are subdivided into mutually exclusive ACGs ("morbidity clusters") based on a patient's age, gender, total number of ADGs, number of major ADGs, and presence of specific ADGs. [11-14]

Thus, the ACG approach assigns each individual to a single, mutually exclusive group (an "ACG") which permits the clustering of morbidities to be captured in similar estimates of resource use. Consider, for example, an individual with three conditions: diabetes, hypertension, and diabetes with renal complications. This person would fall into ADG 10, "Chronic Medical: Stable" (for the diabetes and hypertension), and ADG 9, "Likely to Recur: Progressive" (for diabetes with renal complications). This classification would lead to CADG 6, "Chronic Medical: Stable," and CADG 5, "Chronic Medical: Unstable." The individual then is classified in MAC 24, "Multiple ADG Categories," and finally to ACG 4100, "2-3 Other ADG Combinations, Age > 34." A more detailed description of the ACG and ADG categories can be found in the ACG Manual.[14]

Expanded Diagnosis Cluster (EDCs)

With Version 5.0 of the ACG software, the JHU team introduced a new concept, a disease marker tool called the Expanded Diagnosis Clusters (EDCs) or "Dino-Clusters." Dino-Clusters group ICD-9-CM codes at the person level into clinically-oriented diagnostic categories called EDCs.[2] EDCs, developed on both pediatric and adult populations, are useful in identifying people with specific diseases and symptoms.[14] EDCs were designed to complement the ACGs for certain case management or profiling applications, but they can also be used as a stand-alone tool to compare the distribution of conditions between two populations.

TABLE 2: The MEDC-Types and MEDCs

MEDC-Type	MEDCs
Administrative	Administrative
Medical	Allergy, Cardiovascular, Development, Endocrine, Gastrointestinal/Hepatic, Genetic, General Signs and Symptoms, Hematologic, Infections, Malignancies, Neurologic, Nutrition, Renal, Respiratory, Rheumatologic, Skin, Toxic Effects
Surgical	Dental, ENT, Eye, General Surgery, Genito-urinary, Musculoskeletal, Reconstructive
Obstetric/Gynecologic	Female Reproductive
Psychosocial	Psychosocial

ACG Manual 2001, P.247

The first step in creating EDCs is to assign approximately 9,400 ICD-9-CM diagnosis codes to one of 190 EDCs based on similar clinical characteristics. Each of the ICD-9-CM codes maps into a single EDC. Next, each EDC is placed into one of 27 broad clinical categories termed "Major EDCs" (MEDCs). For example, the two EDCs "Chronic Renal Failure" and "Fluid/Electrolyte Disturbances" fall within the Renal MEDC. The EDCs can also be examined at a broader level; the 27 MEDCs may be aggregated into five MEDC-Types including administrative, medical, surgical, obstetric/gynecologic, and psychosocial. Table 2 presents a list of the five MEDC-Types that includes the 27 MEDCs.[14] A detailed list of EDC categories can be found on the JHU ACG® Case-Mix System website.[2]

Example of Applications of ACGs from VA Research

In previous studies, ACGs have been shown to perform moderately well in the VA population. One study examining the feasibility of adapting ACGs to the VA showed that VA data are adequate for running the ACG software and have the necessary data elements for clinical grouping.[15] The authors also found that all patients could be classified into an ACG (although a small percent of ICD-9-CM codes were not classifiable), and that the average number of ADGs per patient was 4.9. Model R-squares explained from 11% to 25% of the variation in service utilization. These R-squares were, however, lower than those reported by the ACG case-mix system, where R-squares for concurrent modeling of annual visit rates and costs explained from 36.6% to 42.3% of variation in service utilization for ACGs and 33.6% to 38.7% for ADGs [14]. In addition, the ACGs performed more poorly in explaining service utilization in the VA than the Diagnostic Cost Groups (DCGs), another case-mix system; in both concurrent and prospective modeling, R-squares obtained by the DCGs were slightly higher depending upon the outcome being measured (e.g., in predicting service days, R-squares for ACGs and DCGs were 23% and 31%, respectively).

Another study conducted in the VA examined whether two different outcome measures, days of care and average costs, resulted in different assessments of efficiency across the 22 service networks (VISNs) after adjusting for patient case-mix using ACGs.[16] The authors found that assessments of individual network efficiency differed between unadjusted and adjusted rates. There also was some disagreement between the two outcomes on which networks appeared efficient. Thus, assessments of provider efficiency depended upon both the outcome measure and whether case-mix adjustment was used, an important finding that will help to ensure more equitable comparisons across providers.

TABLE 3: VA Encounters and Clinic Stops

Type of Encounters	Clinic Stop Codes*
Pulmonary function	104
X-ray	105
EEG	106
EKG	107
Laboratory	108
Nuclear medicine	109
Ultrasound	115
Evoked potential	126
Pharmacological physiology	145
Computer tomography (CT)	150
Magnetic resonance imaging (MRI)	151
Dental	180
EMG	212
Telephone	103, 147, 148, 169, 178, 181, 216, 324, 325, 326, 424, 425, 428, 526, 527, 528, 530, 536, 537, 542, 543, 544, 545, 546, 579, 611, 729
Local Facility Clinic Stops	451, 452, 453, 454, 455, 461, 464, 465, 472, 475

*Also termed "DSS Identifiers"

SAS Datasets at AAC

The ACG files residing at AAC consist of several datasets for FY 2000 and FY2001: the ACG/ADG dataset and the EDC dataset. These datasets were created by applying the ACG software to VA data. Two ASCII files were initially used to create these ACG datasets. The first ASCII file included a unique patient ID (i.e., scrambled Social Security Number), age, and gender information. The second ASCII file included the same unique patient ID in addition to all ICD-9-CM diagnosis codes from the year of interest. The two files were then processed through the ACG software. The output created by the software includes both ACG/ADG and EDC information, as well as summary information, and the distribution of ACG/ADG categories. Therefore, users *do not need to* create the ACGs by the above process because they have already been created. These datasets can be used "off the shelf."

The datasets housed at the AAC contain information on all patients that used the VA health care system during this time period (including non-veterans). The datasets, however, exclude "rule out" diagnoses (i.e., diagnoses obtained from lab, x-ray, and other ancillary visits) in order to reduce the presence of potentially erroneous diagnoses. Table 3 (above) presents all the clinic stops (now termed "DSS Identifiers") that were used to exclude diagnoses. In the next section, we explain the contents of these two datasets in more detail.

ACG/ADG Dataset:

The ACG/ADG dataset name is **MDPPRD.MDP.SAS.ACG.FYXX.ACGASMT** (XX= 00 or 01). The names and types of variables in this dataset can be found in Table 4 on the following page. The sort order is by scrambled Social Security Number (SCRSSN). There is one observation per patient. Patients can have multiple ADG classifications, but only one ACG classification.

TABLE 4: Alphabetical Listing of Variables in the ACG/ADG Dataset

Name	Type of Variable	Name	Type of Variable
ACG	Character: 82 Categories	ADG20	Number: 1 or 0
ADG01	Number: 1 or 0	ADG21	Number: 1 or 0
ADG02	Number: 1 or 0	ADG22	Number: 1 or 0
ADG03	Number: 1 or 0	ADG23	Number: 1 or 0
ADG04	Number: 1 or 0	ADG24	Number: 1 or 0
ADG05	Number: 1 or 0	ADG25	Number: 1 or 0
ADG06	Number: 1 or 0	ADG26	Number: 1 or 0
ADG07	Number: 1 or 0	ADG27	Number: 1 or 0
ADG08	Number: 1 or 0	ADG28	Number: 1 or 0
ADG09	Number: 1 or 0	ADG29	Number: 1 or 0
ADG10	Number: 1 or 0	ADG30	Number: 1 or 0
ADG11	Number: 1 or 0	ADG31	Number: 1 or 0
ADG12	Number: 1 or 0	ADG32	Number: 1 or 0
ADG13	Number: 1 or 0	ADG33	Number: 1 or 0
ADG14	Number: 1 or 0	ADG34	Number: 1 or 0
ADG15	Number: 1 or 0	AGE: Age in FY2001	Number
ADG16	Number: 1 or 0	PSEUDO: Pseudo SSN	Character: Yes or No
ADG17	Number: 1 or 0	SCRSSN: Scrambled	Number
ADG18	Number: 1 or 0	Social Security Number	
ADG19	Number: 1 or 0	SEX: Gender	Character: F or M

EDC Dataset:

The EDC dataset name is **MDPPRD.MDP.SAS.ACG.FYXX.EDC** (XX=00 or 01). This data set contains two variables: SCRSSN and EDC (Table 5); records are sorted by SCRSSN. This dataset contains each assigned EDC for every patient in the Medical SAS inpatient and outpatient datasets. Since each patient can fall into more than one EDC group, there can be multiple observations per patient. For example, a patient may be assigned to EDC CAR02 (Hypertension), CGU02 (Appendicitis), and END01 (Diabetes Mellitus). As a result, this patient will have three records in the EDC dataset.

To access the files, one must be an authorized AAC user with a Functional Task Code granting access to the Medical SAS Datasets. This can be obtained by submitting VA form 9957 for approval. For more information on obtaining authorization to access datasets located at the AAC, please refer to a past issue of *VIREC Insights* about accessing AAC files.[17]

TABLE 5: Alphabetical Listing of Variables in the EDC Dataset

Name	Description	Type of Variable
EDC	Dino-Cluster	Character: 190 Categories
PSEUDO	Pseudo SSN	Character: Yes or No
SCRSSN	Scrambled Social Security Number	Number

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Suggested Citiation:
Rosen A, Trivedi P, Amuan M, & Montez M. The Johns Hopkins Adjusted Clinical Groups (ACGs) Case-Mix System: A R-adjustment Methodology Currently Available at the VA Austin Automation Center. *VIReC Insights* Vol. 4, No. 1. Hines, IL: VA Information Resource Center, 2003. Available at http://virec.research.va.gov. Accessed [date].

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