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The research reported here represents the current stage of development of the Diagnosis-Related Groups. The initial work on the approach and associated technology for patient classification began nearly a decade ago. Significant contributions were made during the course of this research by Donald C. Riedel, Ronald E. Mills, Lesley Mills and Phyllis Pallett.

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1. Introduction

THE MAJOR FUNCTION of a hospital as an acute-care inpatient facility is to provide the diagnostic and therapeutic services required by physicians in the clinical management of their patients. In addition, the hospital also makes available certain hotel and social services such as meals, laundry and counseling, to patients while they are residents at the institution. Considered as an economic entity, the hospital's outputs are the specific services it provides in terms of hours of nursing care, medications and laboratory tests. Its inputs are the labor, material and equipment used in the provision of these services. Each patient receives a specific set of outputs or services which is referred to here as a product of the hospital.

For example, consider a patient under treatment for uncomplicated pneumonia. His hospital stay may last 6 days. Depending on his treatment process, he could receive several chest roentgenograms, a sputum Gram stain and culture, a blood culture, several complete blood counts, a urinalysis, routine blood chemistries, 2 days of oxygen therapy, 2 days of IV fluids, 2 days of IV penicillin followed by 4 days of IM penicillin and a supply of oral penicillin to be taken at home. During his stay, he will also require various amounts and levels of nursing care. This set of outputs constitutes a product ordered by the physician and provided by the hospital to the patient in addition to meals and other hotel services. Each department within the facility consumes a certain amount of inputs in terms of standard labor, material and overhead, depending on the output produced. For the radiology department, this would include the films, the technician time, and a portion of the departmental overhead expenses for the equipment and space utilized in the production of the various types of roentgenograms.

Since individual patients receive different amounts and types of services, the hospital may be viewed as a multiproduct firm with a product line that in theory is as extensive as the number of patients it serves. The particular product provided each patient is dependent upon his condition as well as the treatment process he undergoes during his stay. For example, in most instances an ulcer patient with a major surgical procedure such as an exploratory laparotomy or gastric resection requires more units of physician and nursing time, more medication, more ancillary services and remains hospitalized at least 10 days longer than a woman admitted for a normal delivery. The former case is generally referred to as more complex since it receives more of the institution's outputs in terms of nursing time, meals, laboratory tests, and special services than the latter case. During any specified time period, an institution admits and discharges a variety of cases representing different levels of complexity. The relative proportions of the different types of cases the hospital treats are collectively referred to as its case mix.

Historically, patient-days of care and the number of admissions or discharges have been used to describe hospital output while cost per patient-day, per cent occupancy and mortality rate have been used to evaluate hospital performance. Such aggregate measures presented out of context of the types of cases treated by an institution and their relative complexity is not particularly useful information to hospital management for internal assessment of efficiency and effectiveness nor to reg-

ulatory agencies for inter-institutional comparisons. In particular, the outcome and cost of the individual patient care processes that give rise to the hospital products cannot be adequately determined. As a consequence, administrators and clinicians cannot ascertain the quality and cost implications of the treatment plans practiced within the insitution nor can regulators assess the impact of alternative methods across institutions.

In order to evaluate, compare, and provide relevant feedback regarding hospital performance, it is necessary to identify the specific products that institutions provide. As defined above, a hospital product is a set of services provided to a patient as part of the treatment process controlled by his clinician. While each individual patient admitted to an institution is unique, he has certain demographic, diagnostic and therapeutic attributes in common with other patients that determine the type and level of services he receives. If these classes of patients with the same clinical attributes and similar processes of care can be identified, then the framework within which to aggregate patients into case types is established. Moreover, if these classes cover the entire range of inpatients in the acute-care setting, then collectively they constitute a classification scheme that provides a means for examining the products of the hospital, since patients within each class are expected to receive a similar product.

The means of defining hospital case mix for this purpose is the construction and application of a classification scheme comprised of subgroups of patients possessing similar clinical attributes and output utilization patterns. This involves relating the demographic, diagnostic and therapeutic characteristics of patients to the output they are provided so that cases are differentiated by only those variables related to the condition of the patient (e.g., age, primary diagnosis) and treatment process (e.g., operations) that affect his utilization of the hospital's facilities. These groups or patient classes may then be useful for certain applications in patient care monitoring, budgeting, cost control, reimbursement and planning.

Various definitions of case mix and measures of case mix complexity have been proposed and applied by a number of researchers.[3,15,17,18,22] The most frequently applied definition of case mix is based on a patient's primary diagnosis. Primary diagnoses are recorded using either of 2 coding schemes—the International Classification of Diseases, Adapted for Use in the United States, Eighth Revision (ICDA8) and the Hospital Adaptation of ICDA, Second Edition (HICDA2).[6,13*] These coding schemes provide a classification of conditions of morbidity and mortality for statistical reporting purposes as well as for information retrieval. Four-digit codes are assigned to diagnoses (3-digit major category descriptor and a fourth-digit modifier) and 3-digit codes to surgical procedures (2-digit major category descriptor and a third-digit modifier).

While partitioning into groups based on diagnosis or ranges of diagnoses alone has benefits in terms of uniform reporting of descriptive statistics about a population, it is not sufficient for defining cases with respect to output utilization. Other variables such as surgical procedures and age of patient in conjunction with diagnosis are necessary to describe adequately sets of patients with similar utilization patterns of inpatient facilities. For example, in one institution examined, it was determined that patients with a primary diagnosis in the general category Gastric and Peptic Ulcer (ICDA8 codes 531–5349) with no surgery or complicating secondary diagnoses were hospitalized on the average 6 days while those with a minor surgical procedure such as endoscopy stayed 12 days, and those

* The 9th Revision, International Classification of Diseases, Clinical Modification (ICD-9-CM) was implemented as of January 1, 1979.

with a major surgical procedure and multiple diagnoses stayed 21 days. Moreover, the first and second sets of patients incurred only 13 and 30 per cent, respectively, of the costs incurred by the latter. Thus, the type of surgery performed and the presence or type of secondary diagnosis make a considerable difference in the hospital product provided to the patient. For this reason, patient case types determined solely by primary diagnosis is not acceptable for use in defining hospital case mix, since it is not precise enough to account for either the condition of the patient or the complexity of the treatment protocol.

Another patient classification scheme in wide use is that developed by the Professional Activity Study (PAS) of the Commission on Professional and Hospital Activities (CPHA), which publishes tables of length-of-stay statistics based on data from participating hospitals.[7] These tables present summaries on the basis of primary diagnosis, the presence of additional diagnoses, the presence of any surgeries, and age. Specifically, the PAS classification divides all possible primary diagnoses into 349 mutually exclusive major diagnostic categories. Each of these major diagnostic categories is then divided on the presence or absence of a secondary diagnosis, presence or absence of any surgery and 5 age categories (0–19, 20–34, 35–49, 50–64, 65+).† This results in 20 subcategories for each of the 349 major diagnostic categories for a total of nearly 7,000 patient classes. The information is currently used extensively by Professional Standards Review Organizations (PSROs) in setting length-of-stay checkpoints as part of their concurrent review process.

Although the PAS scheme takes into account additional patient attributes such as secondary diagnosis, age and information related to the treatment process, such as operation status, these attributes still may be insufficient in certain instances to describe adequately a case in terms of output utilization. Refer to the example described above where the specific type of operation differentiated one set of surgical ulcer patients from another. Thus, because of its uniform structure throughout all 349 diagnosis groups, the PAS scheme tends to overspecify in some diagnostic categories where the extra variables may not be particularly relevant as regards utilization of facilities and underspecify in others where more precise information is required.

As an alternative patient classification scheme, the Diagnosis-Related Groups (DRGs) have been constructed, based on a procedure referred to as the significant attribute method. The fundamental purpose of the DRG approach is to identify in the hospital acute-care setting a set of case types, each representing a class of patients with similar processes of care and a predictable package of services (or product) from an institution. Using this approach, the entire range of diagnostic codes was initially divided into broad disease areas, such as Diseases of the Eye, Diseases of the Ear, Cerebrovascular Diseases, and Infectious Diseases. Each of these categories was further subdivided into groups based on values for those variables that demonstrated an effect in predicting output as measured by length of hospital stay. It was decided to use length of stay (LOS) as opposed to some other output measure since it is an important indicator of utilization, as well as being easily available, well standardized, and reliable. The use of LOS and its relation to other measures is discussed further in the next section. The 383 DRGs that resulted from this process are interpretable from a medical perspective as well as similar with respect to their patterns of length of stay.

This supplement presents a description of the approach implemented to construct the DRGs and a discussion of their application in a number of health care settings. Section 2 provides information regarding

† For major categories 342–349, pertaining exclusively to newborns, birthweight is used in place of age.

the data base, the statistical methodology, and the general process by which the methodology was applied to the data in the formation of the groups. At the end of Section 2 is an example illustrating the procedure, to which readers may initially refer for a general understanding of DRG construction. A discussion of the interpretation and application of the DRGs in utilization review, budgeting, cost control, prospective reimbursement and regional planning is found in Sections 4 through 6.

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2. Construction of Diagnosis-Related Groups

THE PRIMARY OBJECTIVE in the construction of the DRGs was a definition of case types, each of which could be expected to receive similar outputs or services from a hospital. In order that the set of definitions be easily implemented in a wide range of settings as well as meaningful to medical and nonmedical users, it was considered important that the resultant classification scheme have the following attributes:

1. It must be interpretable medically, with subclasses of patients from homogeneous diagnostic categories. That is, when the patient classes are described to physicians, they should be able to relate to these patients and be able to identify a particular patient management process for them.

2. Individual classes should be defined on variables that are commonly available on hospital abstracts and are relevant to output utilization, pertaining to either the condition of the patient or the treatment process.

3. There must be a manageable number of classes, preferably in the hundreds instead of thousands, that are mutually exclusive and exhaustive. That is, they must cover the entire range of possible disease conditions in the acute-care setting, without overlap.

4. The classes should contain patients with similar expected measures of output utilization.

5. Class definitions must be comparable across the different coding schemes.

With respect to point 3, the number of classes considered manageable would clearly depend on the situation in which the patient classes were being applied. Any amount of aggregation involves a trade-off between loss of specificity and ease of review of statistical summaries for comparison purposes. It was decided to construct a set of approximately 500 groups to be used as the basic framework of case types. These could then be further refined or aggregated as needed by investigators depending on the nature of the application.

A number of procedures were tested as potential ways of constructing the groups. Initially, a normative approach was used, which involved having clinicians define case types using values of variables which they felt were important for determining the amount and type of services utilized. There was a tendency for their definitions to include an extensive set of specifications, requiring information which might not always be collected through a hospital's medical information system. If the entire range of patients were classified in this manner, it would ultimately lead to thousands of case types, most of which would describe patients seen infrequently at an institution. It was therefore recognized that the process of case definition would be facilitated if data from acute-care hospitals could be examined to determine the general characteristics and relative frequency of discharges. Also, statistical algorithms would be useful to suggest ways of forming patient classes that are homogeneous with respect to some aggregate output-utilization measure.

This type of approach, requiring the simultaneous inputs of physician judgment, efficient information processing and statistical algorithms, was adopted for the construction of the DRGs. An automated process was developed for screening a large amount of data with the aid of statistical algorithms. Physician review was required to insure that the classes formed by the process were medically meaningful. Length of stay (LOS) was used as the measure of output. While it may not be as accurate an indicator of the level of output as actual costs, it is still an important indicator of utilization as well as being easily available, well standardized and reliable.

The use of LOS as a measure of case complexity has been studied by other researchers. Luke in his work on case mix measurement[19] established the high degree of correlation between LOS and total charges rendered the patient. Lave and Leinhardt found significant correlation between LOS and measures of case mix complexity.[16]

The process of forming the DRGs was begun by partitioning the data base into mutually exclusive and exhaustive primary diagnostic areas, called Major Diagnostic Categories. Each major category was then examined separately and further subdivided into groups based on values of variables suggested by the statistical algorithm. Physician review of these recommended subdivisions often led to modification. Thus, at each stage of the process the subgroups were based both on statistical criteria as well as physician judgment. The precise variables that were included in class definitions varied across the major categories. For example, age was determined to be important in explaining utilization for hernia patients, but not an important factor for gastric ulcer patients. From each Major Diagnostic Category, a number of final patient classes was formed. These final patient classes are the DRGs. A more extensive discussion of the data base, the statistical algorithm, and the general strategy used in constructing the DRGs is presented in the following subsections.

2.1 Data Base

The data base used to construct the scheme contained approximately 500,000 hospital records from 118 institutions in New Jersey, 150,000 records from 1 Connecticut hospital and 52,000 records of federally funded patients from 50 institutions in a PSRO region. These records contained demographic information about each patient (e.g. sex, age) as well as clinical and diagnostic information related to his hospital stay (e.g. problems/diagnoses, surgical procedures, special services used).

Diagnostic information in the data base was coded with both classification systems, ICDA8 and HICDA2. Since there is not a direct match between the 2 schemes, data from all hospitals could not be combined in a unified data base. Thus, it was decided to construct the classification scheme using the more prevalent ICDA8 codes as the standard. The ICDA8 version was then translated to HICDA2. This translation was evaluated with hospital data and necessary modifications were made to insure the consistency of the classification across the 2 coding schemes. Both ICDA8 and HICDA2 record surgical procedures using 3-digit codes. These procedure codes cover not only operations performed but also some therapies and minor diagnostic procedures. For ICDA8, the ranges of codes that were considered to reflect actual operations were 010–999 and A10–A59. Likewise, for HICDA2, the actual code range for operations is considered to be 010–920 and 933–936. In constructing the patient classification scheme, only codes within these ranges were considered as surgical procedures.

2.2 Statistical Methodology

The particular statistical methodology employed is a variation of the Automated Interaction Detector (AID) method of Sonquist and Morgan, which has previously been applied in the analysis of complex sample survey data at the University of Michigan Survey Research Center.[25] The objective of this approach is to examine the interrelationships of the variables in the data base and to determine, in particular, which ones are related to some specified measure of interest, referred to as the dependent variable. This is accomplished by recursively subdividing the observations, through binary splits, into subgroups based on values of variables that maximize variance reduction or minimize the predictive error of the dependent variable. Subgroups are designated terminal

groups when they cannot be partitioned further either because the sample sizes are too small or the remaining variation is either too low to be reduced further or unexplainable in terms of the variables in the data base. Each observation is contained in one and only one of these terminal groups, with a predicted value equal to the mean of the group. That is, if y_{kj} is the value of the dependent variable for the jth observation within the kth group, then

$$y_{kj} = \overline{Y}_k + e_{kj} \qquad (2.1)$$

where $\overline{Y}_k$ is the mean for all members in the kth group and e_{kj} is the error in using $\overline{Y}_k$ to predict or estimate y_{kj}. This procedure minimizes the sum of the $(e_{kj})^2$ over all observations. Thus, individual observations tend to have values close to the mean value of the terminal group to which they belong.

It was decided that the approach had be be implemented on an interactive basis to accommodate a high level of physician intervention. This was an important consideration since group formation using this algorithm is basically iterative in nature. Since no computer system existed that could handle large data bases efficiently in the interactive mode, a new technology was developed called AUTOGRP.[20] AUTOGRP supports a facility allowing one to invoke an algorithm that determines partitions based on the variance reduction criterion of the AID algorithm. This command, or capability, of the system is referred to as the CLASSIFY facility.

Mathematically, the algorithm can be described as follows[20]: Each observation in a data set has a value of the independent variable X and a value of the dependent variable Y. If there are N possible distinct values of the independent variable, then the subset of observations, or records, that has each value X_i $(1 \leq i \leq N)$ is called a category. If there are M_i observations in the ith category $(1 \leq i \leq N)$, the total sum of squares (TSSQ) of the data with respect to the dependent variable is defined as

$$\text{TSSQ} = \sum_{i=1}^{N} \sum_{j=1}^{M_i} (Y_{ij} - \overline{Y})^2 \qquad (2.2)$$

where Y_{ij} is the value of the dependent variable for the jth observation in the ith category of independent variable, and

$$\overline{Y} = \sum_{i=1}^{N} \sum_{j=1}^{M_i} Y_{ij} \Big/ \sum_{i=1}^{N} M_i \qquad (2.3)$$

or the mean value of the dependent variable in the entire data set. The data set can be partitioned on the basis of the independent variable into G groups, where each group is the union of specified categories. That is, we can define the mapping of categories to groups with sets R_k $(1 \leq k \leq G)$, such that

$$R_k \cap R_{k'} = \emptyset, k \neq k'$$

$$\bigcup_{k=1}^{G} R_k = \{1,2,3,\ldots,N\}$$

The "within group sum of squares" (WGSSQ) is the total of the squared deviations (differences) of each group's observations from the group mean with respect to the dependent variable and can be expressed as

$$\text{WGSSQ}(k) = \sum_{i \in R_k} \sum_{j=1}^{M_i} (Y_{ij} - \overline{Y}_k)^2, \; 1 \leq k \leq G \qquad (2.4)$$

where

WGSSQ (k) = within group sum of squares for the kth group

R_k = set of all categories of the independent variable in the kth group and

$$\bar{Y}_k = \left(\sum_{i \in R_k} \sum_{j=1}^{M_i} Y_{ij} \right) \Big/ \left(\sum_{i \in R_k} M_i \right) \qquad (2.5)$$

is the mean value of the dependent variable in the kth group. The total within group sum of squares (TWGSSQ) for the G groups is the sum of the total squared deviations of each group's observations from the respective group mean and is given by

$$\text{TWGSSQ (G)} = \sum_{k=1}^{G} \sum_{i \in R_k} \sum_{j=1}^{M_i} (Y_{ij} - \bar{Y}_k)^2 \qquad (2.6)$$

For a given independent variable, the CLASSIFY algorithm partitions observations into the particular set of groups that results in the minimization of TWGSSQ for a specific dependent variable. Since TWGSSQ is proportional to the variance left unexplained by the independent variable, minimization of TWGSSQ results in the minimization of the unexplained variance of the data.

2.3 DRG Formation from Major Diagnostic Categories

To facilitate the analysis over the wide range of disease conditions in the acute-care setting, all diagnoses were initially divided into 83 mutually exclusive and exhaustive Major Diagnostic Categories. Their formation was also motivated to insure diagnostic homogeneity. Thus, the final clusters do not contain patients that transcended these categories. For example, from the point of view of output utilization, it may be appropriate to form a patient class with hemorrhoids, hypertrophy of tonsils, and normal delivery. The output utilization of these patients is very similar, often requiring a relatively minor surgical procedure with a very short preoperative stay and a total hospitalization period of 2 or 3 days. However, the physicians who would treat these patients as well as the treatment processes of the problems they are presenting are quite different. Therefore, it was felt that including such patients in the same class would not define a medically meaningful category.

The specification of the Major Diagnostic Categories was performed by a committee of clinicians, following 3 general principles:

1. Major Diagnostic Categories must have consistency in terms of their anatomic, physiopathologic classification, or in the manner in which they are clinically managed.
2. Major Diagnostic Categories must have a sufficient number of patients.
3. Major Diagnostic Categories must cover the complete range of codes without overlap.

A list of these categories as defined by their ICDA8 and HICDA2 codes appears in Table 1. There is also an indication of the corresponding Professional Activity Study (PAS) diagnosis groups that correspond to each category. Note that the categories are very broad, such as Diseases of the Eye, Diseases of the Cardiovascular System and Infectious Diseases.

A consistent process was followed in partitioning each Major Diagnostic Category into DRGs. First of all, each category was refined by eliminating certain unwanted observations. Cases with dead patients or bad records, and those that were particularly deviant, were excluded from further analysis. Cases with dead patients were removed from consideration since their lengths of stay were probably atypical of the disease or problem under consideration. Records with obvious coding errors or missing data were also eliminated because their information could be misleading. Ob-

TABLE 1. Major Diagnostic Categories

Major Category	Initial Group Names	PAS Group No.	ICDA8 Codes	HICDA2 Codes
1	Infectious Diseases	1–8, 10–17	000–0689, 071–1360	001–0689 071–1360
2	Malignant Neoplasm of Digestive System	18–23	140–1590	140–1590
3	Malignant Neoplasm of Respiratory System	24–25	160–1639	160–1639
4	Malignant Neoplasm of Skin	27	172–1739	172–1739
5	Malignant Neoplasm of Breast	28	174–1740	174–1742
6	Malignant Neoplasm of Female Genital Organ	29–33	180–1849, 2340, 6211 6291	180–1849
7	Malignant Neoplasm of Male Genital Organ	34, 35	185–1879	185–1879
8	Malignant Neoplasm of Urinary System	36, 37	188–1899	188–1899
9	Malignant Neoplasm of Other and Unspecified Sites	26, 38–42	170–1719, 190–1991	179–1719, 190–1990
10	Neoplasm of Lymphatic and Hemopoietic Tissue	43–46	200–2090	200–2090
11	Benign Neoplasm of Female Genital Organ	53–56	218–2219	218–2219
12	Benign Neoplasm of Other Sites	47–51, 58–62, 64–65	210–2169, 222–2330, 2341–2399, 2552, 7434, 7571	210–2169, 2220–2221 2228–2264, 2266–2399
13	Diseases of Thyroid and Other Endocrine Glands	63, 66, 70, 71	240–2460, 251–2551, 2559–2589	240–2460, 251–2589 2265
14	Diabetes	67–69	250–2509	250–2507
15	Nutritional and Other Metabolic Diseases	72–75	260–2790	260–2790
16	Diseases of Blood and Blood Forming Organs	76–80	280–2890, 2894–2899, 6345	280–2899
17	Psychoses Not Attributed to Physical Conditions	86–92	295–2990	306–3099
18	Neuroses	93–95	300–3029	310–3129
19	Alcoholic Mental Disorder and Addiction	84, 96, 97	291–2919, 303–3039	302–3029, 313–3139
20	Other Mental Disorders	81–83, 85, 98–103	290–2901, 292–2949, 304–3159	290–2959, 296–3019, 303–3059 314–3189
21	Diseases of Central Nervous System	104–108	320–3499	320–3499
22	Diseases of Peripheral Nervous System	109–110	350–3580, 3589	350–3589
23	Diseases of Eye	111–121	360–3789	360–3789
24	Diseases of Ear and Mastoid Process	122–125	380–3879	380–3892
25	Hypertensive Heart Diseases	128, 129	400–4040	400–4050
26	Acute Myocardial Infarction	130	410–4109	410–4109
27	Ischemic Heart Diseases except AMI	131, 132	411–4149	411–4140
28	Arrhythmia and Slowed Conduction	133	3581, 4272–4279	415–4169
29	Heart Failure	135	4270–4271, 7824	427–4279
30	Carditis, Valvular, and Other Diseases	126, 127, 134, 136	390–3980, 420–4260, 428–4299	390–3980, 420–4269, 429–4299
31	Cerebrovascular Diseases	137–141	430–4389	430–4389
32	Diseases of Vascular System	142–147, 150, 152–154	2891–2893, 440–4431, 4438–4480,	440–4489, 452–4549, 456–4589

TABLE 1. Continued.

Major Category	Initial Group Names	PAS Group No.	ICDA8 Codes	HICDA2 Codes
			452–4549, 456–4589	
33	Pulmonary Embolism	148	450–4500	450–4500
34	Phlebitis and Trombophlebitis	149	451–4519	451–4519
35	Hemorrhoids	151	455–4550	455–4559
36	Hypertrophy of Tonsil and Adenoid	163	500–5000	500–5000
37	Acute URI and Influenza	155, 156	460–4650, 470–4741	460–4650, 470–4700
38	Other Diseases of Upper Respiratory Tract	164–167	501–5089	501–5089
39	Pneumonia	157	480–4860	480–4860
40	Bronchitis	158, 159	466–4660, 490–4910	489–4919
41	Asthma	161	493–4930	493–4939
42	Other Lung and Pleural Diseases	160, 162, 168, 169	492–4920, 510–5199	492–4920, 494–4960 510–5199
43	Diseases of Oral Cavity, Salivary Glands and Jaws	170	520–5299	520–5299
44	Gastric and Peptic Ulcer	172–175	531–5349	531–5343
45	Upper GI Diseases except Gastric and Peptic Ulcer	171, 176, 177	530–5309, 535–5379	530–5309, 535–5379
46	Appendicitis	178–180	540–5430	540–5430
47	Hernia of Abdominal Cavity	181–184	550–5539	550–5539
48	Enteritis, Diverticula, and Functional Disorder of Intestine	185, 186	561–5649	561–5649
49	Diseases of Anus	187, 253	565–5660, 685–6850	565–5660, 685–6850
50	Miscellaneous Diseases of Intestine and Peritoneum	188	560–5609, 567–5699	560–5609, 567–5699
51	Diseases of Liver	9, 189, 190	070–0700, 0705–0709, 9992 570–5739	070–0709, 570–5739
52	Diseases of Gallbladder and Bile Duct	191, 192	574–5769	574–5769
53	Diseases of Pancreas	193	577–5779	577–5779
54	Diseases of Kidney and Ureter	194–197, 200	580–5910, 593–5935, 792–7920	580–5910, 593–5939
55	Urinary Calculus	198, 199, 201	592–5920, 594–5940	592–5921, 594–5949
56	Cystitis and Other Urinary Diseases	202–204	595–5999	595–5999
57	Diseases of Prostate	206, 57, 205	600–6020	2222, 600–6029
58	Diseases of Male Genital Organs	207–210	603–6050, 607–6079	603–6079
59	Diseases of Female Genital Organs	213–220	612–6210, 6212–6270, 6290, 6292, 6294, 6296–6299	612–6299
60	Diseases of Breast	52, 212, 211	217–2170, 610–6119	217–2179, 610–6119
61	Abortion	228–231	640–6459	640–6469
62	Obstetrical Diseases of Antepartum and Puerperium	221–227,250	630–6344, 6346–6399 670–6730, 6739–6780	631–6399, 670–6789
63	Normal Delivery	232	650–6500	650–6500
64	Delivery with Complication	233–249	651–6620,6731	651–6649

TABLE 1. Continued.

Major Category	Initial Group Names	PAS Group No.	ICDA8 Codes	HICDA2 Codes
65	Diseases of Skin and Subcutaneous Tissue	251, 252, 254–255	680–6840, 686–7099	680–6840, 686–7099
66	Arthritis	256–258	710–7150	710–7150
67	Derangement and Displacement of Intervertebral Disc	265, 266	725–7259	725–7259
68	Diseases of Bone and Cartilege	261–264	7171–7180, 720–7249	7171–7180, 720–7249
69	Other Diseases of Musculo-Skeletal System	259, 260, 267 268–271	716–7170, 726–7389	716–7169, 719–7199, 726–7390
70	Congenital Anomalies	272–282	740–7433, 7438–7570, 7572–7599	740–7599
71	Normal Mature Born	342, 343	Y20–Y209, Y22–Y239, Y26–Y279	Y20–Y209, Y22–Y229 Y24–Y249
72	Certain Diseases and Conditions Peculiar to Newborn Infants	283, 344–349	Y21–Y219, Y24–Y259, Y28–Y299, Y005, 760–7799	Y21–Y219, Y23–Y239 Y25–Y299, Y40–Y489, 760–7689
73	Symptoms and Signs Referable to Nervous, Respiratory, and Circulatory Systems	284–287	4432, 780–7808, 7814–7815, 7817–7823, 7825–7834, 7836–7837	770–7709, 773–7769, 778–7799
74	Symptoms and Signs Referable to GI and Urinary System	288–290	784–7865	780–7839
75	Miscellaneous Signs, Symptoms, and Ill-defined Conditions	291–295	606–6060, 628–6280, 6293, 6295, 7810–7813, 7816, 7835, 7866–7889, 790–7910, 793–7969	771–7728, 777–7779, 784–7969
76	Fractures	296–310	800–8299	800–8299
77	Dislocation and Other Musculo-Skeletal Injury	311–316	830–8480	830–8489
78	Internal Injury of Cranium, Chest, and Other Organs	317–320, 326 332	850–8699, 950–9599, 9953, 9954	850–8699, 900–9049, 950–9599
79	Open Wound and Superficial Injury	321–325, 327–330	870–9390 996–9969	870–8979, 910–9391
80	Burn	331	940–9499	940–9498
81	Complication of Surgical and Medical Care	338, 339	997–9991, 9993–9999	996–9999
82	Adverse Effects of a Certain Substance	333–337	960–9952, 9955–9959	960–9959
83	Special Admissions and Examinations Without reported Diagnosis	340, 341	Y00–Y004, Y006–Y159, 379–3793, 388–3899, 789–7899	Y00–Y199, Y50–Y896

servations with disproportionately high values of length of stay were excluded since a few deviant records could have a marked effect on the stability of a group's distribution.

The screened set of records in each category was then used as input to the second stage, in which the CLASSIFY algorithm was applied to suggest groups of observations, on the basis of prespecified independent variables, that may be different with regard to length of stay. The set of independent variables selected as input to the algorithm was intentionally limited to those variables descriptive of the patient, his disease condition and his treatment process that would be readily accessible on most discharge abstracts, specifically diagnoses, surgical procedures, age, sex and clinical service. This constraint was applied for several reasons. First, mean lengths of stay are observed to vary across levels of these variables in descriptive statistical summaries of hospital discharge data.[23] Second, these variables are always recorded and entered in almost all hospital information systems. This increases the classification's potential for implementation in most research and applied healthcare settings. Including other items of information such as ancillary services used would limit its applicability to those systems that collect such data, which would exclude, for example, the PSRO PHDDS data base. Finally, restricting the variables to this set also simplifies the class definitions and controls to some extent the final number of categories. A classification with numerous groups and a complex definitional structure is unmanageable.

For each independent variable, output from the CLASSIFY procedure included the total number of observations in the data set, the total number of different values the variable assumed (i.e., number of categories or cells), the number of groups formed, the total sum of squares (TSSQ) and the per cent reduction in total sum of squares attained by such a grouping ((TSSQ-TWGSSQ) / TSSQ)* 100. Once these results were obtained, a clinician selected the most appropriate variable for division.

The interpretation of the partitioning suggested by the algorithm was a complex task, with many factors examined and weighed simultaneously. The decision to accept, to reject or possibly to revise the recommended partitioning was based on both the statistical evidence and the clinician's medical knowledge. The statistical results were examined in light of certain criteria. Variables yielding the highest percentage reduction in variance were prime candidates for dividing the data set. However, the number of cells or values for those variables and the number of groups formed were also considered. It is an artifact of the algorithm that many partitions can be created when the independent variable has a wide range of values. Moreover, too many groups formed at the first split become difficult to manage and are of questionable significance. For example, secondary diagnosis often had many different values and thus often produced significant variance reduction by forming many subgroups. However, such groups were difficult to interpret as a primary partition and tended to be of limited value. In all cases, groups were further examined in a more descriptive framework to determine if the statistical significance was supported by medical interpretability.

The fact that a variable that appeared to be powerful in explaining variance was not selected at a particular stage does not mean that the variable was ignored. Two possibilities still existed. If that variable were independent of other variables in explaining variance, it would appear in subsequent stages with the same power as at the earlier stage. If, however, it were correlated with a variable chosen at an earlier stage, then its explanatory power at subsequent stages would be lessened according to the strength of the correlation. For example, if secondary diagnosis was

strongly related to age and age was selected as a partitioning variable, then secondary diagnosis would not appear powerful in subsequent clustering.

Groups were then generated based on the most appropriate variable, that is, the one that met as many of the criteria specified above as possible. In particular, it 1) exhibited a significant reduction in variance relative to most of the other variables, 2) created a manageable number of groups based on the relatively small number of values of the independent variable, and 3) created groups whose means were significantly different. Also, groups formed were homogeneous from a clinical perspective.

Once each Major Diagnostic Category was initially partitioned into subgroups based on the values of an independent variable, a decision was made whether or not to further subdivide each subgroup based on any of the other available variables or to end the partitioning process by treating them as terminal groups. The statistical basis for this decision was determined by a set of stopping rules. For any given group, the partitioning ceased when either one of the following conditions was met:

1. The group was not large enough to warrant another classification, that is, when the number of observations in the group was less than 100.

2. None of the variables reduced unexplained variation by at least 1%, or ((TSSQ-TWSSQ)/TSSQ)*100 < 1 per cent.*

Otherwise, the group was further subdivided according to the criteria discussed previously for generating new subgroups. In some cases, however, the process was terminated for nonstatistical reasons regarding overall manageability (e.g. maintaining a low number of total groups) or medical interpretability.

* This 1 per cent bound was increased in certain Major Diagnostic Categories.

This grouping process resulted in the formation of 383 final groups or DRGs, each defined by some set of the following patient attributes: primary diagnosis, secondary diagnosis, primary surgical procedure, secondary surgical procedure, age, and in one case, clinical service area. While other variables such as sex, tertiary diagnosis or surgical procedure were examined, they were not found to be significant in explaining output utilization. A list of these groups with a brief narrative description of their contents appears in the Appendix. A more complete specification can be obtained from the Health Care Financing Administration.[1]

The DRGs vary considerably in their structure across the Major Diagnostic Categories. Some Major Diagnostic Categories are not further subdivided, such as Category 35, Hemorrhoids, in which no variable demonstrated a sufficient effect in further explaining output utilization. On the other hand, Appendicitis, Category 46, is further subdivided on the basis of specific primary diagnosis and the presence of a secondary diagnosis. This results in 4 DRGs: appendicitis (without peritonitis) and without a secondary diagnosis, appendicitis (without peritonitis) with a secondary diagnosis, appendicitis (with peritonitis) without a secondary diagnosis, and appendicitis (with peritonitis) with a secondary diagnosis. This symmetric breakdown suggests that the effects of primary diagnosis and the presence of a secondary diagnosis are additive in nature. Major Diagnostic Category 76, Fractures, has the most complex structure, resulting in 13 DRGs, indicating both the importance and interaction of 4 variables: primary diagnosis, secondary diagnosis, primary surgical procedure and age.

It should also be noted that when variables are highly correlated, very often only one appears in the classification for a specific major category. An extreme example of this is Major Diagnostic Category 36, Hypertrophy of Tonsils and Adenoid,

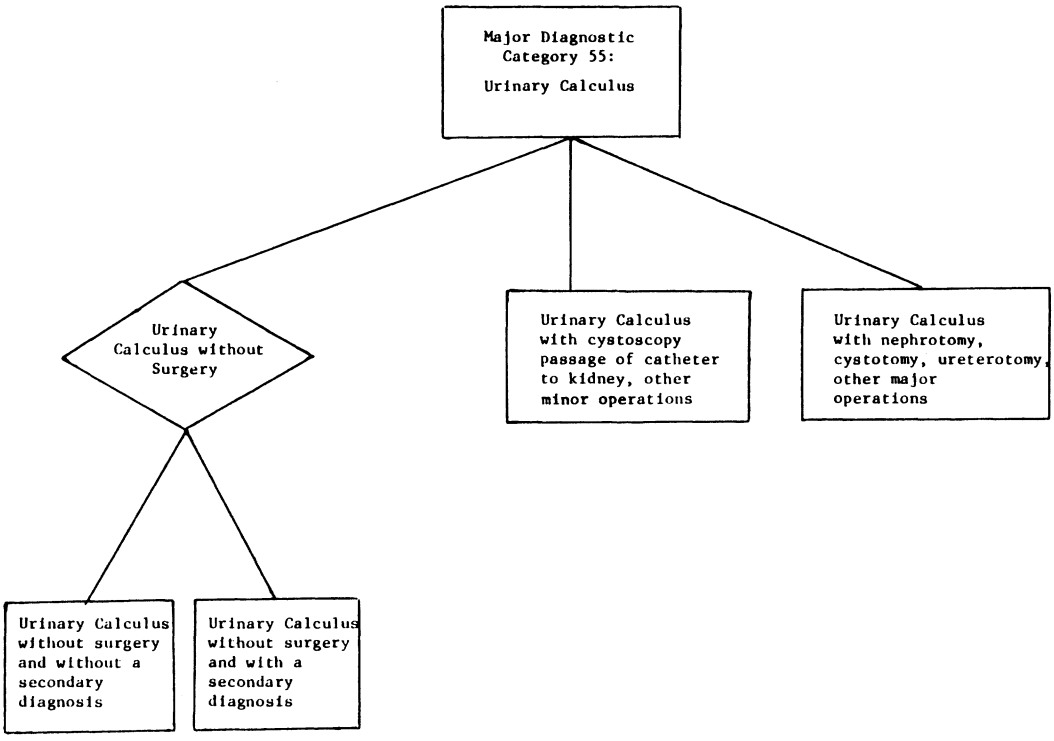

FIG. 1. Tree diagram illustrating partitioning of urinary calculus patients.

where almost everyone has a tonsillectomy and/or an adenoidectomy. The high correlation of primary surgical procedure with primary diagnosis results in no further variance reduction in the category that can be attributed to surgical procedures. Thus, although surgery is almost always used in the treatment of patients with Hypertrophy of Tonsils and Adenoids, since virtually every patient in this category had the same surgical procedure, the surgical information did not differentiate the utilization of these patients and was therefore not used in the formation of the DRGs for this category.

2.4 An Example

The iterative partitioning process used in forming the DRGs can best be illustrated in the context of an example—the classification of Major Diagnostic Category 55: Urinary Calculus. This category contains patients with a primary diagnosis (ICDA8 codes) of either 592, calculus of kidney and ureter, or 594, calculus of other parts of the urinary system. The formation of the DRGs from this Major Diagnostic Category is summarized in the tree diagram presented in Figure 1. First, this category is partitioned into 3 groups based on the variable primary surgical procedure. The first group contains nonsurgical patients, which are those with either no operation or with a procedure code (ICDA8) outside the range 010–999, A10–A59.† The second and third groups are formed on the basis of the specific procedure performed. In particular, the more complicated procedures performed on patients with a urinary calculus—nephrotomy, ureterotomy, cystotomy—are in the third group, while

† Operations coded outside these ranges are not considered actual surgical procedures since they represent minor procedures or therapies.

TABLE 2. Descriptive Statistics for the Partitioning of Major Diagnostic Category 55 (Urinary Calculus).

Size = 1425 Mean = 6.93 S.D. = 6.44

Independent Variables	Partial Variance Explained	DRG No.	Size	Mean Length of Stay	S.D.
Primary surgery	41.75				
Minor		241	428	6.36	4.30
Major		242	286	14.99	7.39
Secondary diagnosis, with no primary surgery	1.17				
None		239	449	3.28	2.88
1 or more		240	262	5.32	5.01

Total variation explained: 42.93.

relatively minor procedures associated with this diagnosis—cystoscopy, passage of catheter to kidney—are contained in the second. The nonsurgical group is partitioned further into 2 groups based on the presence or absence of a secondary diagnosis. In summary, the classification process resulted in the formation of 4 terminal groups, or DRGs 239–242, from the Major Diagnostic Category of Urinary Calculus:

239 Urinary calculus without surgery, and without a secondary diagnosis

240 Urinary calculus without surgery and with a secondary diagnosis

241 Urinary calculus with cystoscopy, passage of catheter to kidney, other operations

242 Urinary calculus with nephrotomy, cystotomy, ureterotomy, other major operations

A descriptive statistical summary of data coded in ICDA8 from the original data base used to construct the DRGs is presented in Table 2. The entire Major Diagnostic Category contains 1,425 observations, with a mean length of stay of 6.93 and a standard deviation of 6.44. The variables used in partitioning this group, primary surgery and secondary diagnosis, explain 42.93 per cent of the total variance, with 41.75 per cent attributed to the former and 1.17 per cent to the latter.

The actual process of forming these DRGs from the Major Diagnostic Category Urinary Calculus is summarized in the following steps:

Step 1

Fifteen records were eliminated: 3 with a discharge status of death, 10 with invalid surgical or diagnosis codes, and 2 with lengths of stay greater than 60 days. This reduced the size of the category from 1,440 to 1,425 observations.

Step 2

The algorithm was invoked on this refined data set to determine the basis for an initial split. The independent variables selected to define potential subgroups were primary surgical procedure (oper1),

TABLE 3.

Variable	No. of Groups	Per Cent Reduction
oper1	3	41.89
oper2	4	21.37
dx1	1	0.0
dx2	5	30.11
age	3	8.19
sex	2	1.63

TABLE 4. Suggested Partitioning (3 groups) of Urinary Calculus Patients on the Basis of Type of Primary Surgery

Group	Size	Mean	Independent Variable	Description
1	1	2.00	749	Other antepartum procedures to terminate pregnancy
	1	2.00	571	Meatotomy
	1	2.00	277	Venous anastomosis, intra-abdominal
	1	2.00	249	Other operations on peripheral vessels
	1	3.00	430	Incision of bile (hepatic) ducts
	1	3.00	862	Arthrocentesis
	1	3.00	601	Vasectomy
	1	3.00	921	Local excision of lesion of skin and subcutaneous tissue
	23	3.28	000	No code
	688	4.08		No code
	1	5.00	551	Ureterectomy
2	2	5.50	574	Repair and plastic operations on urethra
	7	5.71	559	Other operations on ureter
	218	6.25	A46	Cystoscopy and urethroscopy without effect upon tissue
	5	6.40	A45	Endoscopy of colon and rectum without effect upon tissue
	15	6.40	568	Removal of calculus and drainage of bladder without incision
	2	6.50	572	Excision or destruction of lesion of urethra
	146	6.59	557	Passage of catheter to kidney
	21	7.14	575	Dilation of urethra
	1	9.00	A16	Biopsy of thorax
3	2	10.00	A21	Biopsy (continued) of urinary tract
	2	11.50	566	Repair and other plastic operations on bladder
	1	12.00	A44	Esophagoscopy and gastroscopy without effect upon tissue
	1	13.00	549	Other operations on kidney
	1	13.00	556	Repair and plastic operations on ureter
	3	13.67	561	Local excision and destruction lesion of bladder, transurethrol
	2	14.00	562	Local excision and destruction of lesion of bladder, other
	3	14.00	582	Prostatectomy, transurethral
	1	14.00	583	Prostatectomy, other
	8	14.13	545	Nephrectomy, complete
	72	14.46	541	Pyelotomy
	40	14.47	560	Cystotomy
	101	14.63	550	Ureterotomy
	19	15.89	540	Nephrotomy
	1	16.00	513	Hemorrhoidectomy
	11	16.82	544	Nephrectomy, partial
	1	17.00	546	Repair and plastic operations on kidney
			570	Urethrotomy, external
	1	21.00	A27	Biopsy of bone
	1	21.00	563	Cystectomy, complete or partial
	1	22.00	685	Ligation and division of fallopian tubes, bilateral
	3	22.33	558	Ureterolysis
	1	29.00	543	Local excision and destruction of lesion of kidney

secondary surgical procedure (oper2), primary diagnosis (dx1), secondary diagnosis (dx2), age, and sex.

The number of groups formed by the algorithm and the corresponding per cent reduction in unexplained variation for each of the variables are shown in Table 3.

Since the greatest reduction in unexplained variation was achieved with oper1, and a limited number of groups (3) this variable was considered the prime candidate for initial subdivision of the category. The algorithm suggested 3 groups whose contents are described in Table 4. This table presents the different surgical procedures contained in each group, the corresponding number of observations (SIZE), and the mean length of stay (MEAN). Note that more than 98 per cent of the observations in the first group have no surgical procedure listed. The second group primarily contains observations with relatively minor procedures such as cystoscopy and urethroscopy (A46) and passage of catheter to kidney (557), while the third group includes somewhat more complex procedures as ureterotomy (550), cystotomy (560), and pyelotomy (541).

On the basis of these results, it was decided to divide the initial group of Urinary Calculus patients into 3 groups, similar to those suggested by the algorithm, namely, a group of nonsurgical patients, a group with relatively major procedures such as those listed under group 3 in Table 4, and finally a group of all other procedures, which includes cases with minor procedures such as those listed under groups 1 and 2, and biopsy of urinary tract (A21) in group 3. While this latter group represents all other surgical procedures not explicitly listed under group 3, it is primarily represented by the 2 procedures cystoscopy and urethroscopy (A46) and passage of catheter to kidney (557).

Step 3

Each of the groups formed in Step 2 was then considered for further subdivision.

TABLE 5.

Variable	No. of Groups	Per Cent Reduction
dx1	1	0.0
dx2	4	22.66
age	4	14.18
sex	1	0.0

First of all, with respect to the nonsurgical patients, the number of groups formed by the algorithm and the corresponding per cent reduction in unexplained variation for each of the variables (except oper1 and oper2) were as shown in Table 5.

A closer examination was made of the characteristics of the 4 groups formed using the variable secondary diagnosis (dx2), since it exhibited the greatest per cent reduction in unexplained variation. The descriptive statistics for each of the groups are summarized in Table 6.

Several things were considered in evaluating the potential partitioning on secondary diagnosis. With respect to the distribution of observations, groups 3 and 4 were definitely too small (i.e., less than 100 observations) to be considered terminal groups and group 2 with 109 observations was marginal. Further, it was noted that more than 80 per cent of the observations in Group 1 had no secondary diagnoses listed and that the remaining cases in all 4 groups were distributed across 105 different secondary diagnosis codes, usually with less than 10 cases represented for each disease and with no apparent clinical pattern. Thus, it was decided that groups formed on the basis of specific secondary

TABLE 6.

Group	No. Observed	Mean	S.D.
1	534	3.22	2.71
2	109	4.87	2.70
3	50	7.68	4.93
4	18	12.83	12.37

TABLE 7.

Group	No. Observed	Mean	S.D.
No secondary	449	3.28	2.88
Secondary	262	5.32	5.01

diagnosis were not particularly meaningful, but that a more manageable and interpretable partition from a medical perspective would be 2 groups, based on the presence or absence of a secondary diagnosis. The descriptive statistics of these groups are shown in Table 7.

This alternative partition results in a markedly lower per cent reduction in unexplained variation—6.3 per cent lower. But, in terms of the overall objectives of the classification process, the increase in interpretability and manageability was considered more important than the sacrifice in predictive error.

Step 4

With respect to the other 2 groups formed in Step 2 on the basis of specific surgical procedure, the algorithm was applied using the variables secondary surgical procedure, primary diagnosis, secondary diagnosis, age, and sex. For the group with minor operations, the number of subgroups formed by the algorithm and the corresponding per cent reduction in unexplained variation for the variables are shown in Table 8.

Likewise the partitions with respect to these variables suggested for the group of relatively major procedures have the characteristics shown in Table 9. In both cases it appeared that secondary diagnosis had the strongest effect and was selected as the potential variable to use in forming subgroups. However, after examining the contents of the suggested groups, it was found in both instances that at least half the observations had no secondary diagnosis listed and the others had secondary diagnoses distributed across at least 100 different codes, with no apparent clinical consistency. That is, the diagnoses were dissimilar and few were represented by more than 10 cases. Thus, like the nonsurgical cases discussed in Step 3, it did not appear that further division of these groups into subsets by specific secondary diagnosis was meaningful from a clinical perspective.

TABLE 8.

Variable	No. of Groups	Per Cent Reduction
oper2	2	13.36
dx1	1	0.0
dx2	4	34.62
age	2	4.73
sex	1	0.0

TABLE 9.

Variable	No. of Groups	Per Cent Reduction
oper2	3	18.36
dx1	2	1.26
dx2	4	43.03
age	2	3.85
sex	1	0.00

Partitioning each group on the basis of the presence or absence of secondary diagnosis was considered. This would achieve a 2.1 per cent reduction in unexplained variation for the minor surgical group and a 5.6 per cent reduction for the major surgical group. In both instances, it was decided that there was not sufficient medical justification for a further break-

TABLE 10.

Variable	No. of Groups	Per Cent Reduction
age	2	2.73
oper2	2	2.06
dx1	1	0.0
sex	1	0.0

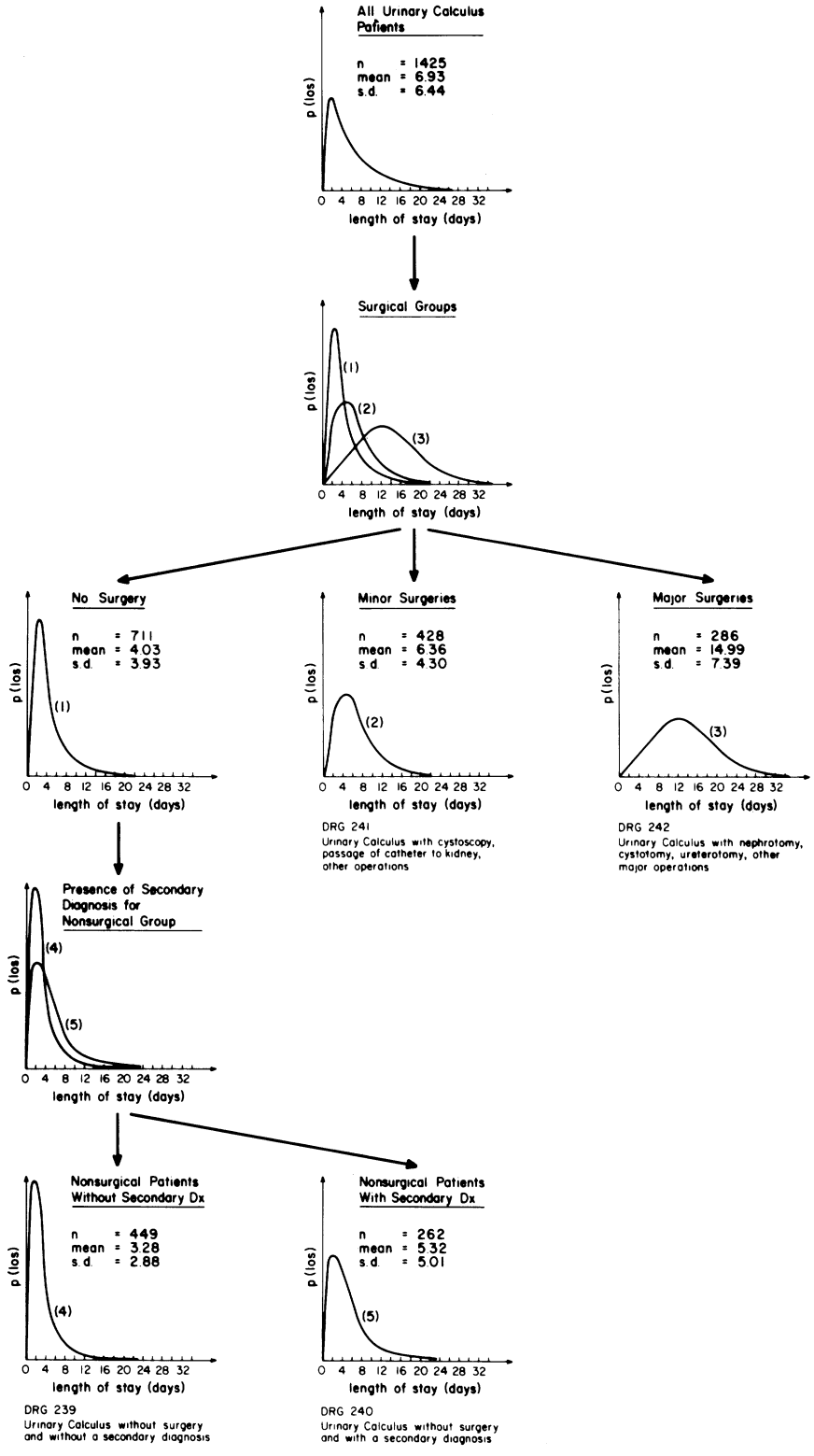

FIG. 2. Summary of length-of-stay distributions for groups formed in partitioning process.

TABLE 11.

Variable	No. of Groups	Per Cent Reduction
age	3	13.05
oper2	1	0.0
dx1	1	0.0
sex	1	0.0

down of the surgical groups on the basis of secondary diagnosis. Moreover, in light of one of the major objectives of keeping the total number of classes low, additional groups formed at this stage of the partitioning of Urinary Calculus patients would be of questionable value. Therefore, the 2 surgical groups were not divided further but were considered terminal groups.

Step 5

The 2 subgroups formed from the nonsurgical cases on the basis of presence or absence of other diagnoses were evaluated to determine if they should be partitioned further or left intact as terminal groups. The algorithm was applied and produced the results shown for the nonsurgical cases without multiple diagnoses. The algorithm produced the results listed in Table 11 for the nonsurgical cases with multiple diagnoses.

With respect to the nonsurgical cases without multiple diagnoses, both sets of groups formed on the basis of age and secondary surgical procedure, respectively, were determined unacceptable. In each instance, more than 95 per cent of the observations fell into the first group, leaving the second group with fewer than 25 cases.

For the nonsurgical cases with multiple diagnoses, the 3 groups formed using age levels were considered as potential subgroups. The age levels defining the boundaries of the groups were 66 and 70. This partition was rejected for reasons similar to those above, namely, the lopsided distribution of cases in the groups. Almost 90 per cent of the observations had an age under 66.

Thus, the nonsurgical groups with and without multiple diagnoses were considered terminal groups.

We conclude, then, that specific surgical procedures and the presence of multiple diagnoses were important variables in predicting length of stay for urinary calculus patients. The 4 DRGs formed were significantly different ($\alpha = 0.01$) with respect to their average lengths of stay and are clinically interpretable. To be sure, by overruling some of the partitions suggested by the algorithm, a certain amount of explanatory power was sacrificed. But, the trade-off was generating a reasonable number of subgroups or DRGs which could be interpreted from a medical perspective. Figure 2 presents a descriptive summary of the length-of-stay distributions for the groups formed as part of the partitioning process in this example.

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3. Interpretation of the DRGs in Health-Care Studies

THE DRGs AS CONSTRUCTED met the original research objectives; that is, they provide a definition of case types by relative output utilization, where the definition of case type has the following properties:

1. The variables used in the definition of a case are limited to those referring to the patient's condition and treatment process that are commonly collected in a hospital information system, namely primary diagnosis, secondary diagnosis, age, primary surgical procedure, and secondary surgical procedure.

2. There are a manageable number of case types or DRGs (383) and they are mutually exclusive and exhaustive.

3. Each DRG has clinical interpretability with closely related diagnoses and operations.

4. Patients within a DRG have similar patterns of utilization as measured by length of stay.

Achieving these objectives meant in all cases a trade-off between maximizing explained variation and maintaining clinical interpretability. For example, there were some Major Diagnostic Categories which could have been partitioned into additional groups based on one of the variables used or the introduction of other variables. While this may have resulted in increased explained variation, the amount of increase was balanced against the potential loss in 1) medical interpretability, 2) the manageability of the resultant number of groups, and 3) the simplicity of case definition.

Since the statistical algorithms were primarily used as a screening device to suggest groups of patients with similar output utilization patterns, the process is to some extent subjective and dependent on the clinician making the decisions, the independent variables he was constrained to use, the dependent variable chosen to represent output utilization (length of stay), and the data base examined. Thus, individuals analyzing their own data within this framework may decide other definitions are more meaningful and significant for their purpose. For example, if cost information is readily available and well standardized, that would be a preferable alternative to length of stay as the output utilization measure. Likewise, additional independent variables may be incorporated, but the analyst should be aware of potential difficulties in this regard. Greatly expanding the set of variables that may be incorporated in a scheme tends to increase the number of final groups and restricts its application to within the immediate setting.

As they are now defined, the DRGs form a manageable, medically interpretable set of case types that allows one to control for differences in complexity attributable to patient characteristics as described by age, primary diagnosis, secondary diagnosis, primary surgical procedure and secondary surgical procedure. On the basis of values for these variables, practitioners can gain some understanding of the patient being identified and specify within reasonable limits expected services to be delivered, criteria to be applied in treatment, and expected outcomes. This is not to say that providers of such care will always agree on the treatment process or that all will agree with the identification. There are certainly disease entities that are not as well understood as others and treatment protocols for which there is lesser or greater consensus among practitioners. For example, senile cataracts are almost always treated by a surgical lens extraction but there is still observed great variation in the case regime and length of hospital stay for this procedure. Thus, while senile cataract patients with lens extraction form a patient class,

differences among providers still remain with respect to length of stay and other output measures which cannot be accounted for by patient characteristics or surgical procedures.

The development of the patient classes is not intended to inhibit in any way the practice of medicine but to offer one the capability of examining reasons for variations in service utilization, treatment process, and outcome. In this context, the groups can provide a framework for the initiation of an ongoing process of comparative analysis of health care with the long-run goal of determining both the cost and value of any kind of care that might be delivered. With such information, meaningful dialogue among clinicians, administrators, planners and regulators can proceed in rationalizing of observed differences. Only in this way can strategy, policy and politics interact to the benefit of the communities served by each institution.

The classification of patient records into DRGs is a constantly evolving process. In fact, the group structure described here represents the third classification scheme developed using the methodology presented in the previous section. As coding schemes change and data are collected that are more current and representative of acute-care institutions in the United States, these groups will be re-examined and revised accordingly.

Currently the DRGs are being applied in a number of different practical and research settings in the health-care field. While these applications are discussed extensively elsewhere, a brief overview is presented in the following sections to give the reader a better understanding of the DRGs' potential utility in a variety of areas.

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4. Applications of the DRGs in Utilization Review

4.1 Case Mix Analysis of Hospital Utilization

IN COMPARING HOSPITAL PERFORMANCE on the basis of patient-care–related measures such as length of stay, cost, and death rate, it is important to determine the extent to which observed differences can be attributed to case mix and to what extent they are related to differing treatment practices. An individual institution has limited control over the former, and one expects utilization and quality-of-care measures to vary across the different types of cases it treats. For example, while a 15 per cent mortality rate is not unusual for acute myocardial infarction patients in most inpatient acute-care facilities, it would be alarming for women with normal deliveries. Likewise, a 2-day stay for tonsillectomies is typical, but it is unusually short for appendectomies. Thus, a hospital with a higher proportion of relatively complex cases could be expected to have, on the average, longer lengths of stay, increased costs, and higher death rates. Any comparison, then, of this institution with another on the basis of such measures must take into account its more complex case mix.

As stated in the introduction, one of the original motivations for the development of the DRGs was to provide a framework of case types that reflects the relative complexity of patients seen at an institution. Given such a framework, case mix–adjusted measures may be computed to control for differences in case mix and used in comparing acute-care inpatient facilities or groups of facilities. In addition, observed differences in some variable between 2 hospitals or a hospital and a set of hospitals may be partitioned into 3 components: 1) the amount of difference attributed to hospital treatment practices; 2) the amount of the difference attributed to hospital case mix; and 3) the amount of the difference attributed to the interaction of hospital treatment practices *and* case mix. This information allows one to make comparisons of hospital utilization and quality of care taking into account case composition. A case mix analysis report has been developed and is currently being applied in several PSRO settings as part of their evaluation of institutional length-of-stay patterns.[4]

4.2 Case Mix Report

Table 12 contains a sample report presenting case mix–related statistics for a set of hospitals in a given region. Of particular interest here is a comparison of their inpatient utilization as measured by length of stay in days. First of all, as noted at the top of the report, all patients in the region, regardless of institution or case type, experienced an average stay of 6.772 days. The report's objective is to examine each hospital's utilization in light of both case mix and length-of-stay patterns and to compare it to the others using the region as the standard reference. The precise mathematical formulation of the statistics contained in the report is presented elsewhere,[4] but a brief descriptive summary is presented here in order to demonstrate the application of DRGs in case mix analyses. In addition, the reader is referred to Hill[11] and Kitagawa[14] for a further discussion of the 2 techniques applied in this context, standardization and separation into components.

A hospital identifier appears in the first column followed by the corresponding number of observations (OBS) or records from that institution used in the computation of the statistics in the remaining columns. Column 3 contains the overall average length of stay (AVERAGE LOS) for patients in that institution, which is the

TABLE 12. Sample Case Mix Report for 8 Institutions Representing a Given Region

(1) Hospital	(2) OBS	(3) AVERAGE LOS	(4) CASE MIX ADJUSTED LOS	(5) LOS WEIGHTED CASE MIX	(6) AVERAGE LOS INDEX	(7) LOS INDEX	(8) CASE MIX INDEX	(9) AVERAGE LOS DIFFER	(10) DIFFER DUE TO LOS	(11) DIFFER DUE TO CASE MIX	(12) INTERACT DIFFER
1	12666	7.580	6.850	7.433	1.119	1.012	1.098	.808	.079	.661	.068
2	24049	6.533	6.591	6.643	.965	.973	.981	−.239	−.180	−.128	.070
3	14117	6.798	6.256	6.999	1.004	.924	1.034	.026	−.516	.227	.315
4	41643	7.479	7.320	6.960	1.105	1.081	1.028	.708	.548	.188	−.029
5	5499	6.395	6.068	7.072	.944	.896	1.044	−.377	−.704	.300	.027
6	8167	6.256	6.585	6.398	.924	.972	.945	−.516	−.187	−.374	.045
7	2828	6.493	6.434	7.230	.959	.950	1.068	−.279	−.338	.458	−.399
8	20494	4.943	5.457	5.785	.730	.806	.854	−1.828	−1.315	−.986	.473

See text for explanation.

number of bed days consumed per discharge. A case mix–adjusted length of stay (CASE MIX ADJUSTED LOS) appears in column 4 and is the mean length of stay the hospital would have experienced with the region's case mix. For the *i*th hospital, it is computed as

$$\sum_{j} a_{ij} P_j, \quad j = 1, \ldots, 383 \text{ (DRG)} \quad (4.1)$$

where a_{ij} is the average stay in the *j*th DRG in hospital i, and P_j is the proportion of the region's cases in DRG j. As such, it standardizes or holds constant case mix across all institutions and results in a measure that one can use to compare hospital utilization based on length of stay.

As a complement to the case mix–adjusted length of stay, column 5 contains the average length of stay the hospital would have experienced with its own case mix, but the region's average length of stay within each of the DRGs (LOS WEIGHTED CASE MIX). That is, for the *i*th hospital it is computed as

$$\sum_{j} A_j p_{ij}, \ j = 1, \ldots, 383 \text{ (DRG)} \quad (4.2)$$

where A_j is the region's average stay in the *j*th DRG, and p_{ij} is the proportion of the *i*th hospital's cases in the *j*th DRG. Since it uses a standard set of relative weights (A_j) for the DRGs, it can be interpreted as a relative measure of case mix complexity, with higher values indicating a more complex case mix, that is, a greater proportion of cases receiving a high amount of the hospital outputs. In interpreting this measure, it should be noted that complexity is a function of both the condition of patients as well as the treatment process selected by physicians. Columns 6 through 8 are indices computed by dividing the measures in columns 3 through 5, respectively, by the region's average length of stay.

Columns 9 through 12 present the observed difference between the institution's

and region's average length of stay (AVERAGE LOS DIFFER) and indicate to what extent this difference can be attributed to DRG-specific average length of stay or the a_{ij} (DIFFER DUE TO LOS), the case mix of its patients or the p_{ij} (DIFFER DUE TO CASE MIX), and the combination of the 2 or their interaction (INTERACT DIFFER).

The separation of the difference into these components is based on the technique described by Kitagawa,[14] briefly described here for the reader's convenience. If a_i and A represent the average length of stay for the ith institution and the region, respectively, then

$$a_i = \sum_j p_{ij}\, a_{ij},\ j = 1, \ldots, 383 \text{ (DRG)} \quad (4.3)$$

$$A = \sum_j P_j\, A_j,\ j = 1, \ldots, 383 \text{ (DRG)} \quad (4.4)$$

The difference between a_i and A can be expressed as

$$\underbrace{a_i - A}_{\text{AVERAGE LOS DIFFER}} = \underbrace{\sum_j P_j\,(a_{ij} - A_j)}_{\text{DIFFER DUE TO LOS}} + \underbrace{\sum_j A_j\,(p_{ij} - P_j)}_{\text{DIFFER DUE TO CASE MIX}} + \underbrace{\sum_j (a_{ij} - A_j)\,(p_{ij} - P_j)}_{\text{INTERACT DIFFER}} \quad (4.5)$$

for $j = 1, \ldots, 383$ (DRG).

This may be rewritten as

$$a_i - A = \left(\sum_j P_j\, a_{ij} - \sum_j P_j\, A_j\right) + \left(\sum_j A_j\, p_{ij} - \sum_j A_j\, P_j\right) + \sum_j (a_{ij} - A_j)\,(p_{ij} - P_j) \quad (4.6)$$

for $j = 1, \ldots, 383$ (DRG),

from which we note that the first 3 differences are computed by subtracting the region's average length of stay from the measures in columns 3 through 5. The interaction component is the residual or the amount of the difference between the hospital and the region not accounted for by the LOS difference (column 10) or the case mix difference (column 11).

The utilization of the report lies in interpreting the differences observed between an individual institution and the set of institutions or region as a whole. For example, consider Hospital 4, the largest with 41,643 cases (column 2). Its average length of stay was one of the longest, 7.479 days (column 3) or 0.708 days longer than the region (column 9). This difference can be attributed in varying degrees to the following components: 1) differences in case composition or case mix; 2) differences in case-specific average lengths of stay; and 3) differences attributed to the interaction of case mix and case-specific average lengths of stay. With respect to the first component, if the hospital's case mix had been treated at the region's average length of stay per DRG, Hospital 4's average length of stay would have been 6.96 days (column 5), for a difference of 0.188 days over the region (column 11). On the other hand, if the case mix were standardized or all institutions were treating the same types of patients, Hospital 4 would have had an average length of stay of 7.320 days (column 4), about a half day (column 10) longer than the region. Moreover, relative to the

others, it would have had the longest length of stay. Thus, institution 4 has an average stay that is .708 days longer than the region; .188 days is attributed to a more complex case mix and .548 days to longer DRG-specific average lengths of stay.

The sign and magnitude of the interaction difference (column 12) is an indication of the extent to which the observed difference between an institution's and the region's average length of stay is accounted for by both case mix and DRG-specific length of stay patterns jointly. It is that amount of the overall difference between the institutional and regional averages that cannot be allocated independently to case mix or DRG-specific utilization. A large positive interaction might arise, for example, if the hospital has an average length of stay higher than the region in those DRGs where it treats proportionately more patients than the region or a lower-than-average length of stay in those DRGs with proportionately less discharges. In this instance, the particular patterns of the hospital's deviation from the region in both case mix and utilization by DRG contibuted to it having a higher average length of stay.

The interaction difference is especially important to consider if its absolute value is large relative to the other differences (columns 10 and 11). Under these circumstances, one should not use the measures in the report for that hospital in comparison to the others. A large interaction indicates that hospital utilization patterns vary by case type and standardization would be misleading. Referring to the information in Table 12 Hospital 4 has a small-magnitude negative interaction component, −.029. On the other hand, consider Hospital 8, with an average length of stay of 4.943 days or 1.828 days shorter than the region. The bulk of this difference is attributed to lower DRG-specific utilization (−1.315 days), but also to a less complex case mix (−.986). However, note that these negative differences are partially offset by a half day (.473 days) attributed to the interaction of case mix and performance. In this instance, because of the relatively large interaction term, one should exercise caution in comparing this institution's standardized utilization measures with the other hospitals in the report.

Since discharge information on all patients is routinely collected by institutions for administrative purposes, census data of complete counts rather than samples are generally available for the report described above. However, because of its size or limitations in the number of services and staff available, an individual institution may not treat patients representing a large range of cases or DRGs. In this instance or in situations where there is known to be large interaction, as discussed in the preceding paragraph, an alternative strategy is to restrict one's comparison to a limited number of institutions with uniformly high numbers of cases or to perform comparisons on a limited set of DRGs, for example, those contained in a few Major Diagnostic Categories of particular interest.

4.3 Institutional and Practitioner Profiles in PSRO Evaluations

Professional Standards Review Organizations (PSROs) were mandated under an amendment to the Social Security Act of 1972 to assure the quality and appropriateness of health-care services delivered to federally funded patients (Medicare, Medicaid, Title V). To this end, one specific responsibility of each organization is "profile analysis"—that is, the construction and review of relevant summaries of aggregated data pertaining to the care and services received by patients and provided by practitioners and institutions in the PSRO area. It is basically a descriptive analysis of health care and service patterns using measures and formats which serve to

1) facilitate the identification of exceptional areas of performance and 2) provide a mechanism of the ongoing monitoring of the overall system, with particular attention to previously defined problem areas.

While considerable latitude is given the PSRO for the format and content of a profile, there are 3 basic components to its design: 1) *the patient group*, which defines the scope of the profile in terms of the population to be analyzed; 2) *the profile subjects*, which define the subset of the patient group whose data is to be profiled; that is, aggregated and summarized in terms of some measures for comparative purposes with other profile subjects or the entire patient group; and 3) *the profile elements*, which are the statistics or measures of interest to be displayed in the profile. These 3 components are chosen to meet the objectives of the analysis to be performed. Of particular importance is the selection of an appropriate patient group, whose definition should control, to the extent possible, those differences in the patient population that may affect the measures being displayed in the profile. For example, if a PSRO were interested in examining length-of-stay patterns for hospitals in its area, it would not be meaningful to form a group of patients from such diverse categories as normal deliveries, acute myocardial infaractions, gastric and peptic ulcers and hemorrhoids. In this case it would be impossible to determine from the aggregate summaries whether particularly deviant patterns for institutions were attributed to differences in the types of patients they treat or to differences in their length of stay.

The DRGs can therefore be an effective mechanism in profile analysis by providing a structure of consistent patient-class definitions within which institutional performance can be compared based on similar types of patients. As part of a project sponsored by the Health Standards and Quality Bureau, 7 PSRO sites have experimented with the use of institutional length-of-stay profiles based on DRGs for the retrospective monitoring of utilization patterns in their area.[10,12] Each site submitted tapes of their hospital abstract data, which were then assigned the appropriate DRG number based on information contained in the record. A series of reports were produced with summary statistics and institutional comparisons for each group.

An example of one report appears in Figure 3 and presents hospital length of stay performance patterns for DRG 121—Acute Myocardial Infarction. A hospital identifier appears on the left, adjacent to a grid containing the median (m), the interquartile range (25th [first x] to the 75th [second x] percentile), the 10th (first *) percentile, and 90th (second *) percentile of length of stay for each hospital. To the right of the grid are columns containing the number of discharges (OBS),the mean or average length of stay (MEAN), the standard deviation (S.D.) and the median (MEDIAN) length of stay, or 50th percentile. In this example, the median length of stay for the region as a whole was 2 weeks. However, there was considerable variation among hospitals. Hospital 8 had a median length of stay of 10 days, while Hospitals 4, 2 and 3 had medians of 15 days. Further investigation in this area through medical care evaluation studies may be warranted to determine if there are quality-of-care problems in the short-length-of-stays hospital or inappropriate utilization in the other 3 institutions.

As illustrated in the above example, these profiles are potentially useful in identifying areas of inappropriate utilization, which can lead to additional issues to address in quality of care. Since the overall number of DRGs is manageable and low compared to alternative classification by diagnosis or PAS group, sample sizes for individual hospitals in most cases are large enough to produce meaningful compari-

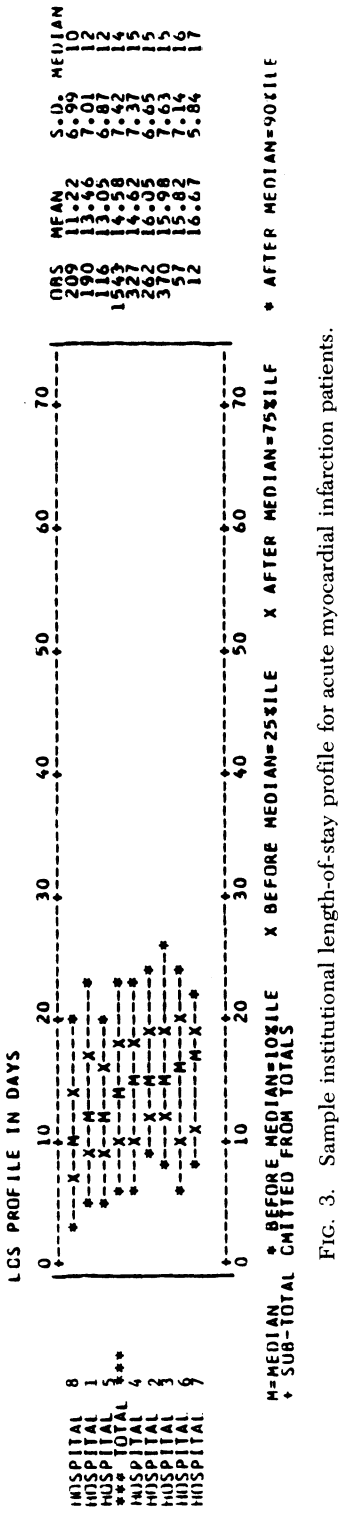

FIG. 3. Sample institutional length-of-stay profile for acute myocardial infarction patients.

sons. Moreover, each group can be reviewed by PSRO personnel and a set selected for follow-up analyses. To facilitate further the identification of aberrant utilization behavior, automated screens based on statistical algorithms have also been implemented that first flag those DRGs with relatively high inter-hospital variation, then determine for each hospital the groups in which its mean length of stay was significantly higher than the area and those in which it was significantly lower.

4.4 A PSRO Monitoring System

The utility of the DRGs in reviewing PSRO data has suggested their potential future application as a control mechanism to replace the present costly concurrent review process with a timely, cost-effective retrospective monitoring system. In this context, at the time of patient discharge, an abstract is produced and a DRG number assigned based on data in the record. When a small sample of records has accumulated in a DRG for an institution or set of institutions under examination, information from the sample can be used to estimate the parameters of the distributions of 1 or more dependent variables related to utilization or quality of care (e.g., length of stay, death rate, postoperative wound infection rate). Once acceptable patterns of practice have been established, the monitoring system can use standard statistical control procedures to detect changes in the process. When changes are detected, special studies may be justified to determine the cause for the change, which may be attributed to errors in the record, 1 or more particularly deviant cases, or an overall change in the treatment process that has affected all the cases. Work is currently under way to develop computer-based systems which could support such a control mechanism in a timely manner on either a hospital or PSRO level.

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5. Case Mix Accounting in Hospital Budgeting, Cost Control and Prospective Reimbursement

5.1 Case Mix Accounting

AN IMPORTANT OBJECTIVE of hospital costing and budgetary systems is the understanding and control of hospital costs. In traditional organizational settings, cost control is most successful in those situations where well-defined products or services are provided with a predictable set of associated costs. The provision of different combinations of products or services results in different levels of total resource consumption and cost requirements. Cost control in such settings basically entails the monitoring of resources consumed and costs incurred during the production process to insure consistency with expected levels. Thus, for such a system to be operational within a hospital, there must be a precise definition of the services provided by the institution. In a general sense, hospitals provide "patient care," but more specifically, they provide patient care of various kinds and intensities over various durations based on the needs of the patients treated.

Since the DRGs form a classification of the patient population into classes with similar expected output utilization, they can provide a definition of the services provided by a hospital. As such, they allow the resources consumed and costs incurred to be related directly to the types of patients or case mix that the hospital treats.[2,8,9] This is important in a hospital setting, where it is not management (i.e., administrators) but rather individual physicians who are reasponsible for allocating resources through various services and departments in order to provide effective patient care. To a large extent, physicians act independently of each other and are not generally aware of the overall financial implications of their individual decisions. If hospital cost control is to be attained, effective communication between the financial systems of the hospital and its physicians must be achieved. By formulating the hospital budget in terms of patient classes with similar patterns of care, a direct linkage between the practices of individual physicians and the financial consequences for the hospital can be realized.

The goal, then, of a case mix accounting system is to provide a complete financial picture of the costs of treating specific types of patients, whose care is the basic service of a hospital. Under the traditional organizational structure of a hospital, there is no department whose responsibility is to insure that individual patients are financially well managed. Typically, the hospital's 2 accounting systems—financial and managerial— deal with patients in the aggregate and not on an individual basis. The financial system provides the basic financial description of the hospital in terms of the balance sheet, income statement and funds flow, while the managerial accounting system provides the financial information oriented at the department level (e.g. nursing, laboratory, medical records) for internal management purposes. Thus, hospital accounting systems have not provided the integrated picture of the financial consequences of the care delivered to individual patients that case mix accounting is designed to produce.

5.2 DRG Cost Model

The process of determining the cost of treating patients in each of the DRGs for an individual hospital or collection of hospitals is decribed elsewhere.[2] In summary, the types of accounts in a hospital chart of accounts can be categorized into 6 distinct service areas: 1) outpatient accounts; 2)

overhead accounts not related to patient care; 3) overhead accounts related to patient care; 4) hotel and other general services accounts; 5) nursing accounts; and 6) ancillary services accounts.

The DRGs currently encompass only the inpatient population; hospital outpatient costs are not included in the DRGs' costs. Overhead accounts are costs incurred by the hospital in its general operation but are either not related or only indirectly related to the provision of patient care. Depreciation and interest charges are examples of overhead costs that are not related to patient care and therefore are not normally included in the DRG costs. Other overhead accounts such as housekeeping or laundry are indirectly related to the provision of patient care and are included in the DRG cost. The definition of the overhead accounts that are considered as patient-care–related versus non–patient-care–related can vary, depending on the goal of the case mix accounting system. For strictly internal management purposes it is reasonable to include as patient-care–related the various administrative services. However, if the case costs of a collection of hospitals are to be compared, then the administrative costs should not be included, since administrative costs can vary greatly across hospitals for reasons other than case mix. The remaining 3 types of accounts are all directly related to patient care and with the addition of the outpatient account, are referred to as the final cost centers. The services associated with these accounts can be directly related to individual patients, allowing the costs to be apportioned to each patient.

The direct costs of each final cost center and the portions of the cost of patient-care–related overhead accounts allocated to each final cost center (as determined by a special algorithm) represent the total cost of providing the services associated with each final cost center. An allocation statistic specific to each final cost center is used as the basis of apportioning the costs to the patients in each of the DRGs. For example, the cost of nursing is allocated to patients based on a DRG-specific per diem nursing weight which was derived through a study of the amount of nursing time spent with patients in each DRG. While all of the allocation statistics possess some defects, they are designed to reflect more equitably the quantity of an institution's resources consumed by the patients in each DRG. The end result of the DRG cost model is the determination of the unit cost of treating patients in each DRG.

5.3 Hospital Budgeting

The full case mix cost accounting approach has been applied to the budgetary process in 2 test hospitals. In the initial year, the unit costs (i.e., average cost per patient) in each DRG were determined. In order to establish the following year's budget, it was only necessary to project the hospital's case mix and apply the appropriate inflation factors. Deviations from the budget due to case mix were immediately detected and the diagnostic and service areas experiencing significant deviations from established unit costs were isolated.

The resulting unit costs in the test hospitals typically varied across DRGs by more than a hundredfold. The following DRGs illustrate this cost variation.

DRG	*Typical 1976 Unit Cost*
127—Ischemic heart disease except acute myocardial infarction with shunt or other major operation	$9,934
187—Gastric and peptic ulcer with gastric resection or other major operation with a secondary diagnosis present	7,362

112—Otitis media, chronic mastoiditis or otosclerosis without any operation	264
273—False labor without any operation	89

Even within a specific diagnostic area the DRGs provide a high degree of cost discrimination. For example, patients with a primary diagnosis of urinary calculus encompass 4 DRGs with the following typical 1976 unit costs:

Urinary Calculus DRGs	*Typical 1976 Unit Cost*
239—Without an operation or secondary diagnosis	$ 394
240—Without an operation with a secondary diagnosis	774
241—With minor operation such as cystoscopy or catheter to kidney	1,032
242—With major operation such as nephrotomy, cystotomy or ureterotomy	2,293

Thus, even within this narrow diagnostic area the unit costs across DRGs varied by a factor of nearly 6.

An example of a unit cost report for DRG 121—Acute Myocardial Infarction—appears in Figure 4. It compares the cost of treating AMI patients in the same hospital across 2 different years. The box at the top of the report summarizes the length of stay, charges, and costs experienced by AMI patients in the 2-year period. The bottom portion of the report breaks down the costs experienced in terms of the final cost centers of that hospital. For each item in the report both the absolute and per cent change across the 2 years are indicated. Such a report allows a hospital administrator to isolate both the diagnostic and service areas where there are significant differences across years or relative to other hospitals if comparable data from other hospitals is available. Once the potential problem areas have been identified, the administrator can begin a more meaningful dialogue with the physicians responsible for the identified patients and services.

5.4 Prospective Reimbursement

Traditionally, most health insurers have reimbursed hospitals retrospectively on the basis of reasonable and allowable costs. While this model of reimbursement guarantees coverage for most hospital expenditures, it provides little economic incentive to hospitals to control costs. Hospital prospective-reimbursement systems establish the rate of hospital reimbursement before the period over which the rate is to apply. The rewards and penalties inherent in a prospective system can potentially provide the motivation for hospitals to become more cost effective without sacrificing the quality of medical care. Under contract No. 600-77-022 from the Health Care Financing Administration, the State of New Jersey is in the process of moving from a per diem reasonable-cost–based reimbursement system to a cost-per-case incentive-based system.[21]

The Standard Hospital Accounting and Rate Evaluation (SHARE) system is the per diem cost-based reimbursement system currently in use in New Jersey. Under the SHARE system, costs are grouped into 31 cost centers according to uniform definitions of functional centers such as laboratory, radiology and the like. The inpatient costs are then regrouped within each cost center into 3 basic categories: 1) non–physician-controllable costs; 2) physician costs (e.g., physician and resident salaries and fees); and 3) other costs which are either not controllable by the hospital, or

DRG 121 ACUTE MYOCARDIAL INFARCTION

	1975	1976	CHANGE	% CHANGE
PATIENTS	267	315	48	17.98
TOTAL COST	736811.12	882896.69	146085.56	19.83
UNIT COST	2759.59	2802.85	43.25	1.57
DAILY COST	199.24	201.26	2.02	1.02
BED-DAYS	3698	4387	689	18.62
AVERAGE LOS	13.85	13.93	.08	.55
TOTAL CHARGES	820269.81	1042593.69	222323.87	27.10
AVERAGE CHARGE	3072.17	3309.82	237.65	7.74
COST/CHARGES	.89825	.84683		

FINAL COST CENTER	1975 UNIT COST	1976 UNIT COST	CHANGE UNIT COST	% CHANGE UNIT COST
DIETARY	127.46	131.44	3.98	3.12
ADMITTING	20.48	22.45	1.97	9.61
BILLING	90.40	97.27	6.87	7.60
HOTEL	159.28	180.74	21.45	13.47
NURSING	702.26	681.49	-20.77	-2.96
INTERNS & RESIDENTS	72.23	71.51	-.73	-1.00
MEDICAL RECORDS	22.01	26.39	4.38	19.87
SOCIAL SERVICE	16.36	17.50	1.14	6.95
NEW BORN CARE UNIT	.00	.00	.00	.00
INTENSIVE CARE UNIT	60.34	69.37	9.03	14.96
CORONARY CARE UNIT	636.73	509.58	-127.15	-19.97
OPERATING ROOM	.00	.00	.00	.00
RECOVERY ROOM	.00	.00	.00	.00
ANESTHESIOLOGY	.00	.00	.00	.00
DELIVERY ROOM	.00	.00	.00	.00
DIAGNOSTIC RADIOLOGY	70.77	86.87	16.10	22.75
RADIOISOTOPES	3.68	4.55	.87	23.55
RADIATION THERAPY	.00	.00	.00	.00
LABORATORY	276.29	330.85	54.56	19.75
EEG	.00	.00	.00	.00
EKG	58.22	55.07	-3.15	-5.41
MED-SURG SUPPLIES	101.24	136.18	34.94	34.51
PHYSICAL MEDICINE	68.74	84.43	15.69	22.83
RESPIRATORY THERAPY	77.25	82.49	5.24	6.79
IV THERAPY	39.82	49.30	9.47	23.79
PHARMACY	156.03	165.38	9.35	5.99
DIALYSIS	.00	.00	.00	.00
UROLOGY	.00	.00	.00	.00
KIDNEY TRANSPLANT	.00	.00	.00	.00

FIG. 4. Sample management report for acute myocardial infarction patients treated during a 2-year period.

which are not to be included in the determination of the SHARE reimbursement rate. After salary rates have been "equalized" in order to avoid distortions due to geographic wage differentials, controllable costs are grouped into 3 clusters of cost centers to allow for trade-offs in treatment modes. Hospital peer groups are formed and cost screens are set for each cluster of cost centers in each peer group. When a hospital's cluster of cost centers fails these screens, each cost center within each cluster is screened again within peer groups. Formulae then are applied to determine any unreasonable costs in the base period that should be disallowed. After a hospital's reasonable costs have been determined, a preliminary per diem reimbursement rate is determined for the hospital. The proposed SHARE per diem is re-examined in an informal review, often followed by appeals to the Department, and in some cases to the courts. Once the SHARE per diem is finalized, it provides the basis of reimbursement except for certain year-end adjustments made for volume variance, actual inflation, and cost increases because of legal and approved management changes, such as Certificates of Need and Blue Cross contractual adjustments.

The essential feature of the SHARE methodology is "peer grouping." This regulatory technique was developed in the utility field, wherein like institutions are classified according to comparable attributes in order to apply "fair" standards and develop reasonable rates. Since hospitals display more complexity than single-output industries such as electric, gas or telephone companies, the technique has been applied not at the aggregate level but at the cost center level. It should be noted that the form or unit of payment under the SHARE system is the per diem and that the basis of payment is cost.

Although the SHARE reimbursement methodology in New Jersey attained significant accomplishments in bringing a certain amount of order to cost reporting by hospitals in the state, there are basic elements to the structure of hospital reimbursement which remain problems and which SHARE is not equipped to address.

The fundamental problem in cost containment is defining the appropriate tools for measuring reasonable efficiency and effectiveness in the hospital setting. Accurate instruments are needed to measure the level of productivity and effectiveness in terms of both outputs and inputs and to respond with the appropriate financial incentives or disincentives. The attempt to measure and compare hospital efficiency at the cost-center level fails to recognize the role of case mix in determining hospital costs. Differences or lack of differences in hospital costs at the cost-center level can be the result of different case mix compositions and may not reflect differences in hospital productivity. Further, the quality or effectiveness of care must be properly identified and measured in order to evaluate accurately hospital productivity. Analyses by cost center may tend to obscure rather than clarify these problems.

The second limitation of the SHARE approach is in the existence of financial disincentives to the delivery of high-quality, appropriate and efficient care. It is no secret that the per diem form of payment tends to encourage longer lengths of stay. Furthermore, the length-of-stay incentive problem is compounded by the use of cost as a basis of reimbursement. The reasonable measure of a hospital financial manager's effectiveness is his success in maximizing reimbursement. The more cost is increased, the greater the revenues. Costs can be skillfully redistributed over different cost centers with the effect of escaping peer cost screens. Another problem for the regulator, and opportunity for the ambitious financial manager, results from a system in which some patients pay costs and others pay charges, compounded be-

cause the ratio of costs to charges can be manipulated. Some opportunities for business gamesmanship will doubtless be found in any reimbursement methodology. The reimbursement system must identify appropriate costs and design a financial incentive to monitor and minimize such practices.

Finally, the need for effective communication is perhaps the most serious problem facing regulation of the health-care industry. To be effective, regulators and managers must build a language to the physicians. It is a reflection of the state of the art that appeals in the hospital industry are managed by lawyers and accountants and therefore examine problems of allocation and finance. If the financial and medical information were merged, it would become possible to trace the relationship between the physicians' decisions and their effects on costs. From this base, the proper questions can be framed to deal equitably with issues of effectiveness, quality and efficiency in patient care.

Thus, the SHARE methodology was not equipped to address the problems of 1) defining and measuring hospital case mix, productivity and effectiveness; 2) providing incentives for better management; 3) avoiding business gamesmenship; and 4) fostering communications between the hospital financial systems and physicians. In order to deal with these problems, New Jersey is developing a prospective case-cost incentive-reimbursement system. The DRGs will provide the basis for the definition of case types and differential reimbursement rates will be established for each DRG. In order to develop the DRG reimbursement rates, it is necessary to obtain the patient abstract, billing and financial information for the case mix cost accounting model described in the previous section.

Since January 1976, New Jersey has been receiving medical discharge abstracts from all 104 acute-care hospitals in the state. In addition, 21 self-selected hospitals are also submitting their billing information. Hospital cost information is obtained through SHARE and is grouped into 2 categories: costs directly related to patient care, and institutional and other costs.

Costs that were judged to be relatively fixed in the short run, and not directly related to patient care, were categorized as institutional costs. Institutional cost centers include managerial services, facilities maintenance, and allied health, nursing and graduate medical education costs. A separate methodology was developed to determine reasonable institutional costs comprised of a fixed sum and variable amounts that relate to teaching commitment and to the total amount of patient-care dollars. The patient-care costs were allocated to the patients in each DRG using the DRG-cost accounting methodology.

The case mix cost accounting approach permits the development of the institutional productivity goals desired by the regulators and the proper recognition of case mix complexity differences across hospitals. Once the DRG costs have been determined, reimbursement standards by DRG provide an appropriate set of goals, which are balanced to reflect the interests of both the public and the industry. The preliminary rate design has set a rate per DRG for each hospital, composed of proportions of the hospital mean case cost per DRG and the state standard (the mean case cost per DRG across the sample of 21 hospitals). The hospital and state proportion would always sum to unity. Thus, for example, in the initial years of the system the rate per DRG might consist of 75 per cent hospital cost and 25 per cent state standard. Although the proportion of state standard would begin to approach 100 per cent over time, the early emphasis on the hospital actual cost will provide a reasonable opportunity for institutions themselves to make use of management information by DRG. Detailed management information by DRG will be provided to each hospital and will be organized to help the

hospitals effectively focus on areas of concern in order to deal with problem areas.

In order to realize fully the potential of the system, the process of implementation currently is planned for 2 distinct stages. Stage 1, the initial development, gives to each hospital both the opportunity and responsibility for reacting to the management information by implementing steps to remedy inefficiency, expanding efficiency, and opening an effective dialogue with their physicians. The motivation for discharging this burden is supplied by prospective, incentive-based reimbursement. Thus, in any given year, a hospital would retain the savings achieved by bringing in its cost per case under the prospective rate. Since the form of payment is per case rather than per diem, the unit of reimbursement no longer poses an incentive to increased lengths of stay. Recalculating the next year's prospective rate based on the previous year's actual achievement serves the public interest by embedding the results in an improved standard.

The second stage in the process of implementation will involve properly crystallizing questions of inter-hospital significance. Health-care issues will be placed in their DRG-specific and medical context, rather than the current collection of financially oriented appeals, thus permitting an examination of efficiency, quality and appropriateness. The stages permit the passage of time required to purge imperfections in the data base and to allow hospital reaction to successive generations of the rate. Beginning in early 1980, prospective DRG rates are scheduled to be set for 26 New Jersey hospitals.

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6. A Case Mix Approach to Regional Planning for Acute Care Hospitals

WHILE THERE ARE ONGOING USES of the DRGs in the areas of utilization review and hospital budgeting, cost control, and reimbursement, the application of the DRGs in the area of hospital regional planning is only in its early stages of development.[5] Regional planning refers to the activity of organizing health-care resources in a defined geographic region to achieve a desired state of affairs in terms of the availability of health care of acceptable quality and cost. The primary thrust of the hospital planning activity has traditionally focused on hospital facilities, primarily beds. Through legislation such as the Hill-Burton Act, much of the planning activity prior to the 1970s emphasized the adequacy and distribution of hospital beds to meet the needs of the population. However, the rapid increase in sophisticated medical technology has resulted in a need to plan on a regional basis not only for hospital beds but also for specific hospital services and equipment. Thus, the planning for the quantity and distribution of major new equipment such as computed tomography scanners or specific hospital services such as open heart surgery has become an integral part of the planning activity. Since certain types of services and equipment are necessary to treat specific patient types, planning decisions will affect the case mix a hospital can treat.

The modification by the planning process of the case mix that an individual hospital can treat will inevitably affect the case mix of the other hospitals in the region. For example, if a new service is added in one hospital, then that hospital will begin to treat additional types of patients. This will likely result in a decrease in the number of those types of patients treated at the other hospitals in the region. Further, the new service may cause the other capacities of the hospital (e.g., beds or operating room time) to be exceeded, requiring that the hospital cease to treat patients to whom it previously provided care. The excess patients will have to be treated in the other hospitals in the region. Thus, the implications of a planning decision can be complex and difficult to predict. A case mix approach to regional planning would have as its central focus the patients being treated and the demands they place on hospital resources. The role of each hospital in the region would be defined in terms of the case mix it treats.

The basic hospital regional planning problem must consider a number of factors simultaneously:

1. All patients must have access to the necessary hospital services. Access would normally be defined in terms of travel time by ground transportation. An acceptable travel time could vary by case type, depending on the prevelance of the patient type and nature of the condition (i.e., chronic, emergency, etc.).

2. The bed and other capacities of the hospitals in the region must be sufficient to meet the demand for care.

3. Patients must only be treated in hospitals with adequate services, equipment and specialists. The type of hospital facilities and specialists necessary for proper care will vary with patient types. For example, it might be determined that patients younger than 14 years of age should only be treated at hospitals with pediatric units.

4. Minimal quality-of-care standards for each patient type must be met. The quality-of-care standards could be as basic as a minimal mortality rate for each patient type. For example, if the mortality rate for acute myocardial infarction patients in a hospital exceeded some percentage, such as 20 per cent, then the planning process must consider requiring that hospital to cease providing care to those patients. The quality-of-care standard could become

more sophisticated and include process and outcome measures.

5. The cost of providing care to the different types of patients must be reasonable. The information from projects such as the New Jersey prospective reimbursement experiment can establish the cost of providing care to each patient type in each hospital. If a hospital proves extremely cost ineffective in providing care to certain types of patients, then the planning process must consider whether a more cost-effective alternative exists.

Thus, the basic hospital regional planning problem can be described as a system of hospitals with the capacity to treat specified numbers and types of patients. In addition, there are a set of basic quality and access constraints that must be met. However, given that the capacity bounds and access and quality constraints can be met by a number of alternative configurations of case mix, the alternative requiring the least cost is likely to be the preferred alternative. Such a problem can be analyzed using linear programming techniques. The DRG can provide the basis for establishing hospital case mix. A case mix–based linear programming model of the regional planning problem should prove to have many immediate practical applications. For example, suppose a proposal to close a particular hospital had been made. The regional planning model could be used to suggest the most cost-effective means of distributing the closed hospital's case mix to the other hospitals in the region while still maintaining adequate access and quality and not exceeding the capacities of any hospital. Alternatively, if there were an existing recommendation for the distribution of the closed hospital's case mix, then the model could be used simply to simulate the impact of the case mix changes on the other hospitals and describe that impact in terms of various hospital parameters, such as occupancy rates and reimbursement levels. There are many other examples of the use of such a model. If there were significant changes in the composition of case types projected because of a new cure or an outbreak of an infectious disease, then the model could be used to evaluate the impact on the hospitals in the region. Thus, while a case mix regional planning model is only in its early stages of development, it does hold the potential to be a powerful tool for the hospital planning process.

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7. Summary and Conclusions

PATIENTS treated in an acute-care facility can vary considerably in both the duration and intensity of services required to provide appropriate patient care. The relative amounts and types of hospital outputs utilized by individual patients are dependent on both the condition of the patient and the treatment process employed. By relating the demographic, diagnostic, and therapeutic characteristics of patients to the hospital outputs they utilize, a patient classification scheme can be developed which provides the framework for both the specification of hospital case mix and the measurement of the impact of case mix on hospital utilization and performance. The Diagnosis-Related Groups represent an attempt to provide such a patient classification scheme. As currently defined, the DRGs provide a manageable number of patient classes (383) that are exhaustive and mutually exclusive with respect to the types of patients seen in an acute-care setting. Further, the DRGs provide patient classes that are clinicially consistent and that have similar patterns of output utilization as measured by length of stay.

The comparison of patient data across institutions or providers will invariably reveal the existence of differential levels of utilization and performance. A comparative analysis by average length of stay, cost, or any other aggregate measure is not meaningful unless the impact of different case mix compositions can be determined. The DRGs can provide a framework for establishing the effects of case mix as well as for identifying diagnostic areas with potential problems. The goal of most comparative analyses is to isolate problem areas so that corrective measures can be initiated. If programs aimed at improving the performance of the hospital health-care system are to be successful, managers and regulators must establish an effective dialogue with those responsible for the delivery of services, the physician community. The DRGs provide the first step in such a dialogue since problems defined in the context of DRGs are understandable from a clinical perspective.

The various actual and potential applications of the DRGs in the areas of utilization review, hospital budgeting and cost control, prospective reimbursement and regional planning emphasize the central role of the patient. By focusing on the types of patients being treated, programs responsible for these activities will share a common conceptual basis even though they are concerned with different aspects of the health care system. While the applications to date have been implemented to meet the immediate needs of the individual programs, future work will be directed toward exploring the potential of the DRGs in achieving better integration and coordination of the different program goals and activities.

The current set of 383 DRGs were developed in light of the available data and its limitations at the time of their construction. As such, they represent just one implementation of an evolving series of patient classification schemes. As more comprehensive and reliable patient data become available and the practice of medicine changes, the DRGs must adapt to reflect these changes. To this end, it is felt that the technology and strategy used in forming the DRGs can be applied in the development of future generations of classification systems. Indeed, a major revision and evaluation of the DRGs will be undertaken as soon as ICD-9-CM data are available in sufficient quantities. Further, work has begun in extending the approach into other areas of health-care delivery, in particular, ambulatory care.[24]

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Appendix
Diagnosis-Related Group Descriptions

	Major Diagnosis Category		Diagnosis-Related Groups
01:	Infectious Diseases	001	Infectious Disease (Enteritis, Diarrhea) with Age less than 16
		002	Infectious Disease (Enteritis, Diarrhea) with Age greater than 15
		003	Infectious Disease (Viral Disease, VD, Meningitis) without Secondary Diagnosis
		004	Infectious Disease (Viral Disease, VD, Meningitis) with Secondary Diagnosis
		005	Infectious Disease (Blood Infection, TB, Salmonella) without Surgery
		006	Infectious Disease (Blood Infection, TB, Salmonella) with Surgery
02:	Malignant Neoplasm of the Digestive System	007	Cancer of the Mouth, Tongue, Large Intestine, Liver, Gallbladder without Surgery
		008	Cancer of the GI System (Esophagus, Stomach, Pancreas, Small Intestine, Rectum) without Surgery
		009	Cancer of the GI System with Surgical Procedure (Biopsy, Endoscopy, Local Excision, Centesis) without Secondary Diagnosis
		010	Cancer of the GI System with Surgical Procedure (Biopsy, Endoscopy, Local Excision, Draining) with Secondary Diagnosis
		011	Cancer of the GI System with Surgery (Gastric Resection, Colon Resection, Esophagus Resection)
03:	Malignant Neoplasm of the Respiratory System	012	Cancer of the Respiratory System (Trachea, Lung, Larynx, Thorax, Mediastinum) without Surgery without Secondary Diagnosis
		013	Cancer of the Respiratory System (Trachea, Lung, Larynx, Thorax, Mediastinum) without Surgery with Secondary Diagnosis
		014	Cancer of the Respiratory System with Surgical Procedure (Biopsy, Endoscopy, Excision of Lesion) without Secondary Diagnosis
		015	Cancer of the Respiratory System with Surgical Procedure (Biopsy, Endoscopy, Excision of Lesion) with Secondary Diagnosis
		016	Cancer of Respiratory System with Surgery (Lobectomy, Laryngectomy, Radical Resection)
04:	Malignant Neoplasm of the Skin	017	Cancer of the Skin except Malignant Melanoma without Secondary Diagnosis
		018	Cancer of the Skin except Malignant Melanoma with Secondary Diagnosis
		019	Cancer of the Skin—Malignant Melanoma with Surgical Procedure without Secondary Diagnosis
		020	Cancer of the Skin—Malignant Melanoma with Surgical Procedure with Secondary Diagnosis
05:	Malignant Neoplasm of the Breast	021	Cancer of the Breast without Surgery with Age less than 63
		022	Cancer of the Breast without Surgery with Age greater than 62
		023	Cancer of the Breast with Surgery without Secondary Diagnosis
		024	Cancer of the Breast with Surgery with Secondary Diagnosis
06:	Malignant Neoplasm of the Female Reproductive System	025	Cancer of the Female Reproductive System (Uterus, Cervix, Vagina, Ovary, Fallopian Tube) without Surgery without Secondary Diagnosis
		026	Cancer of the Female Reproductive system (Uterus, Cervix, Vagina, Ovary, Fallopian Tube) without Surgery with Secondary Diagnosis
		027	Cancer of the Female Reproductive System with Surgical Procedure (D&C, Biopsy, Excision of Lesion) without Secondary Diagnosis

Major Diagnosis Category		Diagnosis-Related Groups	
		028	Cancer of the Female Reproductive System with Surgical Procedure (D&C, Biopsy, Excision of Lesion) with Secondary Diagnosis
		029	Cancer of the Uterus Body with Surgery (Removal of Uterus)
		030	Cancer of the Uterus, Cervix, Ovary with Surgery (Removal of Uterus or other Major Operation)
07:	Malignant Neoplasm of the Male Reproductive System	031	Cancer of the Male Reproductive System (Penis, Prostate, Testicle) without Surgery
		032	Cancer of the Male Reproductive System with Surgical Procedure (Biopsy, Cystoscopy, Removal of Testicle) without Secondary Diagnosis
		033	Cancer of the Male Reproductive System with Surgical Procedure (Biopsy, Cystoscopy, Removal of Testicle) with Secondary Diagnosis
		034	Cancer of the Male Reproductive System with Surgery (Amputation of Penis, Removal of Prostate, Radical Excision of Lesion)
08:	Malignant Neoplasm of the Urinary System	035	Cancer of the Urinary System (Bladder, Urethra, Kidney, Ureter) without Surgery
		036	Cancer of the Urinary System with Surgical Procedure (Cystoscopy, TUR, Excision of Lesion) without Secondary Diagnosis
		037	Cancer of the Urinary System with Surgical Procedure (Cystoscopy, TUR, Excision of Lesion) with Secondary Diagnosis
		038	Cancer of the Urinary System with Surgery (Removal/Excision of Bladder, Kidney, Ureter, Urethra)
09:	Malignant Neoplasm of Other and Unspecified Sites	039	Cancer of the Bone, Thyroid, Connective Tissue, Nerves without Surgery
		040	Cancer of the Brain, Secondary Cancer, Multiple Cancer Sites without Surgery without Secondary Diagnosis
		041	Cancer of the Brain, Secondary Cancer, Multiple Cancer Sites without Surgery with Secondary Diagnosis
		042	Cancer of the Thyroid, Connective Tissue, Nerves with Surgical Procedure (Biopsy, Excision)
		043	Cancer of a Secondary Site, Multiple Sites with Surgical Procedure (Biopsy, Excision)
		044	Cancer of the Bone, Connective Tissue, Nerves, Secondary Site, Multiple Sites with Surgery
10:	Neoplasm of the Lymphatic and Hemopoietic Tissue	045	Tumor of the Lymphatic System, Blood Making Tissue without Secondary Diagnosis with Age less than 16
		046	Tumor of the Lymphatic System, Blood Making Tissue with Secondary Diagnosis with Age less than 16
		047	Disease of the Lymphatic System, Hodgkins Disease, Sarcoma without Surgery without Secondary Diagnosis with Age greater than 15
		048	Disease of the Lymphatic System, Hodgkins Disease, Sarcoma without Surgery with Secondary Diagnosis with Age greater than 15
		049	Tumor of the Lymphatic System, Multiple Myeloma, Leukemia without Surgery with Age greater than 15
		050	Tumor of the Lymphatic System, Blood Making Tissue with Surgical Procedure (Excision of Node) without Secondary Diagnosis with Age greater than 15
		051	Tumor of the Lymphatic System, Blood Making Tissue with Surgical Procedure (Excision of Node) with Secondary Diagnosis with Age greater than 15
		052	Tumor of the Lymphatic System, Blood Making Tissue with Surgery (Splenectomy, Radical Resection) with Age greater than 15

	Major Diagnosis Category		Diagnosis-Related Groups
11:	Benign Neoplasm of the Female Reproductive System	053	Benign Tumor (Papilloma, Polyp) of the Uterus, Vagina, Vulva without Secondary Diagnosis
		054	Benign Tumor (Papilloma, Polyp) of the Uterus, Vagina, Vulva with Secondary Diagnosis
		055	Benign Tumor (Fibroma) of the Uterus, Ovary without Surgery
		056	Benign Tumor (Fibroma) of the Uterus, Ovary with Surgical Procedure (D&C, Excision of Lesion) without Second Surgery
		057	Benign Tumor (Fibroma) of the Uterus, Ovary with Second Surgery
		058	Benign Tumor (Fibroma) of the Uterus, Ovary with Surgery (Removal of Ovary)
		059	Benign Tumor (Fibroma) of the Uterus, Ovary with Surgery (Removal of Uterus)
12:	Benign Neoplasm of Other Sites	060	Benign Tumor of the Intestines, Urinary System, without Surgery
		061	Benign Tumor of the Brain, Pituitary Gland without Surgery
		062	Benign Tumor of the Skin, Bone, Urinary System (Kidney, Bladder), Connective Tissue with Surgery without Secondary Diagnosis
		063	Benign Tumor of the Skin, Bone, Urinary System (Kidney, Bladder), Connective Tissue with Surgery with Secondary Diagnosis with Age less than 43
		064	Benign Tumor of the Skin, Bone, Urinary System (Kidney, Bladder), Connective Tissue with Surgery with Secondary Diagnosis with Age greater than 42
		065	Benign Tumor of the Intestines, Nerves with Surgical Procedure (Excision, Other) without Secondary Diagnosis
		066	Benign Tumor of the Intestines, Nerves with Surgical Procedure (Excision, Other) with Secondary Diagnosis
		067	Benign Tumor of the Intestines, Nerves with Surgery (Colon Resection, Craniotomy Radical Resection, Other Major Operation)
		068	Benign Tumor of the Stomach, Brain, Respiratory System, Esophagus, Pituitary Gland with Surgery
13:	Diseases of Thyroid and Other Endocrine Glands	069	Disease of the Thyroid (Non-Toxic, Simple), Other Endocrine Glands (Adrenal, Pancreas) without Surgery
		070	Disease of the Thyroid (Toxic), Low Function Pituitary without Surgery
		071	Endocrine Disorder with Surgical Procedure (Thyroidectomy, Other)
		072	Endocrine Disorder with Surgery
14:	Diabetes	073	Diabetes without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis with Age less than 36
		074	Diabetes without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis with Age greater than 35
		075	Diabetes without Surgery with Major Secondary Diagnosis
		076	Diabetes with Surgical Procedure (Endoscopy, Biopsy)
		077	Diabetes with Surgery (Amputation of Extremity, Other Major)
15:	Nutritional and Other Metabolic Diseases	078	Metabolic Disorder (Gout, Blood Globulin) without Secondary Diagnosis
		079	Metabolic Disorder (Gout, Blood Globulin) with Secondary Diagnosis (Nutrition Deficiency)
		080	Metabolic Disease (Cystic Fibrosis, Sprue, Unspecified)
		081	Metabolic disease (Obesity, Malabsorption, Unspecified)
16:	Diseases of the Blood and Blood Forming Organs	082	Mediterranean Anemia, Hemophilia without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis with Age less than 11

Major Diagnosis Category		Diagnosis-Related Groups	
		083	Mediteranean Anemia, Hemophilia without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis with Age greater than 10
		084	Disease of Blood Hemoglobin without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		085	Disease of the Blood (Anemias), Blood Forming Organs (Spleen) without Surgery with Major Secondary Diagnosis
		086	Disease of the Blood (Anemias), Blood Forming Organs with Surgery with Age 2–52
		087	Disease of the Blood (Anemias), Blood Forming Organs with Surgery with Age less than 1 or greater than 53
17:	Psychoses Not Attributed to Physical Conditions	088	Schizophrenia (Paranoid, Catatonic, Unspecified) Involutional Melancholia with Psychiatric Service
		089	Schizophrenia (Paranoid, Catatonic, Unspecified) Involutional Melancholia without Psychiatric Service
		090	Schizophrenia (Affective, Acute Episode), Manic-Depressive Psychosis
18:	Neuroses	091	Neurosis (Anxiety, Hysterical, Phobic, Hypochandriacal Unspecified)
		092	Neurosis (Obsessive-Compulsive, Depressive), Personality-Disorders
19:	Alcoholic Mental Disorder and Addiction	093	Alcoholism without Secondary Diagnosis or with Minor Secondary Diagnosis
		094	Alcoholism with Major Secondary Diagnosis (Liver Cirrhosis, Delirium Tremens, Other)
20:	Other Mental Disorders	095	Drug Dependence, Physical Disorder (Probably Psychiatric Origin), Cephalgia
		096	Psychosis, Non-Psychosis Related Brain Condition
21:	Diseases of the Central Nervous System	097	Epilepsy, Migraine, Brain Disorder (Unspecified) without Surgery without Secondary Diagnosis
		098	Epilepsy, Migraine, Brain Disorder (Unspecified) without Surgery with Secondary Diagnosis
		099	Multiple Sclerosis, Paralysis Agitans, Meningitis, Hemiplegia without Surgery
		100	Disease of the Central Nervous System with Surgical Procedure (Nerve Block, Other)
		101	Disease of the Central Nervous System with Surgery (Laminectomy, Spinal Fusion Ventricular Shunt)
22:	Diseases of the Peripheral Nervous System	102	Facial Paralysis, Neuralgia (Trigeminal, Other Unspecified) without Surgery
		103	Sciatica, Polyneuritis without Surgery
		104	Disease of the Median Nerve with Surgery
		105	Disease of the Peripheral Nerves except Median with Surgical Procedure (Nerve Block, Other Unspecified)
		106	Disease of the Peripheral Nerves except Median with Surgery (Spinal Cord, Nerve Roots)
23:	Diseases of the Eye	107	Cross Eyedness, Cataract, Cyst of the Eyelid without Surgery
		108	Glaucoma, Corneal Inflammation/Ulceration, Disease of the Iris, Retina without Surgery
		109	Disease of the Eye with Surgical Procedure (Muscle Repair of Eyelid, Other)
		110	Disease of the Eye with Surgical Procedure (Removal of Lens, Incision into Sclera
		111	Disease of the Eye with Surgical Procedure (Reattachment of Retina, Repair of Cornea)

	Major Diagnosis Category		Diagnosis-Related Groups
24:	Disease of the Ear and Mastoid Process	112	Disease of the Middle Ear (Inflammation, Chronic Mastoid Bone Inflammation) without Surgery
		113	Disease of the Inner Ear (Inflammation, Menieres Disease) without Surgery
		114	Disease of the Ear with Surgical Procedure (Incision of Membrane, Removal of Adenoids, Other)
		115	Disease of the Middle Ear with Surgery (Removal of Bone, Repair of Membrane)
		116	Disease of the Ear with Surgery (Removal of Mastoid Bone, Excision of Middle Ear, Other)
25:	Hypertensive Heart Diseases	117	Hypertensive Heart Disease without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		118	Hypertensive Heart Disease without Surgery with Major Secondary Diagnosis
		119	Hypertensive Heart Disease (Fatal) with Kidney Involvement without Surgery with Major Secondary Diagnosis
		120	Hypertensive Heart Disease with Surgery
26:	Acute Myocardial Infarction	121	Disease of the Heart—Acute Myocardial Infarction
27:	Ischemic Heart Diseases Except AMI	122	Disease of the Heart, Ischemia (Blood Deficiency) except AMI without Surgery without Secondary Diagnosis
		123	Disease of the Heart, Ischemia (Blood Deficiency) except AMI without Surgery with Minor Secondary Diagnosis
		124	Disease of the Heart, Ischemia (Blood Deficiency) except AMI without Surgery with Major Secondary Diagnosis
		125	Disease of the Heart, Ischemia (Blood Deficiency) except AMI with Cardiac Catheterization
		126	Disease of the Heart, Ischemia (Blood Deficiency) except AMI with Surgical Procedure (Endoscopy, Insertion of Electronic Device)
		127	Disease of the Heart, Ischemia (Blood Deficiency) except AMI with Surgery (Shunt, Other Major)
28:	Arrhythmia and Slowed Conduction	128	Disease of the Heart, Irregular Heart Rhythm, Slowed Conduction without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		129	Disease of the Heart, Irregular Heart Rhythm, Slowed Conduction without Surgery with Major Secondary Diagnosis
		130	Disease of the Heart, Irregular Heart Rhythm, Slowed Conduction with Replacement of Heart Device or Cardiac Catheterization
		131	Disease of the Heart, Irregular Heart Rhythm, Slowed Conduction with Insertion of Electronic Heart Device
29:	Heart Failure	132	Disease of the Heart, Failure (Poor Function) without Surgery
		133	Disease of the Heart, Failure (Poor Function) with Surgery
30:	Carditis, Valvular and Other Diseases	134	Disease of the Heart, Inflammation, Valve Problem without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		135	Disease of the Heart, Inflammation, Valve Problem without Surgery with Major Secondary Diagnosis
		136	Disease of the Heart, Inflammation, Valve Problem with Cardiac Catheterization without Secondary Diagnosis or with Minor Secondary Diagnosis
		137	Disease of the Heart, Inflammation, Valve Problem with Cardiac Catheterization with Major Secondary Diagnosis

Major Diagnosis Category		Diagnosis-Related Groups	
		138	Disease of the Heart, Inflammation, Valve Problem with Surgery (Valve Replacement, Other Major)
31:	Cerebrovascular Diseases	139	Circulatory Disorder of the Brain, Occasional Blood Deficiency without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		140	Circulatory Disorder of the Brain, Occasional Blood Deficiency without Surgery with Major Secondary Diagnosis
		141	Blood Clot in Brain Obstructing Circulation without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		142	Blood Clot in Brain Obstructing Circulation without Surgery with Major Secondary Diagnosis
		143	Brain Hemorrhage (Stroke) without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		144	Brain Hemorrhage (Stroke) without Surgery with Major Secondary Diagnosis
		145	Circulatory Dysfunction in Brain with Surgery
32:	Diseases of the Vascular System	146	Disease of the Circulatory System, Inflammation of the Lymph Glands, Varicose Veins (Legs), Raynauds Disease without Surgery
		147	Disease of the Circulatory System (Hardening of Arterial Walls, Arterial Blood Clot) without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		148	Disease of the Circulatory System (Hardening of Arterial Walls, Arterial Blood Clot) without Surgery with Major Secondary Diagnosis
		149	Disease of the Circulatory System with Surgical Procedure (Excision of Varicose Veins, Other) with Age less than 51
		150	Disease of Vascular System with Surgery (Excision of Varicose Veins, Other) with Age greater than 50
		151	Disease of Vascular System with Surgery (Excision of Nerve, Vessel) without Secondary Diagnosis
		152	Disease of Vascular System with Surgery (Excision of Nerve, Vessel) with Secondary Diagnosis
		153	Disease of Vascular System with Surgery (Arterial Reconstruction, Amputation of Extremity)
33:	Pulmonary Embolism	154	Blood Clot of the Lung without Secondary Diagnosis or with Minor Secondary Diagnosis
		155	Blood Clot of the Lung with Major Secondary Diagnosis
34:	Phlebitis and Thrombophlebitis	156	Inflammation of the Veins, Blood Clot without Secondary Diagnosis or with Minor Secondary Diagnosis
		157	Inflammation of the Veins, Blood Clot with Major Secondary Diagnosis
35:	Hemorrhoids	158	Hemorrhoids
36:	Hypertrophy of Tonsil and Adenoid	159	Enlargement of the Tonsils/Adenoids
37:	Acute Upper Respiratory Tract Infection and Influenza	160	Acute Upper Respiratory Tract Infection, Influenza with Age less than 45
		161	Acute Upper Respiratory Tract Infection, Influenza with Age greater than 44
38:	Other Diseases of the Upper Respiratory Tract	162	Disease of the Upper Respiratory Tract except Acute Upper Respiratory Infection and Influenza without Surgery

Major Diagnosis Category		Diagnosis-Related Groups	
		163	Disease of the Upper Respiratory Tract with Surgical Procedure (Biopsy, Visualizations of the Nasal Septum)
		164	Disease of the Upper Respiratory Tract with Surgery (Nose Reconstruction, Incision and Drainage of Sinus)
39:	Pneumonia	165	Pneumonia with Age less than 31
		166	Pneumonia without Surgery without Secondary Diagnosis with Age greater than 30
		167	Pneumonia without Surgery with Secondary Diagnosis with Age greater than 30
		168	Pneumonia with Surgery
40:	Bronchitis	169	Bronchitis with Age less than 46
		170	Bronchitis without Secondary Diagnosis or with Minor Secondary Diagnosis with Age greater than 45
		171	Bronchitis with Major Secondary Diagnosis with Age greater than 45
41:	Asthma	172	Asthma with Age less than 31
		173	Asthma without Secondary Diagnosis with Age greater than 30
		174	Asthma with Secondary Diagnosis with Age greater than 30
42:	Other Lung and Pleural Diseases	175	Lung Collapse, Pleurisy, Pulmonary congestion without Surgery
		176	Emphysema, Empyema, Abscess, Acute Swelling without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis
		177	Emphysema, Empyema, Abscess, Acute Swelling without Surgery with Major Secondary Diagnosis
		178	Disease of the Lung and Pleura with Surgical Procedure (Bronchoscopy, Chest Incision, Other) without Secondary Diagnosis
		179	Disease of the Lung and Pleura with Surgical Procedure (Bronchoscopy, Chest Incision, Other) with Secondary Diagnosis
		180	Disease of the Lung and Pleura with Surgery (Removal of Lobe; Other Major)
43:	Diseases of the Oral Cavity, Salivary Glands and Jaw	181	Minor Problems of the Teeth
		182	Major Problems of the Teeth (Jaw, Salivary Glands, Other Oral Soft Tissue)
44:	Gastric and Peptic Ulcer	183	Stomach Ulcer without Surgery without Secondary Diagnosis
		184	Stomach Ulcer without Surgery with Secondary Diagnosis
		185	Stomach Ulcer with Surgical Procedure (Biopsy, Visualization, Other)
		186	Stomach Ulcer with Surgery (Removal of Portion of Stomach, Other Major) without Secondary Diagnosis
		187	Stomach Ulcer with Surgery (Removal of Portion of Stomach, Other Major) with Secondary Diagnosis
45:	Upper Gastro-Intestinal Diseases except Gastric and Peptic Ulcer	188	Upper GI Disease Except Stomach Ulcer without Surgery without Secondary Diagnosis
		189	Upper GI Disease Except Stomach Ulcer without surgery with Secondary Diagnosis
		190	Upper GI Disease Except Stomach Ulcer with Surgical Procedure (Visualization, Other Minor) without Secondary Diagnosis
		191	Upper GI Disease Except Stomach Ulcer with Surgical Procedure (Visualization, Other Minor) with Secondary Diagnosis
		192	Upper GI Disease Except Stomach Ulcer with Surgery
46:	Appendicitis	193	Appendicitis (without Peritonitis) without Secondary Diagnosis
		194	Appendicitis (without Peritonitis) with Secondary Diagnosis
		195	Appendicitis (with Peritonitis, Other) without Secondary Diagnosis

Major Diagnosis Category		Diagnosis-Related Groups	
		196	Appendicitis (with Peritonitis, Other) with Secondary Diagnosis
47:	Hernia of the Abdominal Cavity	197	Abdominal Hernia with Age less than 15
		198	Inguinal Hernia (without Obstruction) with Age greater than 14 and less than 65 without Secondary Diagnosis
		199	Inguinal Hernia (without Obstruction) with Age greater than 14 and less than 65 with Secondary Diagnosis
		200	Abdominal Hernia Except Simple Inguinal with Age greater than 14 and less than 65 without Surgery
		201	Abdominal Hernia Except Simple Inguinal with Age greater than 14 and less than 65 with Minor Surgery
		202	Abdominal Hernia Except Simple Inguinal with Age greater than 14 and less than 65 with Major Surgery
		203	Abdominal Hernia with Age greater than 64 without Surgery
		204	Abdominal Hernia with Age greater than 64 with Minor Surgery
		205	Abdominal Hernia with Age greater than 64 with Major Surgery
48:	Enteritis, Diverticula, and Functional Disorders of the Intestine	206	Functional Disorder of the Intestine without Surgery
		207	Intestinal Pouching, Regional Enteritis, Ulcerative Colitis without Surgery
		208	Intestinal Pouching (Functional Disorder) with Minor Surgery without Secondary Diagnosis
		209	Intestinal Pouching (Functional Disorder) with Minor Surgery with Secondary Diagnosis
		210	Intestinal Pouching (Functional Disorder) with Major Surgery (Resection, Other)
49:	Diseases of the Anus	211	Disease of the Anus without Secondary Diagnosis
		212	Disease of the Anus with Secondary Diagnosis
50:	Miscellaneous Diseases of the Intestine and Peritoneum	213	Miscellaneous Disease of the Intestine and Abdominal Lining with Age less than 56 without Surgery
		214	Miscellaneous Disease of the Intestine and Abdominal Living with Age greater than 55 without Surgery without Secondary Diagnosis
		215	Miscellaneous Disease of the Intestine and Abdominal Lining with Age greater than 55 without Surgery with Secondary Diagnosis
		216	Miscellaneous Disease of the Intestine and Abdominal Lining with Surgical Procedure (Local Incision, Excision)
		217	Miscellaneous Disease of the Intestine and Abdominal Lining with Visualization of the Intestine without Secondary Diagnosis
		218	Miscellaneous Disease of the Intestine and Abdominal Lining with Visualization of the Intestine with Secondary Diagnosis
		219	Miscellaneous Disease of the Intestine and Abdominal Lining with Major Surgery without Secondary Diagnosis
		220	Miscellaneous Disease of the Intestine and Abdominal Lining with Major Surgery with Secondary Diagnosis
51:	Diseases of the Liver	221	Hepatitis, (Infectious, Serum) Subacute Necrosis of the Liver with Age less than 41
		222	Hepatitis (Infectious, Serum) Subacute Necrosis of the Liver with Age greater than 40
		223	Liver Cirrhosis without Secondary Diagnosis or with Minor Secondary Diagnosis
		224	Liver Cirrhosis with Major Secondary Diagnosis
52:	Diseases of the Gallbladder and Bile Duct	225	Disease of the Gallbladder and Bile Duct without Surgery with Age less than 51
		226	Disease of the Gallbladder and Bile Duct without Surgery with Age greater than 50

Major Diagnosis Category		Diagnosis-Related Groups	
		227	Disease of the Gallbladder and Bile Duct with Surgery without Secondary Diagnosis
		228	Disease of the Gallbladder and Bile Duct with Surgery with Secondary Diagnosis with Age less than 65
		229	Disease of the Gallbladder and Bile Duct with Surgery with Secondary Diagnosis with Age greater than 64
53:	Diseases of the Pancreas	230	Disease of the Pancreas without Surgery
		231	Disease of the Pancreas with Surgery
54:	Diseases of the Kidney and Ureter	232	Disease of the Kidney and Bladder without Surgery without Secondary Diagnosis
		233	Kidney Inflammation without Surgery with Secondary Diagnosis
		234	Nephrotic Syndrome, Nephritis (Chronic) Uremia without Surgery with Secondary Diagnosis with Age less than 65
		235	Nephrotic Syndrome, Nephritis (Chronic) Uremia without Surgery with Secondary Diagnosis with Age greater than 64
		236	Disease of the Ureter Nephrotic Syndrome, with Surgical Procedure (Cystoscopy, Biopsy, Other Minor)
		237	Kidney Inflammation and Degenerative Disease (Including Kidney Pelvis) with Surgical Procedure
		238	Disease of the Kidney and Ureter with Surgery (Kidney Removal, Kidney Transplant, Other Major)
55:	Urinary Calculus	239	Urinary Stone without Surgery without Secondary Diagnosis
		240	Urinary Stone without Surgery with Secondary Diagnosis
		241	Urinary Stone with Surgical Procedure (Visualization, Catheter to Kidney, Other)
		242	Urinary Stone with Surgery (Incision and Drainage of Kidney, Bladder, Ureter and Other Major)
56:	Cystitis and Other Urinary Diseases	243	Bladder Inflammation with Other Urinary Disease without Surgery without Secondary Diagnosis
		244	Inflammation of the Bladder and Urethra with Narrowing of the Urethra without Surgery with Secondary Diagnosis
		245	Bladder (Abnormal Passage, Pouching, Other Disease) without Surgery with Secondary Diagnosis with Age less than 46
		246	Bladder (Abnormal Passage, Pouching, Other Disease) without Surgery with Secondary Diagnosis with Age greater than 45
		247	Disease of the Bladder and Urethra with Surgical Procedure (Visualization, Opening)
		248	Disease of the Bladder and Urethra with Surgical Procedure (Visualization, Excision, Dilatation, Repair) with Age less than 15
		249	Disease of the Bladder and Urethra with Surgical Procedure (Visualization, Excision, Dilatation, Repair) with Age greater than 14
		250	Disease of the Bladder and Urethra with Surgery (Removal of Bladder, Removal of Prostate, Other Major)
57:	Disease of the Prostate	251	Disease of the Prostate without Surgery
		252	Disease of the Prostate with Surgical Procedure (Bladder Visualization, Dilatation of Urethra, Biopsy) without Secondary Diagnosis
		253	Disease of the Prostate with Surgical Procedure (Bladder Visualization, Dilatation of Urethra, Biopsy) with Secondary Diagnosis
		254	Disease of the Prostate with Surgery (Non-Incisional Removal of Prostate) without Secondary Diagnosis
		255	Disease of the Prostate with Surgery (Non-Incisional Removal of Prostate) with Secondary Diagnosis

Major Diagnosis Category		Diagnosis-Related Groups	
		256	Disease of the Prostate with Surgery (Incisional removal of the Prostate)
58:	Disease of the Male Reproductive System	257	Excessive Foreskin over the Glans Penis with Surgery
		258	Disease of the Male Reproductive System Except Circumcision without Surgery
		259	Disease of the Male Reproductive System Except Circumcision with Surgery with Age less than 45
		260	Disease of the Male Reproductive System Except Circumcision with Surgery with Age greater than 44
59:	Disease of the Female Reproductive System	261	Disorder of Menstruation without Surgery
		262	Disease of the Female Reproductive System Except Disorder of Menstruation without Secondary Diagnosis
		263	Disease of the Female Reproductive System Except Disorder of Menstruation with Secondary Diagnosis
		264	Disease of the Female Reproductive System with Surgical Procedures (D&C, Visualization, Removal Fallopian Tubes) without Secondary Diagnosis
		265	Disease of the Female Reproductive System with Surgical Procedure (D&C, Visualization, Other) with Secondary Diagnosis
		266	Disease of the Female Reproductive System with Surgery (Removal of Womb, Repair of Female Reproductive Organ, Other Major)
60:	Diseases of the Breast	267	Benign Breast Tumor, Chronic Cystic Disease without Secondary Diagnosis
		268	Acute Inflammation of the Breast, Enlarged Breast without Secondary Diagnosis
		269	Disease of the Breast with Secondary Diagnosis with Age less than 56
		270	Disease of the Breast with Secondary Diagnosis with Age greater than 55
61:	Abortion	271	Abortion with Secondary Diagnosis
		272	Abortion with Secondary Diagnosis
62:	Obstetrical Diseases of the Antepartum and Puerperium	273	False Labor without Surgery
		274	Threatened Abortion Premature Separation of the Afterbirth, Other Hemorrhage During Pregnancy without Surgery
		275	Obstetrical Complications, Poisons in Blood, Excessive Vomiting, Blood Clot Vein-Extremity without Surgery
		276	Obstetrical Disease Before the After Delivery with Surgical Procedure (D&C, Repair of Neck of Womb)
		277	Obstetrical Disease Before and After Delivery with Surgery (Removal of Tubes and Ovaries, Other Major)
63:	Normal Delivery	278	Delivery without Surgery or with Surgery Assisting Delivery
		279	Delivery with Tying of Tubes, Removal of Tubes
		280	Delivery with Cesarean Section
64:	Delivery with Complications	281	Delivery with Complications without Surgery or with Surgery Assisting Delivery
		282	Delivery with Complications with Cesarean Section
65:	Diseases of the Skin and Subcutaneous Tissue	283	Excessive Scar Tissue, Excessive Pigment, Fatty Cyst, Other Minor Skin Disease without Secondary Diagnosis
		284	Excessive Scar Tissue, Excessive Pigment, Fatty Cyst, Other Minor Skin Disease with Secondary Diagnosis
		285	Skin Inflammation, Abscess, Eczema, Chronic Ulcer without Surgery with Age less than 21
		286	Skin Inflammation, Abscess, Eczema, Chronic Ulcer without Surgery with Age greater than 20

Major Diagnosis Category		Diagnosis-Related Groups	
		287	Skin Inflammation, Abscess, Eczema, Reddened Skin with Surgery without Secondary Diagnosis
		288	Skin Inflammation, Abscess, Eczema, Reddened Skin with Surgery with Secondary Diagnosis
		289	Psoriasis, Eruptive Skin Lesions, Chronic Skin Ulcer
66:	Arthritis	290	Arthritis without Surgery with Age less than 65
		291	Arthritis without Surgery with Age greater than 64
		292	Arthritis with Surgery (Excision of Bone, Joint, Membrane Surgical Joint Fixation)
		293	Arthritis with Surgery (Joint Incision, Spinal Fusions, Excision of Tissue Between Vertebrae)
		294	Arthritis with Surgery (Repair and Restoration of Joint, Removal of Membrane between Vertebrae)
67:	Derangement and Displacement of Intervertebral Disc	295	Disorder and Displacement of disc Between Vertebrae without Surgery
		296	Disorder and Displacement of Disc Between Vertebrae with Surgery
68:	Diseases of the Bone and Cartilage	297	Rheumatism and Inflammation Tissue Covering Bone, Other Minor Bone Disease without Surgery
		298	Disease of the Bone, Inflammation of Marrow (Acute, Chronic), Spongy Bone, Unaided Fracture without Surgery
		299	Disease of the Bone, and Bone Tissue Lining, with Surgery (Excision Bone Lining, Repair of Other Joint)
		300	Disease of the Bone and Bone Tissue Lining with Surgery (Joint Incision, Bone Excision, Bone Fusion)
		301	Disease of the Bone and Bone Tissue Lining with Surgery (Amputation, Hip Restoration, Other Major)
69:	Other Disease of the Musculo-Skeletal System	302	Inflammation of the Component Parts of the Joints, Curvature of the Spine, Deformed Foot without Surgery
		303	Backache, Diffuse Disease of Connective Tissue, Inflammation of Muscle without Surgery without Secondary Diagnosis
		304	Backache, Diffuse Disease of Connective Tissue, Inflammation of Muscle without Surgery with Secondary Diagnosis
		305	Inflammation of the Component Parts of Joints with Deformity (Palm, Finger, Toe) with Surgery
		306	Other Disease of the Muscle and Bone (Major) with Surgical Procedure
		307	Other Disease of the Muscle and Bone (Major) with Surgery (Removal, Repair of the Small Joint, Bone)
		308	Other Disease of the Muscle and Bone (Major) with Surgery (Joining Vertebrae, Other)
70:	Congenital Anomalies	309	Birth Defect (Bone, Stomach, Testicle) without Surgery
		310	Birth Defect (Heart, Kidney, Other Major) without Surgery
		311	Birth Defect (Testicle, Skin, Stomach, Other Minor) with Surgery
		312	Birth Defect (Heart Valve, Other Unspecified Heart Site) with Surgical Procedure (Cardiac Catheterization)
		313	Birth Defect (Palate, Lip, Hip or Other Extremity) with Surgery (Repair of Mouth, Fixation of Hip)
		314	Birth Defect (Heart Valve, Other Unspecified Site) with Surgery (Heart Valve, Septal Repair)
		315	Congenital Diseases (Tetralogy of Fallot, Atrial Septal Defect, Hypospadia, Other) with Surgical Procedure (Catheterization, Repair of Urethra)
		316	Congenital Diseases (Tetralogy of Fallot, Atrial Septal Defect, Other) with Surgery (Valve, Septum, Shunt)

Major Diagnosis Category		Diagnosis-Related Groups	
		317	Birth Defect (Spine, Gullet, Large Bowel) with Surgery
71:	Normal Mature Newborn	318	Normal Full Term Newborn
72:	Certain Diseases and Conditions Peculiar to Newborn Infants	319	Well Baby Care (Pregnancy greater than 9 months), Other Minor Disease or Condition of the Newborn Infant
		320	Immaturity, Hyaline Membrane Disease, Other Major Disease or Condition of the Infant without Secondary Diagnosis
		321	Immaturity, Hyaline Membrane Disease, Other Major Disease or Condition of the Infant with Secondary Diagnosis
73:	Signs and Symptoms Pertaining to the Nervous, Respiratory, and Circulatory Systems	322	Indications of Nervous, Respiratory, Circulatory System Disease without Surgery without Secondary Diagnosis
		323	Convulsions, Fainting, Nosebleed, Chest Pain without Surgery with Secondary Diagnosis
		324	Brain Disorder of Dizziness, Shortness of Breath, Coughing up Blood without Surgery with Secondary Diagnosis
		325	Indications of Nervous, Respiratory, Circulatory System Disease with Surgical Procedure
		326	Indications of Nervous, Respiratory, Circulatory System Disease with Major Surgery
74:	Signs and Symptoms Pertaining to the Gastro-Intestinal and Urinary Systems	327	Indications of Gastro-Intestinal, Urinary System Disease without Surgery without Secondary Diagnosis
		328	Indications of Gastro-Intestinal, Urinary System Disease without Surgery with Secondary Diagnosis
		329	Indications of Gastro-Intestinal, Urinary System Disease with Surgical Procedure (Visual Inspection, Other)
		330	Indications of Gastro-Intestinal, Urinary System Disease with Surgery (Abdominal, Other Major)
75:	Miscellaneous Signs, Symptoms, and Ill-Defined Conditions	331	Sterility (Male, Female), Admission for Observation without Surgery
		332	Chemical Imbalance, Headache, Fever, Other Ill-Defined Indication of Disease without Surgery with Age less than 15
		333	Chemical Imbalance, Headache, Fever, Other Ill-Defined Indication of Disease without Surgery with Age greater than 14
		334	Miscellaneous Indication of Disease with Surgical Procedure (Visual Inspection, Other)
		335	Miscellaneous Indication of Disease with Surgery (Abdominal Surgery, Removal of Uterus, Other Major)
76:	Fractures	336	Fracture (Skull, Face, Forearm, Leg, Foot, Hand) without Surgery with Age less than 30
		337	Fracture (Skull, Face, Forearm, Leg, Foot, Hand) without Surgery with Age greater than 29
		338	Fracture (Spine, Ribs, Bone of the Upper Arm) without Surgery with Age less than 65
		339	Fracture (Spine, Ribs, Bone of the Upper Arm) without Surgery with Age greater than 64
		340	Fracture (Thigh Bone, Pelvis, Multiple) without Surgery
		341	Fracture (Nose, Forearm, Hand, Lower Leg, Foot) with Surgical Procedure (Closed Reduction) without Secondary Diagnosis
		342	Fracture (Nose, Forearm, Hand, Lower Leg, Foot) with Surgical Procedure (Closed Reduction) with Secondary Diagnosis
		343	Fracture (Lower Jaw, Upper Arm, Ankle) with Surgical Procedure (Closed Reduction, Open Reduction of Face) without Secondary Diagnosis
		344	Fracture (Lower Jaw, Upper Arm, Ankle) with Surgical Proce-

Major Diagnosis Category		Diagnosis-Related Groups	
			dure (Closed Reduction, Open Reduction of Face) with Secondary Diagnosis
		345	Fracture (Arm, Hand, Foot, Shoulder Blade) with Surgery (Open Reduction, External Fixation, Other)
		346	Fracture (Ankle, Leg Bones) with Surgery (Open Reduction, External Fixation, Other)
		347	Fracture (Thigh Bone, Pelvis) with Surgery (Open Reduction, External Fixation, Other)
		348	Fracture with Major Surgery (Amputation, Restoration of Hip Joint, Other Major)
77:	Dislocations and Other Musculo-Skeletal Injuries	349	Dislocation (Shoulder, Elbow, Wrist, Knee), Sprains (Ankle, Foot, Hand) without Surgery
		350	Dislocation (Jaw, Hip), Sprains (Knee, Sacroiliac, Other Unspecified) without Surgery
		351	Dislocation (Shoulder, Elbow, Hand), Sprains (Elbow, Wrist, Hand) with Surgery
		352	Dislocation (Knee, Ankle), Sprains (Shoulder, Knee, Ankle) with Surgery
		353	Dislocation (Hip, Multiple), Sprains (Hip, Sacroiliac, Other Unspecified) with Surgery
78:	Internal Injuries of the Cranium, Chest, and Other Organs	354	Internal Injury of the Skull, Other Organ without Surgery without Secondary Diagnosis with Age less than 41
		355	Internal Injury of the Skull, Other Organ without Surgery with Secondary Diagnosis with Age less than 41
		356	Internal Injury of the Skull, Other Organ without Surgery with Age greater than 40
		357	Internal Injury with Surgical Procedure (Suture of Skin, Nerve, Nerve Repair, Other)
		358	Internal Injury with Surgery (Removal of Spleen, Drainage of Chest Cavity, Excision of Skin)
		359	Internal Injury with Surgery (Opening of Skull, Exploration of Abdominal Cavity)
79:	Open Wounds and Superficial Injuries	360	Open Wound (Uncomplicated), Superficial Injury, Foreign Body without Surgery
		361	Open Wound (Complicated), Bruise, Multiple Injuries without Surgery without Secondary Diagnosis
		362	Open Wound (Complicated), Bruise, Multiple Injuries without Surgery with Secondary Diagnosis
		363	Open Wound (External), Foreign Body with Surgical Procedure (Visualization, Suturing, Other)
		364	Open Wound (Complicated) of the Head, Multiple Sites with Surgical Procedure (Visualization, Suturing, Other)
		365	Open Wound (External), Superficial Injury with Surgery (Excision, Other Major)
		366	Open Wound (Complicated) of the Head, Multiple Sites with Surgery (Excision, Other Major)
80:	Burns	367	Burn of the 1st Degree (Uncomplicated) Covering less than 20% of the Body
		368	Burn of the 2nd Degree (Complicated), 3rd Degree Covering more than 20% of the Body
81:	Complications of Medical and Surgical Care	369	Complications of Medical or Surgical Care without Surgery without Secondary Diagnosis
		370	Complications of Medical or Surgical Care without Surgery with Secondary Diagnosis

Major Diagnosis Category		Diagnosis-Related Groups	
		371	Complications of Medical or Surgical Care with Surgical Procedure
		372	Complications of Medical or Surgical Care with Surgery (Replacement of Heart Device, Repair of Stomach)
		373	Complications of Medical or Surgical Care with Surgery (Revision of Shunt, Other Major)
82:	Adverse Effects of Certain Substances	374	Adverse Effect of a Drug, Toxic Effect of Alcohol without Secondary Diagnosis
		375	Adverse Effect of a Drug, Toxic Effect of Alcohol with Secondary Diagnosis
		376	Toxic Effect (Lead, Acid, Alkali, Carbon Monoxide, Radiation) without Secondary Diagnosis
		377	Toxic Effect (Lead, Acid, Alkali, Carbon Monoxide, Radiation) with Secondary Diagnosis
83:	Special Admissions and Examinations without Reported Diagnoses	378	Prenatal Care, Medical and Surgical after Care (Dialysis) without Surgery
		379	Admission for Sterilization, Chemotherapy, Radiation Therapy without Surgery
		380	Follow up (Cancer) Surgery, Medical after Care (Colostomy, Orthopedic, Other) without Surgery
		381	Special Admission with Surgery (Sterilization, D&C, Other)
		382	Special Admission with Surgical Procedure (Bladder Visualization, Removal of Fixed Internal Device)
		383	Special Admission with Surgery (Exploration of Abdominal Cavity, Removal of Uterus, Other Major)