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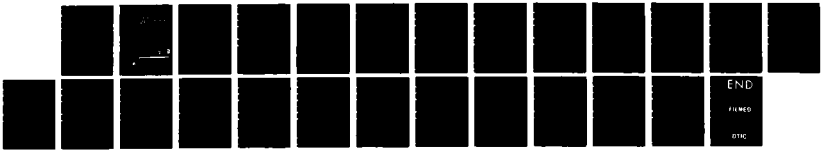

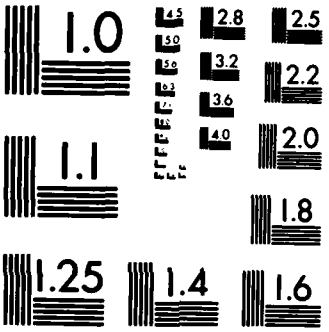

ACCOUNTING FOR VARIATION IN PATIENT LENGTH OF STAY IN NAVAL HOSPITALS USING DIAGNOSIS RELATED GROUPS (DRGs) AS A CASE GROUPING METHOD

Preliminary Results

Research Paper 1-83
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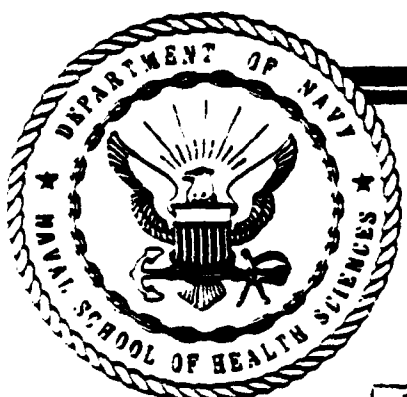
by Terrence L. Kay
Karen A. Rieder



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This report discusses the use of Diagnosis Related Groups (DRGs) as a mechanism for identifying comparable groups of patients within naval hospitals so that performance comparisons can be conducted. Findings indicate that DRGs are a better patient grouping technique than the patient grouping methods currently used by the Navy. However, there must be other important contributors to patient length of stay in naval hospitals since DRGs were able to explain less than 25 percent of the total variation, which is —

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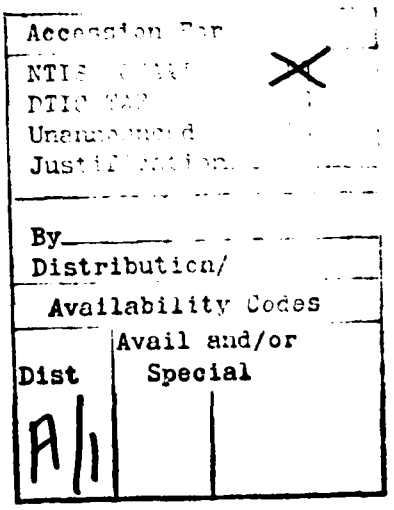
considerably less than the explained variation reported by other case mix researchers. Additional research is planned to identify and quantify other factors that contribute to patient length of stay..



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ACCOUNTING FOR VARIATION IN PATIENT LENGTH OF STAY IN NAVAL HOSPITALS USING DIAGNOSIS RELATED GROUPS (DRGs) AS A CASE GROUPING METHOD

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Managers of large and diverse hospital systems regularly review aggregate data such as average length of stay to monitor the performance of individual facilities. Yet interpretation of aggregate length of stay data is difficult and can be dramatically affected by factors such as patient and hospital characteristics, administrative policies and procedures, and individual physician practice patterns. Therefore, comparing facility performance on the basis of aggregate data can provide misleading results since these factors are likely to have a differential impact on the performance of individual hospitals. For example, large teaching hospitals tend to have longer average lengths of stay than smaller hospitals since they tend to attract more acutely ill patients who require longer periods of hospital treatment.

The contribution of factors such as facility characteristics, administrative policies, and physician practice to patient length of stay have not yet been quantified. Recently, emphasis has been given to quantifying hospital case mix, which is a generic term used to describe patient composition. This composition consists of patient related factors such as medical condition, demographic characteristics, admission status and treatment procedures received

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and are used to group patients into relatively homogeneous groups[1]. The methodology allows managers to compare groups of patients who consume similar levels of hospital resources. Aggregate hospital performance data can also be adjusted to account for differences among facilities in the proportion of patients that are more severely ill.

One particular method of quantifying and describing hospital case mix--Diagnosis Related Groups (DRGs)-- has attracted widespread national attention among U. S. civilian hospital systems. Reimbursement methods based on DRGs have been implemented in the State of New Jersey[4], and a DRG based scheme for the reimbursement of Medicare patients has recently been passed by Congress[6]. Numerous quality assurance committees have used DRGs to study the appropriateness of hospital utilization and length of stay patterns.

A valid and reliable case mix measure such as DRGs may have similar applications for U. S. military hospitals. As with many large civilian health systems, the management of U. S. military hospital systems is a complex task. For example, the Naval Medical Command, Navy Department, Washington, D.C., which will be the primary focus of this article, manages 36 hospitals located worldwide. Included in this system are four hospitals with residency teaching programs, five with family practice teaching programs, and eleven hospitals which are located overseas. Managers of this system would be greatly assisted by a case mix measure that could be used to account for differences among facilities in aggregate patient length of stay data. For example, in conducting studies of hospital length of stay practices, administrators are generally interested in making some judgment as to whether facility length of stay data seem reasonable. That is, that a patient's hospital stay was required for

medical treatment and was not lengthened by administrative policies and procedures. If virtually all of the differences in a facility's performance can be attributed to patient medical condition and other patient characteristics, there is less need to be concerned about that particular facility's administrative practices. On the other hand, if large differences in patient length of stay remain, one can then conduct a medical audit to determine if inappropriate medical practices or administrative procedures exist within the facility.

Currently, the naval hospital system has no standard case mix measure. Individual studies and management reports that attempt to account for differences in case mix usually categorize patients according to their primary diagnosis code. Depending on the level of detail desired, patients are generally grouped by ICD-9 (International Classification of Diseases - Version 9) major diagnostic class, disease subcategory, or three digit diagnosis code. Another patient grouping strategy is to further subdivide each disease subcategory based on whether the patient received surgery or had complications. Each of these grouping techniques are then used to adjust aggregate performance data. Unfortunately, these groupings are not necessarily homogeneous because within groups patients may require widely differing lengths of hospital stay.

The purpose of this report is to explore to what extent patient length of stay at naval hospitals can be accounted for by patient case mix, as measured by DRGs. As a basis for comparison, the performance of DRGs as a case grouping method will be compared with the traditional methods of categorizing patients mentioned previously. It should be cautioned that no grouping methodology has yet been perfected; therefore, the primary focus of this report is to determine

whether comparing hospital utilization data on the basis of DRGs is an incremental improvement over the more traditional methods of comparing utilization.

MEASURING CASE MIX

Traditional Groupings

To account for differences in patient severity among naval hospitals, naval medical department managers generally rely on patient groupings based on the patient's primary diagnosis code, a method commonly referred to as the Single Diagnosis Method[9]. Depending on the level of detail desired, patients are generally grouped by either major diagnostic class, disease subcategory, or three digit diagnosis code in accordance with the criteria established by the latest edition of the International Classification of Diseases coding scheme[7]. The advantage of grouping patients in this manner lies in its simplicity and ease of use. The disadvantage is that groupings based solely on diagnosis codes are not necessarily homogeneous with respect to utilization of hospital resources. That is, widely different levels of care may be provided to patients within a single diagnostic category depending, for example, on whether surgery is required, or whether there are complications or pre-existing conditions that result in the need for more intensive medical care. Further, the number of potential groupings is unwieldy since there are over 1,000 three digit diagnosis codes. To overcome such problems, a fourth method of grouping patients is frequently used which is to subdivide each disease subcategory into four more detailed groups depending on whether surgery was required or complications were present. Such patient groupings are more homogeneous since patients requiring surgery or experiencing complications are more likely to require longer periods

of treatment than patients not requiring surgery and/or not having complications.

Diagnosis Related Groups (DRGs)

DRGs group patients according to their need for resources in a manner that has medical meaning. It was the intention of the DRGs' developers that patients within a specific DRG have similar lengths of stay and that the groupings be clinically coherent, that is, that patients within a DRG obtain treatment requiring a similar level of resource use. Patients were grouped based on a combination of factors--such as diagnosis code, age, sex, and existence of surgery or secondary diagnoses--that accounted for the most variation in length of stay. The partitioning process was guided by medical judgment so that groups formed had medical meaning. The following is a brief summary of the procedures used to develop the ICD9-CM DRGs[9].

The DRGs were developed using ICD9-CM diagnosis and procedure codes. Twenty-three Major Diagnostic Categories (MDCs), based primarily on the organ system involved, were divided into a total of 467 Diagnosis Related Groups (DRGs). The first split in the group formation was made utilizing selected surgical codes, except for mental conditions and other conditions not usually requiring surgical procedures. Since many patients undergo several surgical procedures during an inpatient episode, the one procedure identified by clinical judgment as requiring the most resources became the basis for classification. It should be noted that DRGs were formed with consideration to both clinical and statistical criteria. DRGs, therefore, may not account for the maximum amount

of variation in length of stay that is statistically possible because clinical judgment regarding the proper grouping of patients was judged to be equally important.

METHODOLOGY AND PROCEDURES

Source of Data

All patient data for this study are contained in the U. S. Navy Inpatient Data System for Calendar Year 1980 and were obtained from the Naval Medical Data Services Center (NMDSC), Bethesda, Maryland.

Records Selected for Study

There were a total of 208,762 dispositions at naval hospitals during calendar year 1980. Of the total, 20,460 dispositions (9.8% of the total) were excluded from this analysis because complete patient data was not yet available*, and because certain diagnosis and surgery codes used by the Navy were not compatible with the codes used by the developers of the DRGs. As a result 188,302 or 90.2% of the total dispositions at naval hospitals during CY 1980 are contained in the analysis that follows.

Conversion of ICD9 Diagnosis Codes and ICPM Surgery Codes to ICD9-CM

Naval hospitals code their patient records using International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes[7] and

* At the time of this writing the 1980 file has not yet been finalized but NMDSC is in the process of making final corrections.

International Classification of Procedures in Medicine (ICPM) surgery codes[8]. In contrast, DRGs were developed using a clinical modification to the ICD9 and ICPM codes (ICD9-CM)[2], which provided more precise codes to be used for describing a patient's clinical picture. There is no major problem with compatability of diagnosis codes between these two methods since ICD9 diagnosis codes can generally be assigned to an ICD9-CM code. The surgical codes used by the two systems, however, are very different. Therefore, we completed a preliminary edit that replaced each ICPM surgery code encountered with an appropriate ICD9-CM code. This procedure was not designed to provide an exact mapping between the two systems but was done to ensure that patient records were assigned to the correct DRG. Not all ICD9 diagnosis codes and ICPM surgical codes can be successfully assigned to an ICD9-CM DRG. For example, many of the DRGs included in Major Diagnostic Category 14--Pregnancy, Childbirth, and Puerperium--require more detail than is contained in the ICPM surgery codes. (Contact the authors for a listing of the diagnosis and procedure codes excluded from this analysis.)

Hypotheses and Statistical Techniques

The main hypothesis to be tested was that the amount of variation in length of hospital stay accounted for by DRGs was significantly greater than that accounted for by increasingly more detailed groupings based on ICD9 diagnosis codes: Major Diagnostic Categories (MDCs), Disease Subcategories, Three Digit Codes, and a fourth grouping based on subdividing disease subcategories into four groups depending on whether surgery was required or complications were present. These four grouping methods served as a basis for comparing the ability of DRGs to account for differences in patient length of

hospital stay. The method selected to test this hypotheses is commonly referred to as a partial F-test using the extra sums of squares principle[3]. This technique is commonly used for analysis of variance and regression problems to determine if the additional variance accounted for by adding a variable to a model is statistically significant. Because of the large number of records and patient groupings involved, the partial F-test results were only approximated. That is, given the variation that had already been accounted for by one of the other methods, the minimum amount of additional variation that would be accounted for by using DRGs was calculated. Caution should be used in interpreting these results since very small increases in explained variation may appear significant because of the large number of records included in this analysis. To partially compensate for this problem, we included the additional criteria that the F ratio should have a probability level of $p < .001$ for an increase in explained variance to be considered statistically significant.

RESULTS

The amount of variation in patient length of stay explained by each grouping method examined is displayed in Table I.

As can be seen, DRGs accounted for more variation than any of the comparison methods. DRGs, however, accounted for only a slightly higher percentage of variation than either the three digit codes or disease subcategories when subdivided by surgery and complications. One drawback is evident--a much more complicated procedure is required to group patients by DRG than by the others. Although DRGs accounted for nine percent more variation than disease subcategories (24.5 percent vs. 15.5 percent), DRGs required almost

TABLE I

PERCENTAGE OF VARIATION IN LENGTH OF STAY EXPLAINED BY DRGS, THREE DIGIT CODES, DISEASE SUBCATEGORIES, AND MDCS

Patient grouping method	Number of groups	Percent of variation explained
Comparison methods		
Major diagnostic class	18	5.1
Disease subcategory	118	15.5
Disease subcategory by surgery and complications	451	20.8
Three digit diagnosis codes	905	21.4
DRGs	445	24.5

four times the number of categories as disease subcategories (445 categories for DRGs vs 118 for disease subcategories). One normally can expect to increase explained variation by increasing the the number of groupings used, but this increase in explained variation may not necessarily be statistically significant. The problem to be addressed next is whether the higher percentage of explained variation achieved by DRGs is significantly greater than that achieved by the other methods.

DRGs Compared to Disease Subcategories

As stated previously, grouping patients by disease subcategories accounted for 15.5 percent of total variance in patient length of stay in naval hospitals for 1980. DRGs accounted for an additional nine percent variation, yet required grouping patients into a higher number of categories (118 for disease subcategories vs. 445 for DRGs). Table II provides the results of a partial F-test that tested the statistical significance of this higher explained variation. The additional variation explained by DRGs is significant at the .001 level.

DRGs Compared to Disease Subcategories when Further Subdivided by Surgery and Complications

Subdividing disease subcategories by surgery and complications increases variation explained to 20.8 percent, which is only 3.6 percent less than that accounted for by DRGs. However, this is a statistically significant difference as shown in Table III.

TABLE 11

MINIMUM ADDITIONAL VARIATION EXPLAINED BY DRGS,
AFTER ACCOUNTING FOR VARIATION EXPLAINED BY
DISEASE SUBCATEGORIES

Source	Degrees of freedom	Sum of squares	Mean square	F value	Significance level	Percent of total variation explained
Disease subcategories	117	1,796,136.3	15,351.6	294.1	$p < .001$	15.5
DRGs	444	1,045,189.1	2,354.0	50.4	$p < .001$	9.0
Error	187,740	8,771,126.6	46.7			
Total	188,301	11,612,452.0				

TABLE 111

MINIMUM ADDITIONAL VARIATION EXPLAINED BY DRGS, AFTER ACCOUNTING FOR VARIATION EXPLAINED BY DISEASE SUBCATEGORIES WHEN SUBDIVIDED BY NEED FOR SURGERY AND PRESENCE OF COMPLICATIONS

Source	Degrees of freedom	Sum of squares	Mean square	F value	Significance level	Percent of total variation explained (cumulative)
Disease subcategories by surgery and complications	450	2,420,129.8	5,378.1	114.9	$p < .001$	20.8
DRGs	444	421,195.6	948.6	20.3	$p < .001$	3.6
Error	187,407	8,771,126.6	46.8			
Total	188,301	11,612,452.0				

DRGs Compared to Three Digit Diagnosis Codes

DRGs accounted for only 3.1 percent more variance than three digit diagnosis codes but this mimimum amount is also highly statistically significant as seen in Table IV.

These findings provide evidence that the DRG patient groupings are more homogeneous with respect to patient length of stay than the patient groups formed according to three digit diagnosis codes. This is epecially noteworthy since DRGs require patients to be categorized in fewer than half the number of groups, yet still account for significantly higher variation than the three digit codes. (Details of the analysis of variance results obtained for each grouping method are listed in the Appendix.)

DISCUSSION AND FUTURE DIRECTIONS

The results validate the hypothesis that DRGs are a statistically significant improvement over grouping cases based on current methods. Although only a slightly higher percentage of explained variation was obtained using DRGs in contrast to three digit diagnosis codes, DRGs require less than half the number of categories to describe the patient population. However, there must be other important contributors to patient length of stay in naval hospitals since DRGs were able to explain less than 25 percent of the total variation, which is considerably less than the explained variation reported by other case mix researchers. For example, in an evaluation of the ICD9-CM DRGs[5], the New Jersey State Department of Health reported that DRGs accounted for 43 percent of the variation in selected acute care hospitals.

TABLE IV

MINIMUM ADDITIONAL VARIATION EXPLAINED BY DRGS AFTER ACCOUNTING FOR VARIATION EXPLAINED BY THREE DIGIT DIAGNOSIS CODES

Source	Degrees of freedom	Sum of squares	Mean square	F value	Significance level	Percent of total variation explained
Three digit diagnosis codes	904	2,489,252.0	2,753.6	56.5	$p < .001$	21.4
DRGs	444	352,073.4	793.0	16.9	$p < .001$	3.1
Error	186,953	8,771,126.6	46.9			
Total	188,301	11,612,452.0				

From a management point of view, it is desirable to know to what extent policies and administrative procedures within individual facilities contribute to patient average length of stay. Although it is difficult to quantify this facility factor, one strategy is to account for as much of the total variation in length of stay as possible. The remaining unexplained variation could then be attributed to either individual facility factors and/or to individual physician performance. In this way, hospital administrators can identify specific facilities that have outlier data and can investigate whether other unidentified contributors to length of stay exist or whether aberrant administrative practices are contributing to unusually long lengths of patient stay.

To more fully explain variations in patient length of stay and increase the usefulness of DRGs for naval hospitals, our future plans are to identify and quantify other factors that contribute to patient length of stay. Patient variables possibly related to length of stay but not currently used for patient grouping such as disease severity, patient transfer status (transferred in or out) and beneficiary group (active duty military, retired military, dependents of military, etc.) will be investigated. Other possibilities include hospital teaching status, size and location. For example, perhaps patient length of stay tends to be longer at teaching hospitals even after accounting for patient case mix. Active duty military patients at overseas facilities may have longer lengths of stay after adjusting for case mix since doctors may extend inpatient care due to limited support systems for patients once released. Perhaps overseas patients also have longer lengths of stay because of delays surrounding evacuation to naval hospitals located in the continental United States. These and other possibilities will be examined in an attempt to explain a greater proportion of the variation in patient length of hospital stay at naval hospitals.

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APPENDIX

ACCOUNTING FOR VARIATION IN PATIENT LENGTH OF STAY, BY GROUPING METHOD, NAVAL HOSPITALS, 1980

Grouping method/ source of variation	Degrees of freedom	Sum of squares	Mean square	F-value	R^2 (explained variation)
Major diagnostic class					
Between	17	594,321.0	34,960.1	597.6	.051
Within	188,284	11,018,131.0	58.5		
Total	188,301	11,612,452.0			
Disease subcategory					
Between	117	1,796,136.3	15,351.6	291.4	.155
Within	188,184	9,816,315.7	52.2		
Total	188,301	11,612,452.0			
Disease subcategory by surgery and complications					
Between	450	2,420,129.8	5,378.1	109.9	.208
Within	187,851	9,192,322.2	48.9		
Total	188,301	11,612,452.0			
Three digit diagnosis codes					
Between	904	2,489,252.0	2,753.6	56.5	.214
Within	187,397	9,123,200.0	48.7		
Total	188,301	11,612,452.0			
Diagnosis related group					
Between	444	2,841,325.4	6,399.4	137.0	.245
Within	187,857	8,771,126.6	46.7		
Total	188,301	11,612,452.0			

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