Should children's hospitals have special consideration in reimbursement policy?

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Children's hospitals were excluded indefinitely from the prospective payment system until a methodology for their reimbursement could be developed. Special consideration in reimbursement policy could be made for children's hospitals if their patients were generally more resource intensive than the pediatric patients of other hospitals.

The resource intensity of patients in children's hospitals was compared with pediatric patients in other hospital groups. The results indicate that the patient population of children's hospitals is similar to the pediatric patient population of university hospitals and considerably different from the pediatric patient populations of the urban and rural hospitals.

Introduction

Recognizing that the reimbursement methodology for Medicare inpatient care was contributing to the rapidly escalating national medical care expenditures, Congress enacted Public Law 98–21 in April 1983. The act provided for an entirely different reimbursement methodology, one that completely discarded the retroactive, cost-based method and introduced a prospective price-per-case method based on a patient classification system known as diagnosis-related groups (DRG's) (Fetter, Shin, Freeman et al., 1980).

Described by some as the most significant change in the health care field since the introduction of Medicare and Medicaid (Bambridge and Geeb, 1983), this new reimbursement methodology establishes, prospectively, a unique price for each of 468 DRG's. With some consideration for length-of-stay outliers and cost outliers, this methodology dictates that when the cost to treat a specific patient DRG exceeds the prospectively established price for that DRG a hospital will generate a deficit. When the cost to treat is less than the established price, a hospital will generate a surplus. Clearly, this new method of reimbursement provides an incentive for hospital administration to cut costs.

Under the current administration of the DRG program, because the established price for each DRG is intended to reflect the consumption of resources necessary in the treatment of an average patient within the DRG, the classification system is generalizable to all hospitals operating in such a system. If the resource consumption within a DRG varies systematically according to the type of hospital, the present classification system would not be a representative base from which to establish an equitable reimbursement system.

Given this limitation, the legislation excluded certain specialty hospitals from this reimbursement methodology. One such group of hospitals, children's hospitals, was indefinitely excluded until the possibility of developing a payment system that would adequately address their unique resource consumption pattern could be investigated.

A case for special consideration in reimbursement policy could be made for children's hospitals if it could be demonstrated that the patients they treated were generally more resource intensive than pediatric patients treated in other hospitals. If this were so, the special consideration might include greater reimbursement for each DRG or certain DRG's. It is also possible, however, that the DRG classification system as it now stands is an inadequate classification system for pediatric patients. Special consideration might then include a new or a revised classification system specifically for children's hospitals or pediatric patients.

These two perspectives of justified special reimbursement consideration provide the focus for this research. This study first sought to compare the resource intensity of patients in children's hospitals with pediatric patients in other hospital groups. It then compared the ability of the DRG classification system to explain variance in the resource variables with that of a revised DRG classification system developed in this article.

Methodology

Data source and sample selection

Information in this study is based on data from the 1982 Professional Activity Study (PAS) of the Commission on Professional and Hospital Activities (CPHA). With more than 1,200 member hospitals from all geographic areas of the country, this data base contains more than 16 million patient records with a high degree of national generalizability (CPHA, 1982).

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Five separate pediatric populations were identified for this article, with the following exclusions being made from each of the universes:

- Major diagnostic category 14, Pregnancy, childbirth, and the puerperium.
- DRG 391, Normal newborns.
- DRG 469, Valid diagnosis but not as principal diagnosis.
- DRG 470, Ungroupable, record does not meet criteria for any DRG.
- Length of stay (LOS) longer than 99 days.,
- Incalculable LOS.
- Stillborns.
- Charges not recorded adequately, charges less than $100 and more than $2,000 and those cases in hospitals where less than 10 percent of charges were reported. (These cases were dropped only for the analyses involving charge data.)

Children's hospitals

The PAS data base included 39 children's hospitals. Five of these were identified as specialist hospitals and were therefore dropped from the sample. The remaining 34 hospitals yielded the 235,286 discharges during 1982 that were used in this study.

Comparison groups

It is recognized that the pediatric mix may vary across distinct hospital types. The patient population of children's hospitals is, therefore, compared with the pediatric populations (patients between 0 and 17 years) of four comparison hospital groups: university hospitals with pediatric residencies, all other hospitals with pediatric residencies, urban hospitals without pediatric residencies, and rural hospitals without pediatric residencies.

The criteria for establishing the four comparison groups were as follows:

- For credibility and manageability, the overall total number of discharges for all four groups was established as 250,000.
- Of the 250,000 discharges, 15 percent should be from teaching hospitals and 85 percent from nonteaching hospitals in order to reflect the national discharge distribution.
- National data indicate that 14 percent of the total hospital discharges were pediatric discharges (excluding newborns). Because the hospitals in the data base included all types of discharges, we could expect only 14 percent of the discharges from the sample hospitals to be pediatric discharges.
- The sample distribution of university hospitals with pediatric residencies and of nonuniversity hospitals with pediatric residencies should approximate the distribution of discharges for teaching hospitals by census region and pediatric-dedicated bed size. The sample distribution of the urban hospitals without pediatric residencies and rural hospitals without pediatric residencies should approximate the distribution of discharges for nonteaching hospitals by census region and pediatric-dedicated bed size.

The sampling rate was established from these criteria, resulting in a rate of 23.7 percent for teaching discharges and a rate of 19.6 percent for nonteaching discharges. (Details of the sampling procedure are available from the authors on request.) This resulted in the following samples:

- 235,286 discharges from 34 children's hospitals (sample A).
- 56,715 discharges from 15 hospitals identified as university owned and affiliated with a pediatric residency program (sample B).
- 27,616 discharges from 10 hospitals identified as nonuniversity owned or affiliated with a pediatric residency program (sample C).
- 116,721 discharges from 130 hospitals identified as urban hospitals (located in a metropolitan statistical area) (MSA) without a pediatric residency program (sample D).
- 54,073 discharges from 97 hospitals identified as rural hospitals without a pediatric residency program not located in an MSA (sample E).

In general, the sample of discharges from university hospitals with pediatric residency programs and from nonuniversity hospitals with pediatric residency programs compared favorably with the distribution of pediatric discharges for all U.S. teaching hospitals. The sample of discharges from urban hospitals without pediatric residency programs and rural hospitals without pediatric residency programs compared favorably with the distribution of pediatric discharges for all U.S. nonteaching hospitals. (These comparisons are available from the authors on request.)

Analytical procedures

Having identified five mutually exclusive groups of hospitals, the first objective of this research was to analyze their differences (or similarities) on six measures of resource intensity. Major diagnostic category, diagnosis-related group, disease stage, average length of stay, average charges, and expected severity were included as measures of resource intensity in six separate analyses.

The chi-square test of independence (or lack of statistical association) formed the basis of the first three analyses, with the appropriate statistics for measuring the strength of the association. In comparing the average length of stay and average charges of the five hospital groups, a one-way analysis of variance (ANOVA) was performed.

The second objective of this research was to evaluate the ability of the DRG classification system to explain the variance in resource consumption and to compare that with a revised DRG classification system developed in this work. Charges and length of stay were included as proxy measures for expected resource intensity, or the vector of resources, that each patient is expected to consume during his or her hospital stay. Disease stage (Gonella, Louis, and McCord, 1976) was included because of its potential implications for the cost of patient care.

With each of the three criteria listed above serving as the dependent variable and hospital groups and DRG classification categories serving as independent variables, similar separate analyses were performed. A nested (hierarchical) ANOVA was perfomed to determine the amount of variance in charges, length of stay, or disease stage that the DRG classification system explains for a hospital group.

Using DRG classification as the independent variable, a one-way ANOVA was performed for each hospital to determine the proportion of variance explained by the DRG classification system. The resulting estimates for each hospital were used as the dependent variable in a one-way ANOVA that incorporates hospital group as the independent variable. Adjustments were made that took into account the hospital's contribution to sample size and the number of hospitals included in the classification. The strength of the relationship between the amount of the variance explained by DRG's and hospital group was evaluated by the Eta^2 statistic. Separate comparisons of pairs of hospital groups were made, using the Scheffe Post Hoc Test.

In order to evaluate the ability of a revised classification system to explain the variance in the resource variables, it was decided to select specific DRG's and apply the revised classification system within DRG's. In this manner, if the classification refinement explained an additional amount of variation, it could be considered an improvement on the DRG classification system.

Sixty-one DRG's were selected for this part of the analysis.[1] Several methods of classification within DRG's were evaluated but, in the interest of brevity, only one is reported here.[2] The National Association of Children's Hospitals and Related Institutions' (NACHRI) age categories is a classification system that is readily adaptable to the existing DRG system. Given its ease of application to the current system and its equally favorable results to the other classification refinements systems used in this work, the NACHRI age categories is the only refinement to DRG's presented in this article. The NACHRI age categories are as follows:

- Under 1 month.
- 1 month to under 1 year.
- 1–5 years.
- 6–12 years.
- 13 years or over.

[1]Twenty-four DRG's appeared in the top 50, by patient volume, for both discharges from children's hospitals and total patient discharges. Twenty-six DRG's were the remaining DRG's in the top 50 of children's hospitals' discharges only. Six DRG's were in the top 50 of total patient discharges only and 5 DRG's were selected as being potentially unique to children's hospitals.

[2]Principal diagnosis, principal procedure, presence of comorbidity or complications, and disease stage were also evaluated as possible refinements of the DRG classification system.

Table 1

Percent distribution of patients in major diagnostic categories, by hospital group

Major diagnostic category	Hospital group A	B	C	D	E
	Percent distribution				
Total	100	100	100	100	100
1 Diseases and disorders of the nervous system	11	9	7	6	6
2 Diseases and disorders of the eye	3	3	2	2	1
3 Diseases and disorders of the ear, nose, and throat	12	7	10	19	16
4 Diseases and disorders of the respiratory system	12	8	9	11	17
5 Diseases and disorders of the circulatory system	5	6	2	1	1
6 Diseases and disorders of the digestive system	14	11	13	16	18
7 Diseases and disorders of the hepatobiliary system and pancreas	1	1	0	1	0
8 Diseases and disorders of the musculoskeletal system and connective system	10	9	8	9	7
9 Diseases and disorders of the skin, subcutaneous tissue, and breast	3	3	3	3	3
10 Endocrine, nutritional, and metabolic diseases and disorders	4	5	2	1	2
11 Diseases and disorders of the kidney and urinary tract	4	3	2	3	3
12 Diseases and disorders of the male reproductive system	2	2	2	2	2
13 Diseases and disorders of the female reproductive system	0	0	1	1	1
15 Newborns and other neonates with conditions originating in the perinatal period	5	19	29	17	14
16 Diseases and disorders of the blood and blood-forming organs	3	2	1	1	1
17 Myeloproliferative diseases	3	3	1	0	0
18 Infectious and parasitic diseases	2	2	2	3	3
19 Mental diseases and disorders	1	2	1	1	1
20 Substance use and substance induced organic mental disorders	0	0	0	1	0
21 Injury, poisoning, and toxic effects of drugs	3	2	3	2	3
22 Burns	1	1	1	0	0
23 Factors influencing health status and other contacts with health services	1	2	1	0	1

NOTES: X^2 = 92.955; degrees of freedom = 21; and W = .8857. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residence programs.

With each of the 61 DRG's, a separate one-way ANOVA was performed with age level serving as the independent variable and average length of stay (ALOS) as the dependent variable. This was repeated with average charge as the dependent variable, with both series of analyses being separately conducted in each of the five hospital groups.

Results

Throughout these analyses, when the five hospital groups are included, the following designation applies:

- Group A = Children's hospitals.
- Group B = University hospitals with pediatric residency programs.
- Group C = Nonuniversity hospitals with pediatric residency programs.
- Group D = Urban hospitals without pediatric residency programs.
- Group E = Rural hospitals without pediatric residency programs.

Throughout the remainder of this article we will refer to patient populations although the study addresses only the relevant pediatric patient population.

The comparison of patients for the five hospital groups by 22 of the 23 major diagnostic categories (MDC's) used in this article is shown in Table 1.

This analysis was completed in a manner that evaluated the ranking of each MDC by the five hospital groups. If each MDC tended to be ranked (in terms of percent of patients) similarly by all five hospital groups, the Kendall's Coefficient of Concordance (W) would be close to unity (1.0). A coefficient of W = .886 indicates that the variance between MDC's is almost as great as total variance, thereby indicating that the five hospital groups were remarkably similiar with respect to the type of patients they treated.

It is shown in Table 2 that when all possible $\binom{5}{2}$, or 10-paired comparisons, were examined for a possible relationship, all Spearman's Rank Order Correlation (r_s) coefficients were in excess of .73, with the average r_s being .86. This confirms that all five hospital groups were remarkably similar in terms of the distribution of patients across MDC's.

The distribution of patients in the five hospital groups were next compared by diagnosis-related groups (DRG's). The distribution of patient volumes by DRG for the top 20 DRG's in all of the five hospital groups is shown in Table 3. For convenience,

Table 2

Correlation (r_s) between sample major diagnostic category volumes

	Sample				
Sample	A	B	C	D	E
A		.9551	.8851	.7572	.7620
B			.8568	.7365	.7518
C				.9447	.9560
D					.9763
E					

NOTES: Average r_s is .8566. See discussion of samples under Methodology.

Table 3

Percent of patients in diagnosis-related groups, by hospital group and rank order

	Hospital group									
	A		B		C		D		E	
Rank	DRG	Percent	DRG	Percent	DRG	Percent	DRG	Percent	DRG	Percent
Total	—	44.6	—	47.9	—	61.2	—	63.0	—	69.6
1	98	6.7	390	6.0	390	11.1	60	7.8	184	10.7
2	184	5.8	389	4.7	389	8.4	184	7.7	98	8.7
3	60	3.0	98	4.3	184	6.2	390	6.9	91	7.8
4	26	2.8	184	4.2	98	4.4	98	5.8	390	6.1
5	91	2.6	385	2.9	91	3.1	91	4.7	70	5.6
6	163	2.0	26	2.4	385	2.7	389	4.5	60	4.9
7	298	2.0	298	2.2	60	2.7	70	3.2	389	3.4
8	468	2.0	387	2.1	388	2.6	58	3.0	422	2.8
9	41	1.9	163	2.1	70	2.6	422	2.1	163	2.1
10	58	1.7	386	2.1	387	2.5	167	2.0	26	2.0
11	70	1.7	468	2.0	386	2.0	62	1.9	58	1.9
12	422	1.6	125	2.0	422	1.8	385	1.9	167	1.9
13	385	1.6	91	1.7	26	1.8	26	1.8	385	1.8
14	125	1.6	388	1.6	163	1.7	163	1.7	33	1.7
15	3	1.5	405	1.4	451	1.5	388	1.6	451	1.7
16	451	1.3	410	1.3	167	1.3	33	1.6	322	1.5
17	396	1.2	3	1.3	62	1.3	451	1.3	398	1.5
18	405	1.2	70	1.2	298	1.2	55	1.3	62	1.2
19	55	1.2	60	1.2	467	1.1	222	1.1	282	1.1
20	62	1.2	422	1.2	468	1.1	322	1.1	71	1.0

NOTES: X^2 = 1,993.09; degrees of freedom = 448; and W is .8898. DRG is diagnosis-related group. Data are for the top 20 DRG's only. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

only the top 20 DRG's are given in Table 3, but the test of the difference (or similarity) of distributions is calculated on the whole set of DRG's represented in the data.

The Kendall's Coefficient of Concordance (W = .890) indicates that the distribution of patients by DRG is remarkably similar for all five hospital groups.

When all 10 possible comparisons are made, all of the rank order correlation coefficients exceed .74, with an average r_s of .86. This confirms that all five hospital groups were remarkably similar in terms of the distribution of patients across all DRG's (Table 4).

Table 4

Correlations (r_s) between sample diagnosis-related group volumes

	Sample				
Sample	A	B	C	D	E
A		.9194	.8762	.7953	.7471
B			.9304	.8808	.8200
C				.9381	.8919
D					.9587
E					

NOTES: Average r_s = .8622. See discussion of samples under Methodology.

The frequency distributions of patients in the five hospital groups were next compared by stage of disease. The disease staging methodology was modified and employed to classify all patients in this study. Stages 1 through 4 (without death) represent increasing levels of disease severity and stage 5 includes all deaths. The distribution of patients in the five disease stages for all five hospitals groups is shown in Table 5.

The contingency table analysis shows a statistically significant large X^2 value, indicating a relationship between hospital group and disease stage. However, statistical significance is easily attained with such a large number of subjects (N), so a measure of the strength of the relationship is required. Cramer's V is a measure that can take on the value of 0 when no relationship exists and +1 when the two variables are perfectly related. The Cramer's V in this analysis is 0.0773, indicating that there is very little relationship between hospital group and disease stage. This is an indication that hospital groups do not differ relative to the disease level of their patients. That is to say, all hospital groups have approximately the same patient mix with respect to severity of illness.

A more intuitive measure of this similarity of hospital groups is provided in the uncertainty coefficient. This measure reflects the amount of uncertainty removed in the probability of finding a patient in a specific disease stage given that we know the hospital group that patient is in. The measure can take on a value of 0 if no uncertainty is eliminated and 1 if all uncertainty is eliminated. An uncertainty coefficient of 0.0174 in this analysis indicates that knowing the hospital group to which a patient belongs reduces the uncertainty of predicting the disease stage of the patient by only 1.7 percent. This, then, is a further indication of the similarity of the distributions of patients in the disease stages for the five hospital groups.

The five hospital groups were next evaluated in terms of LOS and charges. The results for LOS are given in Table 6, and the results for charges are given in Table 7. For both average length of stay (ALOS) and average charges (AC's), there was a statistically significant difference between hospital groups. The very large N was probably responsible for this. When we consider the Eta^2 coefficient, it can be seen that only two-tenths of 1 percent of the variance in ALOS and one-tenth of 1 percent of the variance in AC is explained by hospital group. This can be interpreted as an indication that there is no important difference in the ALOS or AC of the five hospital groups.

The proportion of each hospital group's total patients appearing in each of the five disease stages was compared in Table 5. A more sensitive measure of the overall severity level of a given patient population, however, is the proportion of patients within each DRG that appears in stage 3 or above.

Table 5

Number and percent distribution of patients in disease stages, by hospital group

	Hospital group									
	A		B		C		D		E	
Disease stage	Number	Percent distribution	Number	Percent distribution	Number	Percent distribution	Number	Percent distribution	Number	Percent distribution
1	168,291	71.2	42,311	74.8	22,434	81.3	96,176	82.4	44,458	82.2
2	39,372	16.8	7,786	13.8	3,495	12.7	16,100	13.8	7,765	14.4
3	24,549	10.5	5,115	9.0	1,191	4.3	3,814	3.3	1,606	3.0
4	246	0.1	51	0.1	12	0.0	9	0.0	2	0.0
5	3,355	1.4	1,311	2.3	466	1.7	596	0.5	233	0.4

NOTES: X^2 = 11,711.6619; degrees of freedom = 16; Cramer's V = 0.0773; and uncertainty coefficent = 0.0174. Disease stages 1 through 4 represent increasing levels of disease severity, and stage 5 represents death. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

This measure can then be used to form an index by comparing it to the proportion of patients in stage 3 or above in the total data set.

An Expected Patient Severity Index was constructed for each hospital by taking the proportion of the individual hospital's patients in stage 3 or above of the disease staging classification, within DRG, relative to the proportion of patients in stage 3 or above in the overall data set. The higher the value of the index, the more resources the patient population is expected to consume. It is shown in Table 8 that the mean Expected Patient Severity Index for the five hospital groups is statistically significantly different. The Eta^2 (0.6170) indicates that 62 percent of the variance in severity index is explained by the hospital group. In addition to this, the R (-0.754) indicates a strong negative linear relationship. There is strong evidence, therefore, that when using this more sensitive measure of overall disease level, the patient population of children's hospitals appears more resource intensive than patient populations of the other hospital groups.

Further specification of the difference in resource intensity is possible by considering the 10 possible paired comparisons. In terms of resource intensity, the patient populations of children's hospitals and university hospitals are not statistically significantly different (Table 9). However, the patient populations of the other three hospital groups differ significantly from the patient populations of both children's hospitals and university hospitals. These results suggest that the five hospital groups might be viewed as two groups with respect to patient severity level. Children's hospitals and university hospitals with pediatric residencies would form one group and all other hospitals in the study falling into the other group.

The second objective of this study was to evaluate the ability of the DRG classification system to explain variance in resource variables. LOS, charges, and stage of disease were the resource variables incorporated in this part of the study. A two-stage analysis was used.

In the first stage, for each hospital, a one-way ANOVA was performed with LOS serving as the dependent variable and DRG's serving as the independent variable. From this, the amount of explained variance was determined for each hospital. (In the interest of clarity and brevity, these individual results are not reported here.) In the second stage, the amount of explained variance for each hospital was then incorporated as the dependent variable in a one-way ANOVA that included hospital group as the independent variable.

Table 6

Analysis of variance results for length of stay, by hospital group

Hospital group	Mean	Standard deviation	Number
A	5.6821	8.7127	235,286
B	7.2296	10.8785	56,715
C	5.8527	9.2312	27,616
D	4.0333	5.4911	116,721
E	3.6933	3.9594	54,073

NOTES: F = 2,272.398; degrees of freedom = 4; and Eta^2 = .002.
The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 7

Analysis of variance results for charges, by hospital group

Hospital group	Mean	Standard deviation	Number[1]
A	$3,553.68	$7,024.95	163,151
B	4,506.82	8,380.07	20,168
C	3,179.07	6,962.98	10,046
D	1,444.87	3,104.44	33,058
E	986.28	1,038.49	11,597

[1] Number does not agree with number for Table 6 because charge data was not available for all discharges.

NOTES: F = 1,235.218; degrees of freedom = 4; and Eta^2 = .001.
The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 8

Analysis of variance results for Expected Patient Severity Index, by hospital group

Hospital group	Mean	Standard deviation	Number[1]
A	1.6975	0.4320	137
B	1.5406	0.4138	33
C	0.7927	0.1132	16
D	0.7375	0.2514	69
E	0.7761	0.1554	32

[1] Number for each group reflects the adjustment.

NOTES: F = 113.179; degrees of freedom = 4; and Eta^2 = 0.6170; R = -0.7540.
The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 9

Paired comparisons for Expected Patient Severity Index, by hospital group

Hospital group	A	B	C	D	E
A		ns	*	*	*
B			*	*	*
C				ns	ns
D					ns
E					

NOTES: * is significant at 1-percent level; ns is not significant at 1-percent level. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

This procedure was repeated for both charges and stage of disease; results are shown in Tables 10, 11, and 12.

From the Mean column in Table 10, it can be seen that the DRG classification, on average, explains less of the variance in LOS in children's hospitals than it does in the other hospital groups. This means that DRG's are less homogeneous in terms of LOS in children's hospitals. The difference in means is statistically significant, and hospital group can be considered a strong predictor of the amount of variance in LOS explained by DRG's (Eta^2 = .45). It can also be seen that, with the exception of group D, there is a monotonic increase in the amount of variance explained as one moves from children's hospitals to rural hospitals. This linear relationship is reflected in R = .62 and can be considered strong.

From Table 11 it can be seen that the DRG classification explains less of the variance in charges in children's hospitals than it does in urban hospitals and rural hospitals. However, it explains even less of the variance for university hospitals with a pediatric residency program and for nonuniversity hospitals with a pediatric residency program.

The difference in means is statistically significant, and hospital group can be considered a good predictor of the amount of variance in charges explained by DRG (Eta^2 = .35). It can also be seen that there is a suggestion of a monotonic increase in the amount of explained variance as one moves from children's hospitals to rural hospitals. This linear relationship is reflected in R = .50 and can be considered reasonably strong.

The DRG classification explains less of the variance in disease stage in children's hospitals than it does in the other hospital groups (Table 12). The difference in means is statistically significant, although hospital group is not a strong predictor of the amount of variance in disease stage explained by DRG's (Eta^2 = .10). The linear relationship between hospital group and the amount of explained variance in disease stages is not nearly so strong in this analysis (R = .22).

Knowing the group to which a hospital belongs allows us to make reasonable predictions regarding the homogeneity of DRG's in terms of ALOS and average charges. That is to say, knowing that a hospital belongs to group A, we can predict that DRG's will be less homogeneous with respect to ALOS for that hospital than they will, generally, for hospitals in the other groups. Similar predictions can be reasonably made for average charges (DRG's for group B hospitals are less homogeneous), but no reasonable predictions can be made for disease stage.

Table 10

Variance explained by diagnosis-related groups in length of stay, by hospital group

Hospital group	Mean	Standard deviation	Adjusted number
A	.3237	.0553	138
B	.3356	.0440	33
C	.3837	.0629	16
D	.4923	.1116	68
E	.4470	.1231	32

NOTES: F = 57.365; degrees of freedom = 4; Sig = <.01; Eta^2 = .4495; and R = .6185. The 5 hospital groups are:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 11

Variance explained by diagnosis-related groups in charges, by hospital group

Hospital group	Mean	Standard deviation	Adjusted number
A	.3591	.0590	70
B	.3304	.0689	9
C	.3258	.0502	4
D	.5156	.1485	14
E	.4838	.1683	5

NOTES: F = 13.291; degree of freedom = 4; Sig = <.01; Eta^2 = .3540; and R = .4981. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 12

Variance explained by diagnosis-related groups in disease stage, by hospital group

Hospital group	Mean	Standard deviation	Adjusted number
A	.3449	.0450	138
B	.3887	.0813	33
C	.4145	.1124	16
D	.3932	.0931	68
E	.3704	.0978	32

NOTES: F = 7.494; degrees of freedom = 4; Sig = <.01; Eta^2 = .0964; and R = .2236. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Further specificity of these three sets of results is possible by comparing each group, separately, with all the other groups; results are shown in Tables 13, 14, and 15.

Generally speaking, the homogeneity of DRG's with respect to ALOS and average charges is very similar for children's hospitals, university hospitals with pediatric residencies, and nonuniversity hospitals with pediatric residencies. Urban hospitals and rural hospitals also appear very similar to each other but different to the other three groups on these measures. The homogeneity of DRG's in terms of disease stage is similar for all groups, with the exception of children's hospitals.

The extent to which NACHRI age categories explained variance in charges and LOS beyond that attributable to DRG was examined next. It is suggested that age categories are associated with different levels of resource requirement within DRG's and, therefore, would add to the explanatory strength of DRG's.

Within each of the 61 selected DRG's, for each hospital group, two separate ANOVA's were performed: The NACHRI age categories served as the independent variable in both sets of analyses, with charges serving as the dependent variable in one set and LOS serving as the dependent variable in the other set.

The individual results are not reported here, but they are available from the authors on request. These results show that an additional 5 percent, or more, of the variance in charges and LOS was explained in 35 of the 61 DRG's.

These results indicate that the NACHRI age categories, used as a refinement of DRG's, are somewhat successful. It appears to be particularly true of DRG's 55, 74, 109, 125, 156, 163, and 222; but, of these, only DRG 163 appears in the top 20 DRG's by patient volume of all five hospital groups (Table 2). The results also indicate that, generally, the NACHRI age categories are less successful in explaining additional variance in the children's hospitals than in the other hospital groups.

Table 13

Paired comparisons for variance explained in length of stay by hospital group

	Hospital group				
Hospital group	A	B	C	D	E
A		ns	ns	*	*
B			ns	*	*
C				*	ns
D					ns
E					

NOTES: * is significant at 1-percent level; ns is not significant at 1-percent level. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 14

Paired comparisons for variance explained in charges, by hospital group

	Hospital group				
Hospital group	A	B	C	D	E
A		ns	ns	*	ns
B			ns	*	ns
C				*	ns
D					ns
E					

NOTES: * is significant at 1-percent level; ns is not significant at 1-percent level. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Table 15

Paired comparisons for variance explained in disease stage, by hospital group

	Hospital group				
Hospital group	A	B	C	D	E
A		ns	ns	*	ns
B			ns	ns	ns
C				ns	ns
D					ns
E					

NOTES: * is significant at 1-percent level; ns is not significant at 1-percent level. The 5 hospital groups are as follows:
Group A is children's hospitals.
Group B is university hospitals with pediatric residency programs.
Group C is nonuniversity hospitals with pediatric residency programs.
Group D is urban hospitals without pediatric residency programs.
Group E is rural hospitals without pediatric residency programs.

Summary and conclusions

When the five hospital groups are compared in terms of distribution of patients by MDC, DRG, and stage of disease (Tables 1, 3, and 5), there do not appear to be any important differences. When LOS and charges are considered (Tables 6 and 7), the amount of variance explained by hospital group is two-tenths of 1 percent for LOS and one-tenth of 1 percent for charges, indicating again no important difference. However, the correlation coefficients of MDC volumes (Table 2) and DRG volumes (Table 4) suggest that children's hospitals (group A) are very similar to university hospitals with pediatric residency programs (group B) (r_s = .96 and .92) and nonuniversity hospitals with pediatric residency programs (group C) (r_s = .89 and .88), but not so similar to urban hospitals without pediatric residency programs (group D) (r_s = .76 and .80) and rural hospitals without pediatric residency programs (group E) (r_s = .78 and .75). The LOS means (Table 6) and charge means (Table 7) also support this contention. The Expected Patient Severity Index analysis provides strong evidence that the resource intensity of the patients in children's hospitals and university hospitals with pediatric residency programs is greater than that of the patients of the other three hospital groups.

It would appear from this study that specialty hospitals such as children's hospitals and teaching hospitals tend to attract similar patient populations with similar resource intensities. This would argue for special consideration for both of these hospital types in reimbursement policy. This is not to suggest that the reimbursement rate for children's hospitals should include the teaching adjustment. Rather it suggests that the two rates be similar before the teaching adjustment is added to the teaching hospitals.

The second part of this research evaluated the ability of DRG's to explain the variance in resource variables. The findings indicate that, when the current DRG patient classification system is applied to pediatric patients, the resulting groups of patients are less homogeneous with respect to resource intensity in children's hospitals than in the other four hospital groups studied (Tables 10 and 12). With greater variation in terms of resource requirements, within DRG, the predetermined, fixed reimbursement level under the PPS is less equitable.

Any patient classification system used as the basis for reimbursement must have the capability of capturing patients of the same resource intensity within the same group. It is recognized that in the development of DRG's some minor adjustments were made to improve medical meaningfulness. This work provides support for the argument that DRG's do not serve their purpose well in patients of children's hospitals or in the pediatric patients of the other hospitals studied here. At best, less than 50 percent of the variance in the resource variables included in this work, is explained by the DRG classification. This would suggest that some other classification system, or a modification of the DRG system, might better apply to pediatric patients.

A simple modification of DRG's was developed with the NACHRI age categories being used to further classify patients within DRG. The capability of this revised classification system to explain variance in the resource variables beyond that explained by DRG's was examined. Such a modified DRG classification has the advantage of being readily available and easily applied.

The results indicate that a simple modification such as introducing NACHRI age categories into the DRG system adds somewhat to the integrity of the classification system for pediatric patients. The current DRG classification system does allow for the possible difference in resource intensity of patients of different age groups with the same principle diagnosis. It would not, therefore, be undermining the basic methodology of the system to incorporate age grouping in the classification of younger patients. As discussed in this article, this modification is simple to apply, and the findings of this research are encouraging enough to suggest further research using DRG's modified by the age grouping of pediatric patients.

References

Fetter, R. B., Shin, Y., Freeman, J. L., et al.: Case-mix definitions by diagnosis-related groups. *Med Care* Supp. 18(2):1–53, 1980.

Bambridge, M. A., and Geeb II, D. G.: The effect of PPS on Medicare timing differences. *Health Care Financial Management* 37(9):64–68, Sept. 1983.

Commission on Professional and Hospital Activities: *Professional Activity Study*. Ann Arbor, Michigan, 1982.

Gonella, J. S., Louis, D. Z., and McCord, J. J.: The staging concept: An approach to the assessment of outcome of ambulatory care. *Med Care* 14(1):13–21, 1976.