Prospective payments to hospitals: Should emergency admissions have higher rates?

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Systematic variation in patient resource use can be a significant problem for a system based on diagnosis-related groups (DRG's) if this variation is not evenly distributed across hospitals. If certain hospitals routinely treat patients who require more services than average under DRG's, the long-run financial viability of these hospitals will be threatened. In this study, the authors examine whether patients who are admitted on an emergency or urgent basis represent an identifiable group of patients whose costs are systematically higher than those of electively admitted patients, controlling for DRG. Alternative approaches for incorporating admission status into a DRG payment system are developed and tested.

Introduction

Systematic variation in patient resource use and costs not captured by diagnosis-related groups (DRG's) can be a significant shortcoming of a DRG-based prospective payment system. The underlying assumption of the DRG-based case-mix classification system is that patients in the same DRG consume relatively similar amounts of resources. If resource use varies systematically by factors ignored by the classification system, and if patients exhibiting these factors are unevenly distributed across hospitals, the reimbursement system may unfairly penalize hospitals with a larger proportion of such patients. These hospitals will be underpaid relative to the average resource requirements of their patients. Over the long term, the financial viability of these hospitals may be threatened, not because they are more inefficient, but because of their mix of patients.

In this study, we examine whether patients who are admitted on an emergency or urgent basis represent an identifiable group of patients whose costs are systematically higher than those of electively admitted patients within a DRG. The hypothesis that nonelective admissions require more inpatient resources is based on several factors. First, emergency admissions, because they are unplanned, limit the range of options available to physicians. Diagnosis and treatment begin only after the emergency patient is in the hospital. In contrast, the physician of a patient admitted on an elective basis has the opportunity to plan and schedule resource use. Physicians tend to have more information for such patients and so are able to expend fewer hospital resources in determining the problem and mapping out a course of treatment.

Second, a related source of hospital cost savings for elective admissions is the use of outpatient services to begin diagnosis or even treatment prior to admission, when possible. This approach may reduce the cost of diagnostic services during the inpatient stay and/or may reduce the length of stay (LOS). This may be particularly true for surgical admissions. When it is not more efficient to provide services in an outpatient setting, the result is not necessarily a savings in total cost, but rather in inpatient costs.

Third, emergency admissions may require more resources if these admissions reflect a higher level of illness severity. Patients admitted on an emergency basis may be concentrated in the more serious diagnoses within a DRG and may be more acutely ill than electively admitted patients in the same DRG. Similarly, patients admitted on an elective basis may be less likely to have secondary diagnoses, comorbidities, or other complications that may increase treatment requirements.

Previous empirical studies

The existing literature on patient-level analyses of the relative cost of emergency admissions controlling for case mix is quite sparse. One study estimated the total costs, expected reimbursement, and expected profit under Medicare's prospective payment system (PPS) for DRG's with a high percentage of emergency admissions (Munoz et al., 1985). The authors found that the expected net profit for these DRG's is negative under PPS and thus concluded that hospitals with emergency departments will not fare well under PPS. For purposes of making policy, the study done by Munoz et al. is quite limited. The most important drawback stems from limitations in the sample used for the study—the data were drawn from a single hospital. Thus one cannot be sure that the findings reflect a general pattern or if they are merely specific to the hospital studied.

A second study, also conducted by Munoz et al. (1986), compared the cost of admissions from hospital emergency rooms (ER's) with a matched sample of non-ER admitted patients within the same DRG's. In this second study, the authors found that the cost of emergency admissions exceeded the cost of nonemergency admissions within the same DRG in more than 70 percent of the DRG's. The data for this study were drawn from the 11 hospitals in the

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New York City Health and Hospitals Corporation. Again, one cannot be sure whether the finding of greater costs for emergency admissions within a DRG is generalizable or if it is limited to the 11 large inner-city hospitals in this system, which represent only one segment of the hospital industry in New York.

Study objectives

The objectives of this analysis are twofold. The first is to determine whether patients admitted on an emergency or urgent basis are significantly different from elective patients in the same DRG in terms of use of inpatient resources. Specifically, we examine whether differences in resource use can be partially explained by differences in admission status. We are interested in both the aggregate effect across all DRG's and in a DRG-specific effect. For example, if a significant effect were found using data aggregated across all DRG's, we would then want to know whether the effect is similar for each DRG or whether it varies for different DRG's. Because significant differences are found between emergency or urgent admissions and elective admissions, the second objective of our analysis is to explore whether incorporating information on admission status into the DRG classification system would improve the system's ability to explain variation in costs.

Even if admission status were valuable in improving the ability to predict resource use, there are limitations to its usefulness as an adjuster for reimbursement purposes. Because the criteria for coding admission status are somewhat subjective, providers would have both an incentive and an opportunity to recode at least some elective admissions to either urgent or emergency status, thereby increasing revenue. Nevertheless, it is important to understand the association between admission status and costs, because it affects the fairness of hospital payment rates. Moreover, this association points to a potential weakness in the DRG classification system—if patients admitted on an emergency basis are indeed more expensive, then hospitals will have an incentive to limit such admissions.

Data sources and methodological approach

Data

The sample includes all inpatient discharges in 1982 from 96 of the 98 short-term, acute care hospitals in New Jersey. Patient-level data, including the DRG assignment, primary payer, admission status, and costs, were obtained from the New Jersey Department of Health (NJDOH), which collects uniform hospital discharge data. Data on hospital characteristics, such as location and teaching status, were also obtained from NJDOH.

Our analysis estimates the effect of admission status on inpatient hospital resource use, which is measured by inpatient cost per admission, LOS, and inpatient cost per day. Only measures of hospital inpatient costs are included. Physician costs for inpatient services are not included.

The cost estimates are based on recorded hospital charges for each patient. Costs for non-revenue-producing cost centers (laundry, dietary, etc.) were allocated to revenue-producing centers using standard step-down cost-allocation procedures. Accommodation charges were reduced to costs by applying hospital-specific, cost-to-charge ratios for routine care costs. Ancillary charges were reduced to costs using departmental-specific, cost-to-charge ratios.[1] Only patient care costs are included in the cost estimates. Capital and direct teaching costs are excluded. Differences in the price of hospital inputs, as measured by wage differentials across hospitals, are removed. Leveled costs per admission are calculated by multiplying the full cost per admission by a wage equalization factor, calculated by NJDOH.

Our analyses are conducted with data that include both inlier and outlier admissions and with data that include only inlier admissions. Because outlier admissions are considered to have substantially different resource requirements, the DRG payment rate does not apply to such admissions. Instead, payment is based on controlled charges, which are designed to reflect hospital costs.

New Jersey defines seven categories of outliers: high LOS, low LOS, admitted and discharged on the same day, discharged against medical advice, died while in the hospital, low volume DRG's (number of admissions for a given DRG are so low—fewer than 5 statewide—that a payment rate is not set), and clinical outliers (DRG's that are very heterogeneous, defined statistically by a large coefficient of variation, and for which no payment rate is set). Outlier admissions comprised close to 26 percent of total admissions in 1982.[2] Inlier admissions therefore include all other admissions not described above.

Methodology

The primary goal of this analysis was to determine whether patients with elective admissions experience different average costs per admission than do patients with emergency or urgent admissions. If such differences exist, to what extent are they the result of differences in LOS or cost per day? Furthermore, to what extent does the addition of admission status improve the ability of DRG's to explain variation in costs? To answer these questions, we tabulated

[1]The cost-to-charge ratios were calculated by NJDOH from audited annual cost reports submitted by hospitals.

[2]The New Jersey program defines outliers differently than does Medicare in its DRG-based PPS program. Medicare recognizes high-cost outliers and high-LOS outliers. However, its criteria are such that a smaller proportion of admissions are classified as outliers than are in New Jersey. The State had a Medicare waiver in 1982, so the Medicare program reimbursed hospitals according to the State's rules rather than its own.

descriptive statistics on the magnitude and distribution of the different types of admissions, and we estimated several multiple regression equations of cost per admission, LOS, and cost per day on one or more of the following explanatory variables: DRG, admission status, and hospital teaching status. The inclusion of DRG and hospital teaching status reflects the key parameters on which payment rates are based under the New Jersey system.

Two sets of regressions were run using patient-level data. One set, executed on a 20-percent sample of patients in the 100 highest volume DRG's, was designed to estimate an aggregate effect of admission status (averaged over patients in all of the top 100 DRG's). The second set was designed to estimate a DRG-specific effect, by measuring the effect of admission status separately for each of 463 DRG's, using a 100-percent sample of inlier patients. (Although NJDOH recognized 470 DRG's, 3 were omitted because they consist of ungroupable diagnoses, and 4 were omitted because they had a very small number of admissions, leaving a total of 463 DRG's.)

The regressions on aggregate data were estimated twice, once using all admissions (both inliers and outliers) in the 20-percent sample of the top 100 DRG's, and then using only inlier admissions. Regression analyses were run on inlier admissions because DRG payment rates are calculated for inlier patients only. The 100 highest volume DRG's accounted for 71 percent of inlier admissions. A comparison of the proportion of elective, medical, and surgical admissions between the top 100 DRG's and all DRG's (using the 20-percent sample) can be seen in Table 1. The proportions are similar between the two groups.

Table 1

Percentage of elective, medical, and surgical admissions for all diagnosis-related groups (DRG's) compared with the 100 highest volume DRG's (20-percent sample): New Jersey, 1982

Group	Number of inlier admissions	Type of admission		
		Elective	Medical	Surgical
		Percent		
All DRG's	177,330	47.3	59.9	30.3
The 100 highest volume DRG's[1]	125,925	49.9	61.2	26.0

[1]The 100 highest volume DRG's constitute 71 percent of all DRG's.

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

Model specification

Because the distribution of costs and LOS was skewed, the dependent variables were transformed by taking the natural logarithm of each. (Observations in which either costs or LOS were equal to zero were dropped from the analysis.) In turn, the functional form of the estimated equations is log-linear. This implies the following relationship between the dependent variable (Y) and the explanatory variables ($X_1, \ldots, X_n$):

$$Y = \exp(b_0 + b_1X_1 + \ldots + b_nX_n)\exp(\epsilon)$$

Taking the natural logarithm of both sides of this equation, we get the log-linear form:

$$\ln(Y) = b_0 + b_1X_1 + \ldots + b_nX_n + \epsilon$$

Variable definition

In the aggregate regressions, a separate dichotomous variable was used to control for each DRG. Each DRG variable takes on a value of one for patients categorized into the corresponding DRG and zero otherwise.

Both the aggregate and DRG-specific regressions control for teaching status. MAJTEACH equals one for patients admitted to a major teaching hospital and equals zero otherwise. Similarly, MINTEACH equals one for patients treated at a minor teaching hospital and equals zero otherwise. The omitted category is nonteaching hospitals.[3]

Patient admission status is represented by the dichotomous variable, ELECTIVE, which equals one for patients admitted on an elective basis and zero for patients with an emergency or urgent admission. In one set of aggregate regressions, elective medical and elective surgical DRG's are controlled for separately by the inclusion of two dichotomous variables, ELECMED and ELECSURG.[4]

Definition of admission status

According to NJDOH guidelines, admissions are classified into one of three categories: elective, urgent, or emergency. Admission status is coded by the admitting physician at the time of admission. Criteria for coding admissions may vary across hospitals, because they are not required to adhere to NJDOH definitions. Consistency across hospitals may be partially enforced by payers. For instance, the Medicaid regulations for classifying patients are the same as NJDOH guidelines. Moreover, Medicare requires prior authorization for elective admissions. Enforcement of this requirement presumably means that hospitals are encouraged to adhere to a uniform definition of elective admissions.

NJDOH defines the three categories of admission status as follows:

- Elective admissions: These are scheduled or routine admissions, in which there is no urgency for immediate or very early medical evaluation or treatment, because the possibility of serious consequences resulting from delayed treatment is small. The elective status of an admission does not mean that there is no medical need for the admission. It merely means that it is deferrable and

[3]The coefficient of a dichotomous variable in a log-linear regression can be transformed into a measure of the percentage difference between the identified group and the omitted group. The transformation is $\exp(b) - 1$, where b is the estimated coefficient.

[4]Each DRG is classified as medical (256 DRG's), surgical (193), or other (14).

can, therefore, be scheduled. Uncomplicated pregnancies and all newborns are classified as elective.

- Urgent admissions: These may involve medical conditions or acute trauma such that medical attention, although not immediately essential, should be provided very early to prevent possible loss or impairment of life, limb, or body function. These admissions include those cases in which early evaluation or treatment is necessary, because the patient has either serious disease or injury or symptoms of such disease or injury.
- Emergency admissions: These involve acute trauma or medical conditions in which life, limb, or patient function depends on the immediacy of medical treatment. A patient does not have to be admitted through the ER to be considered an emergency admission. Conversely, not all patients admitted through the ER are classified as emergency admissions.

Even though uniform guidelines categorizing admission status were recommended by the State, we were uncertain of the extent to which hospitals and physicians interpreted these guidelines consistently. To determine adherence to the State's definitions for admissions coding, we selected the 100 highest volume DRG's and sorted them by the percent of inlier admissions that were elective. We then examined the DRG's that fell into each range of the distribution to verify that the coding of admission status makes clinical sense. The coding appeared to reflect what one would expect to see clinically. Procedures such as rhinoplasty and tonsillectomy had a high proportion of elective admissions, and acute conditions, such as drug overdose and myocardial infarct, had a low proportion. Other DRG's, comprised of a less homogeneous group of principal diagnoses, have a more balanced proportion of elective, urgent, and emergency admissions.

A related problem is whether patients admitted on an urgent basis should be considered a separate category or should be grouped with either emergency admissions or elective admissions. To examine this, we conducted additional regression analyses that included separate variables for patients admitted as urgent and those admitted on an elective basis. The results revealed that patients admitted as urgent had costs similar to those of patients admitted on an emergency basis. We therefore group emergency and urgent admissions together and report only the results using the ELECTIVE variable to represent admission status.

Aggregate regressions

In the aggregate regressions, two different equations were estimated for cost per admission. First, cost per admission was regressed on patients' DRG classification, MINTEACH, MAJTEACH, and ELECTIVE. This specification permits an assessment of the following question: After controlling for all the factors included in the New Jersey rate-setting system, how do the costs of patients with elective admissions differ from those of patients with emergency or urgent admissions?

Because elective medical and elective surgical admissions may offer different opportunities to substitute outpatient services for inpatient services, the effect of elective admissions may differ between medical and surgical DRG's. Thus, in the second specification, cost per admission was regressed on patients' DRG classification, MINTEACH, MAJTEACH, ELECMED, and ELECSURG.

Assuming that the costs of elective versus emergency or urgent admissions are significantly different, an important question is whether the inclusion of a single admission status variable (covering all DRG's) improves the DRG classification system's ability to explain variation in costs. Or is the effect of admission status so different across DRG's that a separate adjustment factor is needed for each DRG? This issue was addressed by estimating two additional aggregate equations. Cost per admission was first regressed solely on patients' DRG classification and then on DRG classification and admission status (ELECTIVE). Next, the adjusted R^2 values from these two equations were compared. An additional comparison was made to the equation that included teaching status (MINTEACH, MAJTEACH), DRG, and ELECTIVE as independent variables.

To test whether our model omits important correlates of admission status, we ran two regressions of cost per admission on a larger set of explanatory variables. The first consisted of additional variables for hospital location, hospital size (total admissions and total admissions squared), and patient age and sex. The second equation adjusted for all hospital-specific fixed effects by including a dummy variable for all but one hospital. It also included dummy variables for patient age, sex, and payment source. The inclusion of these additional variables resulted in no significant change in the effect of admission status. Therefore, we report only the results of analyses using DRG, hospital teaching status, and admission status as explanatory variables.

Differences in cost per admission between elective and emergency or urgent admissions can be decomposed into differences in LOS and cost per day. To determine the contribution of LOS and cost per day to differences in cost per admission, the two variables were each regressed on DRG classification, MINTEACH, MAJTEACH, and admission status (either ELECTIVE or ELECMED and ELECSURG).

Regressions by diagnosis-related group

The issue of whether a separate adjustment factor is needed for each DRG was also explored by the execution of separate regressions for each of 463 DRG's. In these equations, cost per admission was regressed on MINTEACH, MAJTEACH, and ELECTIVE. This set of regressions permits an assessment of whether the effect of admission status is

in the same direction and of similar magnitude for all DRG's or whether it varies by DRG. To test for omitted variable bias, we selected a subset of DRG's and ran regressions that included variables for hospital location and teaching status, patient age, sex, and admission status. Again, because the results were not substantially different in the more expanded models, we report only the results for the first model.

Empirical results

The 20-percent sample of hospital admissions, used to conduct the aggregate regression analyses, contained 239,411 admissions, of which nearly one-half were elective. The number of admissions and the proportion of emergency, urgent, and elective admissions for all admissions, for inliers only, and for outliers are shown in Table 2. Approximately 74 percent of the admissions were inliers, of which 35.0 percent were admitted on an emergency basis, 16.9 percent urgent, and 47.3 percent elective.

Table 2

Percentage of emergency, urgent, and elective admissions, by selected patient categories: New Jersey, 1982

Category of patients	Number of admissions	Type of admission		
		Emergency	Urgent	Elective
		Percent		
Inliers and outliers	239,411	34.2	16.1	48.9
Inliers	177,330	35.0	16.9	47.3
Low LOS outliers	34,693	17.0	7.7	74.6
High LOS outliers	18,574	48.8	21.3	28.9
Other outliers	4,963	47.9	21.0	30.2

NOTE: LOS is length of stay.

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

A relatively high proportion (75 percent) of low-LOS outliers were admitted on an elective basis, and a much smaller proportion (29 percent) of high-LOS outliers were elective. This association between outlier status and admission status could be attributable to either of two factors: elective admissions may enable physicians to more efficiently plan resource use, thus potentially reducing LOS and increasing the likelihood that such admissions will have unusually low lengths of stay; or, on the other hand, patients who become high-LOS outliers may have a greater severity of illness.

Distribution of elective admissions

Before discussing the regression results, we first examine the distribution of elective admissions by DRG, by hospital and hospital type, and by payer. The distribution of DRG's by the percent of inlier admissions that are elective within each DRG can be seen in Figure 1. As one would expect, there is a wide variation in the proportion of elective admissions within DRG's. Less than 10 percent of admissions are elective in 10 percent of all DRG's. At the other extreme, more than 90 percent of admissions are elective in 4 percent of the DRG's.

With respect to the association between admission status and average costs and the implications for the fairness of the payment system, the DRG's at the extreme ends of this distribution are of less concern. Because these DRG's are fairly homogeneous with respect to admission status, rates for these DRG's are based on either a relatively low or high percentage of elective admissions. However, DRG's that are in the middle of the distribution are much more heterogeneous with respect to admission status. If admission status is a predictor of costs, and emergency and urgent admissions are more costly, then the payment rate may create incentives to discourage these nonelective admissions. Hospitals with a disproportionate number of emergency admissions are likely to receive payments for selected DRG's that are substantially lower than their actual treatment costs.

The distribution of elective admission status by medical versus surgical DRG categories is also shown in Figure 1. The proportion of elective admissions clearly differs between surgical and medical DRG's. Surgical DRG's tend to have a much higher proportion of such admissions.

Elective admissions distribution across hospitals

If hospitals do not have relatively equal proportions of elective admissions and if elective admissions are associated with lower costs, then hospitals with higher proportions of elective admissions may experience financial windfalls, whereas hospitals with lower proportions of such admissions may suffer financial losses.

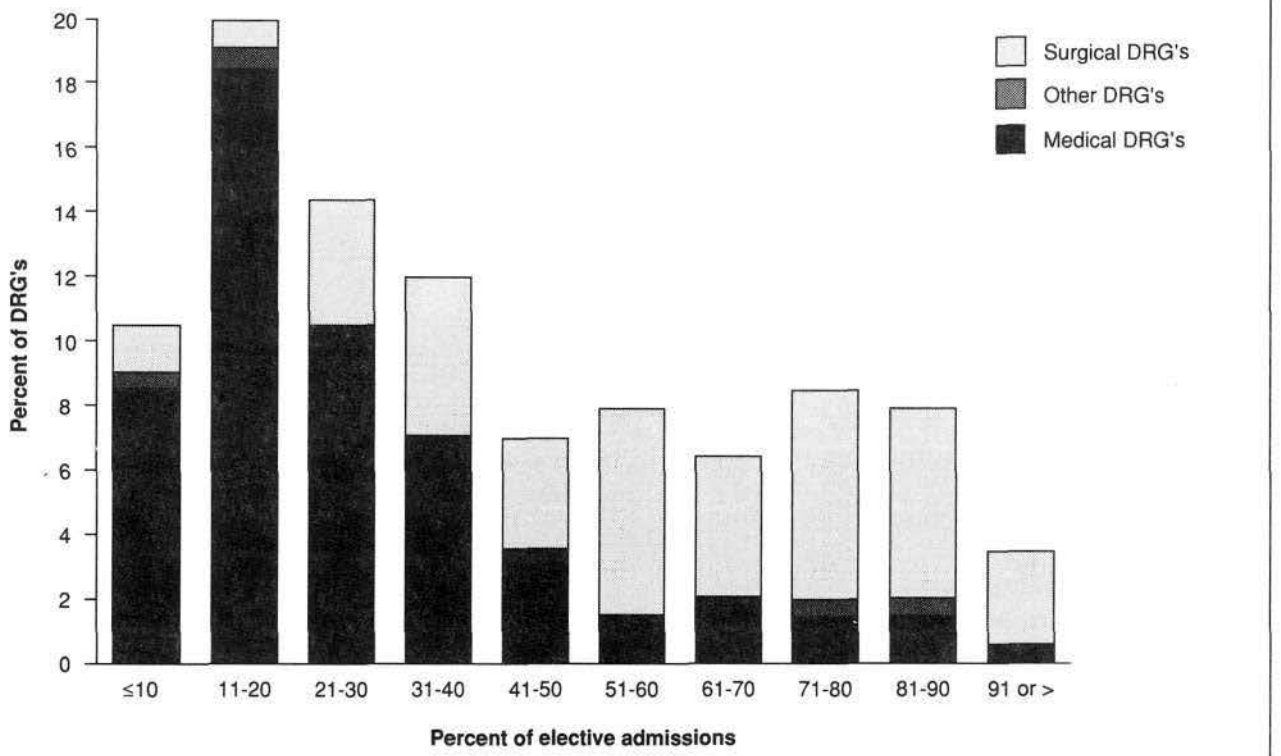
The distribution of hospitals by the percent of total inlier admissions that are elective is shown in Figure 2. In the largest group of hospitals, elective admissions comprise 41 to 50 percent of admissions. However, in more than one-third of hospitals, elective admissions comprise less than 40 percent of total admissions.[5]

There are two possible explanations for a hospital having a lower-than-average proportion of elective admissions. It may have fewer admissions in DRG's that tend to have a high proportion of elective admissions, such as rhinoplasty or tonsillectomy (but in the few admissions in these DRG's, the proportion of elective admissions is the same as in other hospitals). Or it may have fewer elective admissions within each individual DRG. The two explanations do not carry the same distributional implications. It is only with the second factor that one need be concerned about the financial consequences of having fewer elective admissions. In the first case, the hospital's reimbursement level for each DRG presumably reflects resource use, because it has a proportionate share of elective admissions within each DRG. It merely has a different distribution of DRG's.

[5]The data for hospitals at the extreme ends of the distribution should be interpreted somewhat cautiously, as the results may be the result of differences in how these few hospitals code admission status.

Figure 1

Distribution of diagnosis-related groups (DRG's), by the percent of elective admissions: New Jersey, 1982



SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

In the second case, resource use may exceed average reimbursement levels, because a higher proportion of admissions within DRG's is emergency or urgent admissions.

What are the characteristics of hospitals that could possibly account for the differences in the distribution of elective admissions? We examined differences by teaching status and by location. Hospitals are categorized as major teaching, minor teaching, or nonteaching by NJDOH. Nonteaching hospitals account for more than one-half of the hospital admissions in the State (54 percent), major teaching hospitals account for almost one-third (31 percent) of the hospital admissions, and minor teaching hospitals account for 15 percent. The proportion of elective admissions in each of the three types of hospitals is shown in Table 3. Even though major teaching facilities are expected to serve a more severe case mix, the proportion of elective admissions is very similar to that of nonteaching and minor teaching hospitals. Apparently, teaching status does little to explain differences in the proportion of elective admissions among hospitals.

The type of area in which a hospital is located is expected to influence the nature of admissions within a hospital. For example, rural hospitals are often justified because residents of outlying areas need access to emergency care. Therefore, these hospitals might be expected to have a higher proportion of emergency admissions than do suburban hospitals. Inner-city hospitals may also be expected to have a higher proportion of emergency admissions. Suburban hospitals account for 37 percent of the admissions in the State, urban 28 percent, inner-city 26 percent, and rural 9 percent. The distribution of elective admissions by location of hospital is shown in Table 3.

There is a pronounced difference in the proportion of elective admissions by location. Rural and inner-city hospitals have the lowest proportion of elective admissions, and suburban hospitals have the highest proportion.

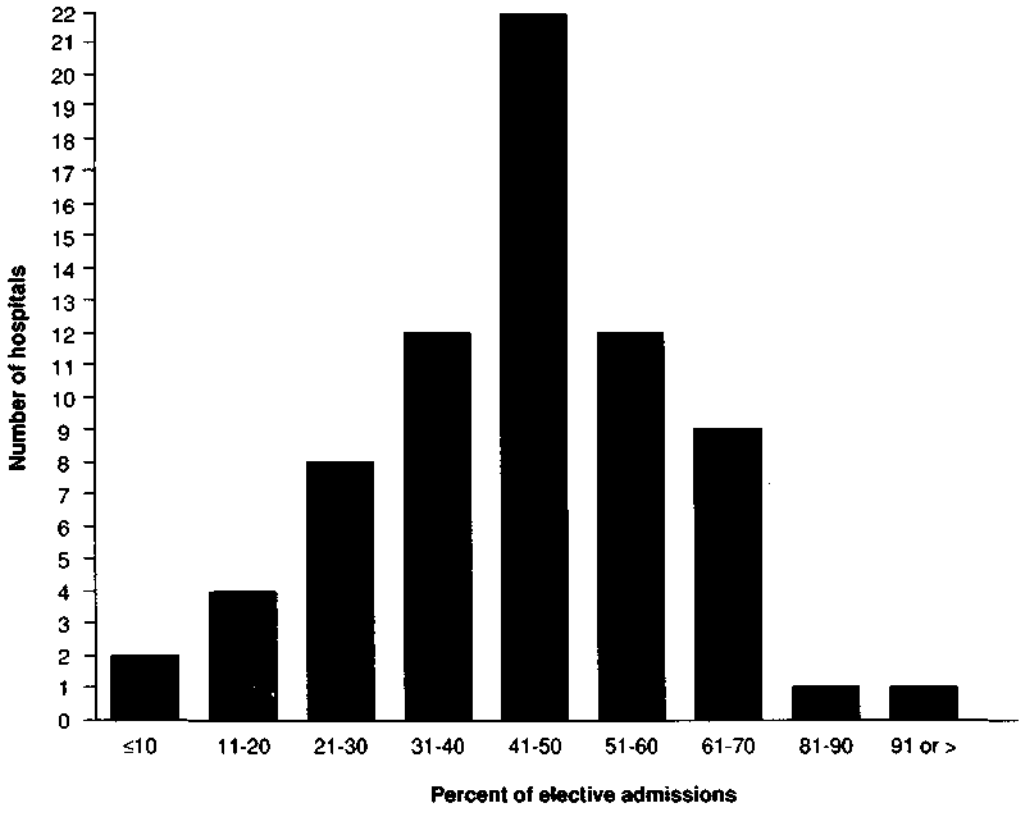
Elective admissions distribution across payers

We also examined the distribution of elective admissions across payers. The major payer categories include: Blue Cross and commercial insurers, Medicare, Medicaid, self-pay patients, and other patients (including enrollees in health maintenance organizations and individuals whose medical costs are paid through workers' compensation or no-fault automobile insurance). The proportion of total admissions contributed by each payer group can be seen in Table 4.

Because admissions for routine pregnancies and newborn infants are considered elective and because

Figure 2

Distribution of hospitals, by the percent of elective admissions: New Jersey, 1982



SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

Table 3

Percentage of elective admissions, by hospital teaching status and location: New Jersey, 1982

Hospital type	Percent total admissions	Percent elective: Inliers and outliers	Percent elective: Inliers only
Teaching status			
Nonteaching	54	49.0	46.8
Minor teaching	15	50.5	49.5
Major teaching	31	46.2	45.1
Location			
Inner-city	26	40.8	39.2
Urban	28	49.3	48.0
Suburban	37	54.8	52.6
Rural	9	40.5	39.6

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

these types of admissions are not distributed uniformly across all payers, we examined the distribution of admissions for all DRG's and for the set of DRG's that excludes those associated with routine pregnancy. It can been seen in Table 4 that Medicaid and self-pay patients have a much lower proportion of elective admissions than other payers, after routine pregnancies are removed.

Table 4

Percentage of elective admissions by payer: New Jersey, 1982

Payer	Percent of total admissions	Percent elective: All DRG's	Percent elective: Nonpregnancy-related DRG's
Blue Cross and commercial	48.5	56.3	46.6
Medicare	27.5	33.6	33.6
Medicaid	10.3	44.1	28.9
Self-pay	7.1	37.6	21.8
Other	6.6	49.7	42.5

NOTE: DRG is diagnosis-related group.

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

Regression results

Aggregate regression results for the top 100 DRG's are presented in Table 5. The three dependent variables (cost per admission, cost per day, and LOS) are regressed on the teaching status of the hospital and on the patient's DRG category[6] and admission status. The results from regressions based on all patients (both inliers and outliers) are shown in the upper panel, and the results based only on inliers are

[6]The coefficients of the 99 dichotomous variables used to control for DRG are not reported.

Table 5

Aggregate regression results for the top 100 diagnosis-related groups (20-percent sample): New Jersey, 1982

Dependent variable	Major teaching hospital	Minor teaching hospital	Elective admission	R^2	F-statistic	Number of admissions
Sample of inliers and outliers						
Cost per admission	*0.104	0.004	* −0.198	0.499	1,555	159,133
	(0.003)	(0.004)	(0.004)			
Length of stay	*0.037	0.003	* −0.205	0.521	1,696	159,168
	(0.003)	(0.004)	(0.004)			
Cost per day	*0.067	0.002	*0.006	0.459	1,323	159,133
	(0.002)	(0.002)	(0.002)			
Samples of inliers only						
Cost per admission	*0.087	*0.019	* −0.067	0.622	2,007	124,341
	(0.003)	(0.003)	(0.003)			
Length of stay	*0.008	** −0.005	* −0.035	0.654	2,299	124,342
	(0.002)	(0.003)	(0.002)			
Cost per day	*0.079	*0.024	* −0.032	0.546	1,467	124,341
	(0.002)	(0.002)	(0.002)			

* Significant at $p = 0.01$.
** Significant at $p = 0.05$.

NOTES: Hospital costs are adjusted for differences in input prices. Standard errors are presented within parentheses.

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

in the lower panel. There exists a significant, negative association between elective admissions and cost per admission, for both all and inlier admissions. Transforming the ELECTIVE coefficients reveals that, after controlling for DRG and hospital teaching status, elective admissions are 18.0 percent less expensive on average than emergency or urgent admissions when the comparison is made over all patients, and 6.5 percent less expensive when the comparison is made over just inliers[7] (derived from Table 5). The difference in average cost between elective and nonelective admissions is greater whenoutlier admissions are included. This is because short-stay outliers (who tend to have a lower DRG-adjusted average cost per admission compared with other patients) have a disproportionate share of elective admissions (75 percent), and long-stay outliers (who tend to have higher costs) have a disproportionate share of emergency and urgent admissions (69 percent).

The negative association between cost per admission and elective status is the consequence of a shorter average LOS in the inlier and outlier sample. However, in the inlier sample, the lower cost per admission associated with elective admissions is the result of both a shorter average LOS and a lower cost per day. For the comparison made across all patients, elective admissions have an average LOS that is 18.5 percent shorter (after transforming the regression coefficient) and an average cost per day that is 0.6 percent greater than emergency and urgent admissions. For the inlier sample, the average LOS is 3.4 percent shorter for elective admissions, and the average cost per day is 3.1 percent lower (derived from Table 5). Therefore, lower costs per admission stem from nearly equal reductions in LOS and cost per day for inlier admissions, but only from reductions in LOS for all (inlier and outlier) admissions.

Results from the regression of the three dependent variables on DRG classification, hospital teaching status, and elective medical and elective surgical admissions are shown in Table 6. These equations were estimated using the inlier sample. Columns 2 and 3 contain the coefficients for ELECMED and ELECSURG, respectively, and column 1 repeats the ELECTIVE coefficients from the lower panel of Table 5. A comparison of the ELECMED and ELECSURG coefficients for the cost per admission equation reveals that the savings of elective surgical admissions are twice as large as the savings of elective

Table 6

Differences in hospital resource use for elective medical and elective surgical admissions in the top 100 diagnosis-related groups (20-percent sample): New Jersey, 1982

Dependent variable	(1) All elective admissions	(2) Elective medical admissions	(3) Elective surgical admissions
Cost per admission	* −0.067	* −0.050	* −0.108
	(0.003)	(0.004)	(0.006)
Length of stay	* −0.035	* −0.017	* −0.088
	(0.002)	(0.003)	(0.003)
Cost per day	* −0.032	* −0.033	* −0.020
	(0.002)	(0.002)	(0.004)

* Significant at $p = 0.01$.
** Significant at $p = 0.05$.

NOTES: Hospital costs are adjusted for differences in input prices. Standard errors are presented within parentheses.

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

[7]Because ELECTIVE is a dichotomous variable, the regression coefficients reported in the table were transformed by $\exp(b) - 1$ to get the percent difference between elective and emergency or urgent admissions.

Table 7

Incremental reduction in unexplained variation achieved by adding admission status as an explanatory variable in estimating cost per admission[1]: New Jersey, 1982

Model specification	Major teaching hospital	Minor teaching hospital	Elective admission	Adjusted R^2	F-statistic	Number of admissions
Sample of inliers and outliers						
DRG only				0.487	1,524	159,133
DRG and ELECTIVE			*−0.209 (0.005)	0.496	1,565	159,133
DRG, MAJTEACH, MINTEACH, and ELECTIVE	*0.104 (0.003)	0.004 (0.004)	*−0.198 (0.004)	0.499	1,555	159,133
Sample of inliers only						
DRG only				0.617	2,022	124,341
DRG and ELECTIVE			*−0.075 (0.003)	0.619	2,017	124,341
DRG, MAJTEACH, MINTEACH, and ELECTIVE	*0.087 (0.003)	*0.019 (0.003)	*−0.067 (0.003)	0.622	2,007	124,341

*Significant at $p = 0.01$

[1]Hospital costs are adjusted for differences in input prices.

NOTE: Standard errors are presented within parentheses. DRG is diagnosis-related group.

SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

medical admissions. Transforming the coefficients reveals that elective surgical admissions are 10.2 percent less costly on average than emergency and urgent admissions, but elective medical admissions are only 4.9 percent less costly than emergency and urgent admissions (derived from Table 6). Furthermore, for surgical DRG's, 82 percent of the lower cost of elective admissions is attributable to a shorter LOS, but for medical DRG's, 65 percent of the lower cost is the result of lower average cost per day.

The results presented in Tables 5 and 6 indicate that, averaging across DRG's, elective admissions are substantially less expensive than emergency or urgent admissions. Still unanswered, however, is the question of whether the addition of admission status improves the ability of DRG's to explain variation in cost per admission. The results presented in Table 7 address this question.

In Table 7, one can see a summary of the regression of cost per admission on three different specifications: DRG's only; DRG's and ELECTIVE; and DRG's, ELECTIVE, MINTEACH, and MAJTEACH. These equations were estimated using both the inlier and outlier sample and the inlier sample.[8] The result of particular importance is the almost-identical values of the adjusted R^2 from each equation. It ranges from 0.487 to 0.499 for the inlier and outlier sample and from 0.617 to 0.622 for the inlier sample. The addition of a single adjustment factor for admission status (i.e., one that is constant for each DRG) adds almost nothing to the DRG classification system's ability to explain variation in cost per admission.[9] The implication of this result is that, when averaged across all DRG's, elective admissions are less costly than emergency and urgent admissions, but the impact of admission status varies substantially across individual DRG's. To understand the magnitude of this variation, we now turn to the DRG-specific regression results.

The distribution of the ELECTIVE coefficients from the 463 DRG-specific regressions is shown in Table 8. The results of the DRG-specific regressions verify that the effect of elective admissions varies widely across individual DRG's. For medical DRG's, the values of the coefficient range from −0.9741 (DRG 317, renal failure with dialysis) to 0.5188 (DRG 462, rehabilitation). For surgical DRG's, the values range from −0.7830 (DRG 271, skin ulcers) to 0.2962 (DRG 153, minor small and large bowel procedures,age under 70 years, no secondary diagnosis). However, nearly 75 percent of all the values for the coefficient fall between −0.20 and 0.10. Although the aggregate relationship between elective admissions and cost per admission is negative,

Table 8

Distribution of elective admissions coefficients for diagnosis-related group (DRG)-specific regressions

Value of coefficient	All DRG's		Medical DRG's		Surgical DRG's	
	Number	Percent	Number	Percent	Number	Percent
< −.40	12	2.6	4	1.6	6	3.1
−.40 − −.31	17	3.7	3	1.2	14	7.2
−.30 − −.21	65	14.0	29	11.3	36	18.6
−.20 − −.11	122	26.3	50	19.5	67	34.7
−.10 − −.01	151	32.6	103	40.2	45	23.3
0 − .09	69	14.9	51	19.9	16	8.3
.10 − .19	17	3.7	12	4.7	5	2.6
.20 − .29	6	1.3	1	0.4	4	2.1
≥ .30	4	0.8	3	1.2	0	0.0

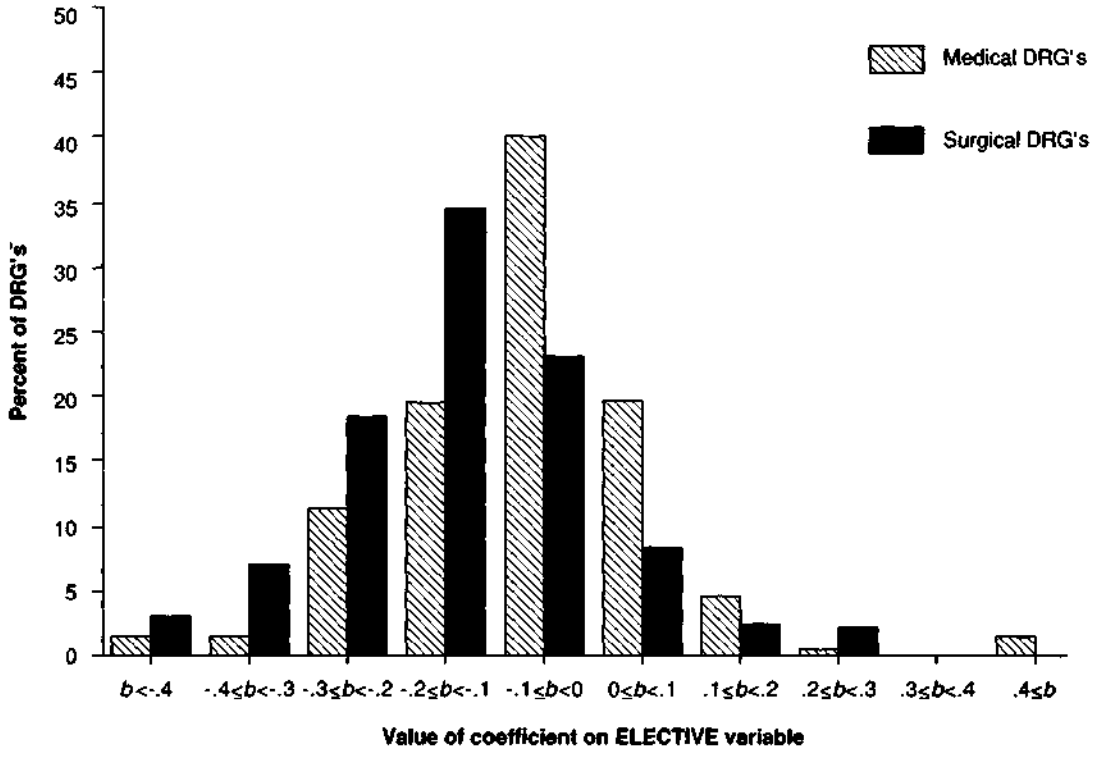
SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

[8]The coefficients on the 99 DRG dichotomous variables are not reported.

[9]A similar comparison using the adjusted R^2 from a regression of cost per admission on DRG classification, ELECMED, and ELECSURG yielded the same result. Therefore, the inclusion of separate elective admission adjustment factors for medical and surgical DRG's also does not increase the explanatory power of DRG's.

Figure 3

Distribution of ELECTIVE coefficients for medical and surgical diagnosis-related groups (DRG's): New Jersey, 1982



NOTE: The *b*'s are the estimated coefficients from the individual DRG regressions.
SOURCE: New Jersey Department of Health: Hospital discharge data, 1982.

there is a positive association in 13 percent of surgical DRG's and 26 percent of medical DRG's.

The distribution of the estimated coefficients for the regression of admission status on cost per admission for the 256 medical DRG's and the 193 surgical DRG's[10] are shown in Figure 3. From the perspective of setting reimbursement policy, one may be willing to overlook "small" differences in costs, but would want to take into account "large" differences. For illustrative purposes, assume that a plus-or-minus-5-percent difference in cost is too small to be of concern. By this standard, 65 percent (166) of the medical DRG's and 85 percent (164) of the surgical DRG's are of concern.

Summary and discussion

The analyses show that in the aggregate, elective admissions are less expensive on average than emergency and urgent admissions, after controlling for DRG and hospital teaching status. This difference is more pronounced in surgical DRG's. However, our analysis of individual DRG's shows that the effect is not the same for each DRG. Thus, including a single adjuster for admission status does not improve the ability of the DRG system to explain variation in hospital cost per admission. Although for most DRG's, elective admissions have a lower average cost per admission than emergency and urgent admissions, they have a higher average cost per admission in 26 percent of medical DRG's and 13 percent of surgical DRG's.

Even though emergency and urgent admissions are found to have higher average costs after controlling for case mix, the desirability of including an admission-status variable in a DRG-based reimbursement system is debatable. First, inclusion of a single adjuster does little to reduce unexplained variation in cost per admission after controlling for DRG. Second, the incentives of such an adjuster are problematic.

Ideally, one would want to base reimbursement rates on objective clinical characteristics of patients that are less amenable to provider manipulation. Basing reimbursement on treatment decisions provides an incentive to alter the course of treatment in such a way as to maximize reimbursement. Because the coding of admission status is somewhat subjective, it

[10]Fourteen of the 463 DRG's used for DRG-specific regressions are classified as "other."

could be subject to manipulation—the equivalent of "DRG creep." If higher levels of reimbursement were set for nonelective admissions, hospitals would have an incentive to classify admissions as emergency or urgent if at all possible.

One option in developing an adjuster is to use clinical correlates of admission status that would adjust for severity level. Finding such correlates, however, may not be an easy task. Coulton et al. (1985) showed that for 10 of the 13 most prevalent DRG's in a medical intensive care unit (ICU), patients who spend some time in an ICU consumed more hospital resources than other patients who received only routine hospital care. But including ICU use as an adjuster would pose the same problems as including admission status, in that hospitals would have an incentive to shift patients to an ICU, at least for a portion of their hospital stay. Ideally, a reimbursement adjuster would not be based on the actions of providers in treating patients but on the objective clinical characteristics of patients themselves.

Although the use of admission status to adjust hospital payment rates may not be feasible, the existing policy of not adjusting for admission status may be unfair to hospitals with a higher-than-average proportion of emergency admissions. The finding that even after controlling for DRG, emergency and urgent admissions have higher average costs than elective admissions points to a weakness in the DRG system that can potentially be exploited by providers.

Admission status is a variable that hospitals can easily identify. As such, it is an easy target for hospitals attempting to improve their bottom lines. Hospitals can reduce the likelihood of emergency admissions by closing or downgrading their emergency rooms. To increase the proportion of elective admissions, they may develop or strengthen programs or services that cater to populations likely to be admitted on an elective basis. Because of these potential problems, further research into the role of admission status in a DRG-based reimbursement system is needed.

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