Medicare prospective payment without separate urban and rural rates

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The elimination of urban-rural differences in the Medicare prospective payment system (PPS) standard rates implies a need to re-examine all the PPS payment adjustments. Refinements for case mix, outliers, and the wage index can make a significant contribution to avoiding payment disparities in a single-rate system. However, changes in the adjustments for teaching and disproportionate-share (DSH) hospitals are also needed. The typically urban location of these hospitals makes it difficult to balance PPS payments and costs among major groups of urban and rural hospitals without some form of higher payment for all hospitals located in large urban areas.

Introduction

In October 1983, Medicare's method of paying for inpatient hospital services changed from retrospective, cost-based reimbursement to a PPS. Under PPS, Medicare pays a fixed basic rate for each inpatient stay. This standard rate is either increased or decreased depending on the diagnosis-related group (DRG) applicable to the stay and factors such as the area wage level, the extent of the hospital's teaching activity, and the degree to which the hospital serves low-income persons. Additional payments are also made for unusually expensive cases (outliers). Initially, separate standard rates were established for urban and rural hospitals. Effective October 1987, Congress created two urban standard rates: one for hospitals in metropolitan areas with populations of more than 1 million (large urban) and another for hospitals in other urban areas.

The Omnibus Budget Reconciliation Act of 1990 (OBRA 1990) phases out the separate standard rates for urban and rural hospitals between fiscal year (FY) 1991 and FY 1995. The elimination of separate rates will be achieved by increasing the rural standard rate more rapidly than the urban rate. The OBRA 1990 action continues a process that began in FY 1988, when the rural standard rate first received a higher annual rate of increase (annual update factor) than the urban. In FY 1995, there will be a single standard rate for rural and other urban hospitals, and a slightly (1.6 percent) higher rate for hospitals in large urban areas.

At the outset of PPS, the standard rate for urban hospitals was more than 20 percent higher than the rate for rural hospitals (as a percent of the urban standard rate). This differential was based on analysis of the 1981 Medicare cost report data, which formed the basis for the original PPS standard rates. The data showed that average rural hospital costs per case were about 40 percent lower than the average urban hospital cost per case (as a percentage of the urban costs). After accounting for differences in case mix, labor costs, and indirect teaching costs, a difference of more than 20 percent remained.

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The difference in the initial PPS urban and rural standard rates reflected the unexplained urban-rural cost differences and was motivated by a desire to not disadvantage urban hospitals financially. The relationship between the costs of urban and rural hospitals has changed very little since the inception of PPS. However, the financial condition of rural hospitals and potential adverse consequences for rural Medicare beneficiaries' access to care have been a source of perennial concern.

This concern and the perception that a separate rural rate may be inequitable are responsible for the gradual elimination of the urban-rural differences. Differential annual update factors and technical changes in the calculation of the standard rates (effective October 1, 1987, the rates were case-weighted instead of hospital-weighted and separate urban-rural offsets to finance outlier payments replaced a single offset) substantially narrowed the urban-rural differential even prior to the OBRA 1990 decision to phase out the rate differences. Particularly notable were the FY 1990 annual update factors, which increased the rural standard rate by 9.7 percent, compared with 5.6 percent for the large-urban rate and 5.0 percent for the other-urban rate. By FY 1991, the initial difference of more than 20 percent had been reduced to about 8.1 percent for the large-urban versus the rural rate and about 6.6 percent for the other-urban versus the rural rate.

Related studies

Congressional concern for rural hospitals has spawned a number of studies in recent years. The U.S. General Accounting Office (1990) analyzed reasons for rural hospital closures (Lillie-Blanton et al., 1992). The Prospective Payment Assessment Commission (ProPAC) investigated changes in PPS aimed at raising rural hospital payments and estimated the effect of those policies, had they been in effect at the beginning of PPS. ProPAC (1991) also studied the impact of low volumes of admissions on hospital costs and payments. The U.S. Congressional Budget Office (CBO) (1991) also examined the changes in PPS that were intended to raise rural hospital payments. They compared the effects of the PPS rules that were or would be in effect under current law in FY 1984, FY 1991, and FY 1995 and assessed their implications for the financial conditions of hospitals (U.S. Congressional Budget Office, 1991).

In the Omnibus Budget Reconciliation Act of 1989 (OBRA 1989), Congress directed the Secretary of the U.S. Department of Health and Human Services (USDHHS) to re-examine all the PPS adjustments (for case mix, teaching hospitals, rural referral centers [RRCs], sole community hospitals [SCHs], DSH hospitals, and outlier cases) to the standard rates for their appropriateness if separate urban-rural rates were eliminated and to recommend changes as well as additional payments or adjustments. In this article, we summarize the analyses conducted by the Health Care Financing Administration (HCFA) in response to this mandate. In contrast to the ProPAC and CBO studies, we do not evaluate the effects of past policy changes. Rather, we evaluate the payment adjustments that would be consistent with a single standard rate.

In scope and method, this study is similar to the 1987 USDHHS (1987) Report to Congress that examined the appropriateness of the separate urban-rural rates. The report noted that the PPS adjustments for teaching, DSH, and RRC hospitals are all accommodations to the fact that separate urban and rural rates do not account for high-cost hospitals within the urban and rural groups. The report did not recommend eliminating the separate standard rates but did point out that there is a strong correlation between intensity of care, hospital size, and teaching activity and that all of the PPS adjustments would need to be re-evaluated under a single-rate system.

The analyses described in this article apply only to Medicare payments that cover hospitals' inpatient operating costs. In October 1991, Medicare began paying for its share of allowable capital costs under a new capital PPS based on a per discharge average amount. Once this capital PPS is fully phased in (current law specifies a 10-year period), HCFA believes that payments for operating and capital costs should be based on a single standard rate adjusted by one set of payment adjustments. Discussions of payment adjustments appropriate to combined operating and capital costs appear in the *Federal Register* (1991) and in Cotterill (1992).

Overview of this study

In this article, we assess the need for payment adjustments in a PPS without separate urban and rural rates. We concern ourselves here with the distribution of payments among the various groups of urban and rural hospitals and do not address whether Medicare's overall level of payments to all hospitals is too high or too low. Other articles in this issue of the *Review* are more relevant to the question of the aggregate level of payments (Sheingold and Richter, 1992; Peden, 1992; Bradley and Kominski, 1992).

The chief criterion used to evaluate the appropriateness of the PPS payment distribution is that payment-to-cost ratios should be similar across hospital groups. Using the most recent available cost data at the time of the analysis, simulations of payment-to-cost ratios are compared for FY 1991 rules, FY 1995 rules, and a simpler single-rate system that eliminates some special provisions of FY 1995 rules. These comparisons serve to illustrate the effects of eliminating the separate urban-rural rates and to identify hospital groups where further payment adjustments may be desirable. The central finding is that, compared with FY 1991 rules, a single-rate system redistributes payments from urban to rural hospitals, especially small rural hospitals (Table 1, columns 2 and 4). The payment-to-cost ratio of rural hospitals is too high, and the ratio of hospitals in large urban areas is too low. Among urban hospitals, major teaching hospitals and teaching hospitals that also qualify as DSH hospitals maintain their shares of payments better than any other groups.

To improve the balance between the payment-to-cost ratios of rural and urban hospitals, we first examined the case-level adjustments for differences in hospitals' case-mix severity. DRG refinements to improve case-mix measures of severity and modifications of outlier payment policy were evaluated. An analysis of wage-index refinements was also conducted, which is described in a separate article in this issue of the *Review* (De Lew, 1992). Our simulations incorporate the results of that analysis.

By their nature, the DRG refinement and outlier payment changes shift payments to hospitals with higher proportions of relatively expensive cases. The wage-index change (dividing each State rural area into counties with populations greater than 25,000 and those with less than 25,000) has a similar effect. Together, these changes would be expected to move the payment-to-cost ratios in the desired directions, because rural hospitals tend to have less costly cases than hospitals in large urban areas. Indeed, the combination of case-level refinements did achieve parity among the payment-to-cost ratios of the broad urban and rural hospital categories.

However, some striking disparities are also evident. For example, the payment-to-cost ratio of the major teaching hospitals increased markedly, and it was already the highest among the groups examined under the simple single-rate system. To address this problem, the payment adjustments for indirect medical education (IME) and DSH costs were re-evaluated. Regression analysis was used to estimate the relationship between Medicare cost per case and the IME and DSH variables. The basis for the IME and DSH adjustments was solely their relationship to hospital costs. This approach, which embodies the policy judgment that Medicare should only pay for hospital costs related to the delivery of care to Medicare beneficiaries, differs from ProPAC's current position. ProPAC's approach involves estimating the IME adjustment without controlling for DSH effects and then determining the DSH adjustment as a policy decision independent of Medicare cost. The DSH payment is viewed as a Medicare subsidy to assist hospitals in ensuring access to quality care for low-income Medicare beneficiaries (Prospective Payment Assessment Commission, 1992).

In our analysis, the resident-to-average-daily-census ratio replaces the resident-to-bed ratio as the IME

Table 1

Normalized payment-to-cost ratios by hospital groups, using current-law adjustments for fiscal year (FY) 1991 and FY 1995, and a single-rate system with FY 1991 adjustments absent further refinements

Hospital group	(1) Number of hospitals	(2) Current law FY 1991	(3) Current law FY 1995	(4) Baseline single-rate system
National average	4,907	1.0000	1.0000	1.0000
All urban	2,620	1.0024	0.9984	0.9970
Large urban	1,275	1.0027	0.9993	0.9906
Other urban	1,345	1.0021	0.9974	1.0045
Rural	2,287	0.9858	1.0095	1.0180
Urban bed size				
0-99 beds	607	0.9597	0.9517	0.9538
100-199 beds	776	0.9942	0.9916	0.9884
200-299 beds	582	0.9765	0.9726	0.9712
300-499 beds	488	1.0126	1.0083	1.0083
500 beds or more	167	1.0347	1.0307	1.0276
Rural bed size				
0-49 beds	1,132	1.0049	1.0373	1.0434
50-99 beds	696	0.9895	1.0272	1.0318
100-149 beds	238	0.9860	1.0194	1.0330
150-200 beds	108	0.9821	0.9995	1.0102
More than 200 beds	112	0.9697	0.9663	0.9752
Teaching status				
Non-teaching	3,876	0.9740	0.9774	0.9799
Minor teaching	856	1.0030	0.9984	0.9990
Major teaching	175	1.0954	1.0962	1.0842
Current disproportionate-share status				
Non-DSH	3,534	0.9647	0.9621	0.9663
DSH URB with 100 beds or more	975	1.0531	1.0555	1.0477
DSH URB with fewer than 100 beds	97	1.0526	1.0448	1.0529
DSH rural	301	1.0437	1.0767	1.0954
Special category urban				
URB TCH and DSH	517	1.0653	1.0677	1.0593
URB TCH and no DSH	437	0.9843	0.9743	0.9778
URB no TCH and DSH	555	1.0275	1.0296	1.0235
URB no TCH no DSH	1,111	0.9402	0.9320	0.9356
Special category rural				
NON-MDH/SCH/RRC/RECLASS	1,207	0.9610	1.0196	1.0448
MDH	501	1.0292	1.0045	1.0314
SCH	352	1.0230	1.0601	0.9900
RRC	203	0.9939	0.9852	0.9981
SCH and RRC	24	0.9766	0.9806	0.9455

NOTES: SCH is sole community hospital. RRC is rural referral center. MDH is Medicare-dependent hospital. DSH is disproportionate-share hospital. URB is urban. TCH is teaching hospital. RECLASS is reclassified rural hosital. Hospital costs are from FY 1988. Total payments are constrained to the amount estimated to be paid out during (FY 1988). Hospitals in Maryland and Puerto Rico, New York hospitals that participate in the Finger Lakes Area demonstration, and Indian Health Service hospitals have been excluded from the analysis. The single-rate column employs one payment rate, with current law (FY 1991) payment adjustments and no special payment provisions for SCHs, RRCs, MDHs, reclassified rural hospitals, or the regional floor.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data development by Office of Research.

measure of teaching intensity. An analysis of these alternative measures of teaching activity and reasons for the choice of the resident-to-average-daily-census ratio appear in a separate article in this issue of the *Review* (Phillips, 1992).

Our analysis found a significant DSH effect only for urban hospitals of 100 beds or more, and this effect existed for hospitals in both large-urban and other-urban areas. Furthermore, there were independent effects of DSH and urban location, which suggests that greater payment equity could be achieved by adjusting for both factors separately. Cost regression estimates were used jointly with simulations to evaluate alternative add-on payments for hospitals in large-urban areas.

Our estimated IME and DSH adjustments improved the parity of the payment-to-cost ratios of teaching and DSH hospitals relative to other hospital groups. However, urban hospitals not receiving the IME and/or DSH adjustments still had lower payment-to-cost ratios than hospitals receiving those adjustments. It proved difficult to maintain parity among the broad urban and rural hospital groups while simultaneously balancing the ratios of subgroups within urban and rural areas. The best approach to emerge from our analyses was to combine re-estimated IME and DSH adjustments with a small add-on of about 3 percent for all hospitals in large urban areas.

Assessing the need for adjustments

The purpose of payment adjustments in PPS is to avoid penalizing hospitals for sources of cost variation that are beyond the hospital's control. Initially, PPS adjusted payments for differences in DRG case mix, wage levels, and IME costs. In 1986, the DSH adjustment was added, which provided for additional payments to hospitals that treat a high proportion of low-income persons. In theory, existing or proposed payment adjustments would be evaluated by comparing payments that incorporate the adjustments of interest with the efficient costs that reflect only those factors beyond a hospital's control. The fairness or equity of the payment system would be measured by how well individual hospital payments match this ideal measure of cost. The ideal payment-cost relationship would require that, for each hospital, PPS operating revenue equal ideal, efficient operating costs, because any differences would be attributable to a failure of the PPS payment formula to adjust for appropriate differences in costs.

Of course the ideal cost measure is unobservable, and therefore, it is only possible to evaluate the payment-cost relationship using actual Medicare costs. Because actual Medicare costs must be used, payment-cost comparisons for individual hospitals are not appropriate. However, if inefficiency is not highly correlated with hospital characteristics such as teaching status and location, payment-cost comparisons for hospital groups can be used to measure payment equity. Significant variations among hospital groups' performances under this system can be attributed to shortcomings in the system's payment adjustments. The assumption that average cost variation among groups of hospitals is not attributable to inefficiency is a critical underpinning of the evaluation of payment equity described in this article.

In this study, we evaluate payment equity using payment-to-cost ratios for groups of hospitals, with cost data from the most recent available set of Medicare cost reports. At the time the study was conducted, cost reports for the fifth year of PPS (PPS5) (hospital accounting years beginning during FY 1988) were the latest data available. If cost relationships among hospital groups change over time, payment-cost relationships will change. Therefore, this evaluation of payment equity clearly depends on the cost relationships in the PPS5 data.

It would be particularly troublesome if biases in the payment system itself had induced some groups of hospitals to inappropriately constrain costs, and the resulting cost structure was then used as the basis for further changes in the payment system. Although there is some evidence that hospitals under greater fiscal pressure exert more effort to contain costs (Hadley, Zuckerman, and Feder, 1989), there is no evidence that such cost containment has been inappropriate.

Other work (Friedman and Farley, 1990; Peden, 1992) implies more generally that hospitals' costs respond to changes in revenue. In particular, rising revenues have stimulated increased expenditures. This research is directly relevant for considering how to determine annual updates to the PPS standardized amounts, but it also has potential implications for the cross-sectional cost structure. Systematic relationships between financial performance and the hospital group characteristics used in this article may affect the cross-sectional cost structure and, in turn, our results. It is very important to remember that the findings of this study regarding payment equity may be sensitive to systematic biases in the observed PPS5 cost structure.

Measuring payment equity

A simulation model was employed to evaluate alternative sets of PPS payment rules. PPS payments for each hospital were simulated under either actual or hypothetical rules and then combined with costs from Medicare cost reports to construct simulated payment-to-cost ratios. Such ratios for groups of hospitals were compared under alternative payment proposals to evaluate payment equity. (The less the variation in the ratios across hospital groups, the greater the payment equity.)

Payment-to-cost ratios were "normalized" for each hospital group by dividing the group average payment-to-cost ratio by the national average ratio. As a result, the normalized national average ratio is always 1, and the closer the group ratios are to 1, the greater the payment equity. Payment-to-cost ratios were normalized to separate the issue of the aggregate level of PPS payments from the issue of the relative treatment of different hospital groups (relative payment equity). The former is primarily a matter for the annual budget decision on the update factor for the standard rates; the latter deals directly with the distribution of payments, irrespective of their aggregate level. As indicated earlier, the analyses described in this article deal only with distributional equity.

Payment-to-cost ratios were used rather than Medicare margins (PPS revenues minus Medicare operating cost divided by PPS revenues). Unlike Medicare margins, relative differences in normalized payment-to-cost ratios are not affected by differences in the aggregate level of payments. In addition, the absence of an additive term in the payment-to-cost ratio helps preserve relative relationships more precisely than is the case with margins. Differences in payment-to-cost ratios can alternatively be interpreted as the percent difference between the group's ratio and the overall ratio or as the percent difference between the group's share of PPS payments and its share of Medicare operating costs. As a result of the additive term, margins cannot be directly interpreted in this manner.

Data

Simulating PPS payments requires a variety of information for each hospital. DRG case-mix indexes and outlier payments were derived from the FY 1989

Medicare Provider Analysis and Review (MEDPAR) file. The wage index was constructed from the 1988 HCFA wage survey (excluding the effects of the 1990-91 decisions of the Medicare Geographic Classification Review Board). The teaching and DSH variables for each hospital were derived from both the 1988 HCFA Provider Specific file and the PPS5 cost reports.

The data set comprises 4,907 hospitals and excludes hospitals operating under PPS waivers (Maryland and Finger Lakes Area hospitals), Indian Health Service hospitals, and hospitals located in Puerto Rico. Other hospitals were excluded because of the absence of a PPS5 cost report, and 29 hospitals were deleted based on data edits.

Impact of single standard rate

The simulated payment-to-cost ratios for three sets of payment rules are shown in Table 1. Normalized payment-to-cost ratios are shown for hospitals located in large-urban, other-urban, and rural areas, as well as for hospitals grouped by various other characteristics. Columns 2 and 3 of Table 1 show the payment-to-cost ratios for FY 1991 and FY 1995 payment rules calculated from 1988 data. Column 4 displays the effects of using a single standard rate in conjunction with FY 1991 payment adjustments, also eliminating the regional floor and payment protections for special classes of rural hospitals. The payment rules shown in this column represent a purer form of single rate than the FY 1995 payment rules and serve as a better point of reference for evaluating the need for payment adjustments as a result of eliminating differences in standard rates.

1991 versus 1995

As described earlier, OBRA 1990 set in place a process to equate the rural and other-urban standard rate in FY 1995. A differential of 1.6 percent will be maintained for the large-urban standard rate. Eliminating the rural rate without making other changes would redistribute funds from all urban hospitals to all rural hospitals. According to our estimates, the urban normalized payment-to-cost ratio would fall from 1.0024 (FY 1991) to 0.9984 (FY 1995). The rural hospitals' ratio would rise from 0.9858 (FY 1991) to 1.0095 (FY 1995).

Although current law makes minimal other payment changes, DSH payments will increase effective October 1, 1993. There will be a series of increases in DSH payments to urban hospitals with 100 or more beds and a DSH percentage greater than 20.2 percent, and to rural hospitals with 500 or more beds and a similar DSH percentage.

Therefore, although PPS payments would shift from urban to rural hospitals overall, urban hospitals with 100 or more beds would benefit from higher DSH payments than they currently receive. The payment-to-cost ratio of this hospital group is very similar under FY 1991 and FY 1995 rules. On the other hand, the payment-to-cost ratios of urban hospitals not receiving the DSH increases are at least 0.8 percentage points lower under FY 1991 than under FY 1995 rules (see the rows labeled "DSH URB with fewer than 100 beds," "URB TCH and no DSH," and "URB no TCH no DSH," which stand for, respectively, urban hospitals with fewer than 100 beds that receive DSH adjustments, urban hospitals receiving adjustments for IME but not DSH, and urban hospitals receiving neither adjustment).

Also noteworthy in Table 1 is the lack of change in the payment-to-cost ratios of major teaching hospitals (those with resident-to-bed ratios greater than 0.25) after elimination of the rural rate. Their ratios remain above 1.09 in both the FY 1991 and FY 1995 columns and are among the highest of any group. Although these hospitals are primarily located in urban areas, and therefore their ratios would be expected to fall relative to those of rural hospitals, many of them also qualify for DSH payments and would benefit from the higher DSH adjustments. The level of the teaching adjustment would remain at approximately 7.7 percent for every increase of 0.1 in the resident-to-bed ratio through FY 1995. The payment-to-cost ratios for non-teaching hospitals are lower under FY 1991 than under FY 1995 rules, and those for minor teaching hospitals are slightly higher.

1995 versus a single rate

Rather than eliminating the separate rural rate by raising it to the level of the other-urban rate and maintaining a higher large-urban rate, the simulation shown in Table 1, column 4, applies the same standard rate to all hospitals. Consistent with a single-rate system, this simulation also differs from FY 1991 payment rules by eliminating the regional floor provision and the special payment protections for SCHs, RRCs, Medicare-dependent hospitals (MDHs), and reclassified rural hospitals. The wage index and the payment adjustments for IME costs and DSH are the same as under the FY 1991 rules.

As expected, hospitals in large urban areas do worse under this system than under FY 1995 rules (0.9993 versus 0.9906) because of the absence of the large-urban differential and the additional DSH payments that are part of FY 1995 rules. Other-urban and rural hospitals would do better under a single-rate system than under FY 1995 rules.

The absence of the special provisions for SCHs is especially noticeable in comparing the single rate and FY 1995 rules. Under the single rate, the payment-to-cost ratio for SCHs is 0.9900, whereas the ratio is 1.0601 under FY 1995 rules. Also, the 24 hospitals qualifying for both SCH and RRC status would fare considerably worse without special protection. However, MDHs and RRCs would gain under a single rate.

Summary

Changing to a single standard rate without any refinements to the payment adjustments would result in too large a redistribution of payments from hospitals in large urban areas to those in other urban and rural locations. The payment-to-cost ratio of all rural hospitals would be greater than 1, and the ratio for hospitals in large urban areas would be less than 1. Even greater disparities occur within urban and rural groups. For example, the ratio for urban hospitals not receiving IME or DSH payments is well below 1, and the ratio for small rural hospitals is well above 1. In addition, SCHs would do worse under a single standard rate without special protection than under either FY 1991 or FY 1995 payment rules.

Case-level refinements

Under PPS, the standard rate for an individual case is adjusted for differences in the patient's diagnosis and the hospital's area wage level, and additional payments are provided if the case is unusually expensive or involves an unusually long stay in the hospital. The total payments distributed to hospitals on the basis of the standard rate and these three adjustments can be described as "case-level" DRG payments. DRG refinement and outliers are related. Improving the DRG classification system, by reducing the within-DRG variation in resource use, reduces the number of outlier cases. Outlier policy refinements attempt to reduce hospitals' financial risks by better targeting outlier payments to the cases with the largest financial losses.

These refinements are expected to improve the distribution of hospital payment-to-cost ratios under the baseline single-rate system by increasing payments to high-cost cases and decreasing payments to low-cost cases. The payment-to-cost ratio of rural hospitals, especially small rural hospitals, should fall, and the ratio of hospitals in large urban areas should rise.

Patient classification system refinements

PPS accounts for variation in resource use resulting from differences in patients' treatment needs by categorizing patients into discrete classes, or DRGs. The relative average cost of each DRG (the DRG relative weight) is then used to adjust the standard rate in determining the payment for each case.

The DRG system uses a treelike structure to classify cases into major diagnostic categories (MDCs) on the basis of the principal diagnosis. Medical cases are then categorized into distinct DRGs by diagnosis, and surgical cases are categorized by operating procedure. Finally, some DRGs further differentiate between cases based on the age of the patient and the presence or absence of a significant comorbidity or complication.

Two recent efforts to refine the DRG classification system use catastrophic complications and comorbidities (CCs) to better account for patient severity of illness and differences in resource requirements. The Yale refined DRGs were developed at Yale University under a HCFA-funded project (Yale University, 1989), and the New York grouper was developed for New York State by 3M/HIS. The Yale system divides DRGs based on the effect additional diagnoses and CCs have on expected resource requirements. Medical DRGs are divided into three refined DRGs (RDRGs): minor or no effect, moderate effect, and major effect. Surgical DRGs are divided into four RDRGs: minor or no effect, moderate effect, major effect, and catastrophic effect. The Yale revision expands the number of patient classes to 1,263 RDRGs.

After analyzing the Yale refined DRG system, the New York State Department of Health, in conjunction with 3M/HIS (Averill et al., 1993) concluded that the biggest improvement in case-mix measurement was accomplished with the addition of the catastrophic CCs. Based on this finding, New York developed a uniform list of major CCs that would apply across all DRGs. Further analysis showed that, within any MDC, patients with major CCs were similar. That is, the presence of the CC was a better indicator of the resources used than the principal diagnosis or the type of surgery performed. Therefore, New York created major CC categories by MDC. Most MDCs have at least two major CC DRGs—one for surgical cases and one for medical cases. The net effect is the addition of 54 new DRGs, for a total of 539.

Table 2 compares the predictive power of the HCFA grouper, the Yale refined DRGs, and the New York grouper in explaining costs. The mean coefficient of variation is also displayed, showing the degree of homogeneity of resource use within DRGs. The Yale refined DRGs and the New York grouper, which incorporate catastrophic complications and comorbidities, perform significantly better than the current HCFA grouper. These results are consistent with those of the HCFA-funded study at Queens University, which concluded that the Yale refined DRGs are as powerful as any of the other systems in predicting costs (Queens University, 1991).

Finally, the stability of the relative weights across years for the three patient classification systems was examined by comparing the percentage of the DRG weights that changed by more than 5 percent between 1987 and 1988. Forty-eight percent of the Yale refined DRG weights changed by more than 5 percent, compared with 24 percent of the HCFA DRG weights and 23 percent of the New York DRG weights. Although this is an incomplete longitudinal analysis, it does appear that both New York and the current HCFA system are more stable than the Yale refined DRGs. One explanation is that the Yale refined DRGs have more than twice as many DRGs as either New York or

Table 2

Comparison of explanatory power of various diagnosis-related group (DRG) classification systems

Classification system	R^2	Coefficient of variation (charges)
1991 HCFA grouper	.3022	93.37
New York grouper	.3320	86.13
Yale refined DRGs	.3466	82.47

NOTE: HCFA is Health Care Financing Administration.

SOURCE: HCFA, Bureau of Data Management and Strategy: Data development by Bureau of Policy Development.

the current HCFA system, resulting in smaller cell sizes and greater variability.

Yale's significant improvement in ability to explain costs and case-level homogeneity is offset by the instability of the weights, the large number of DRGs, and the number of low-volume DRGs. The New York grouper approaches the Yale refined DRGs in terms of predictive power, while equaling or improving upon the HCFA grouper in terms of low-volume DRGs and the stability of the relative weights. The New York grouper incorporates the most important aspect of the Yale refined DRGs (catastrophic CCs) at the cost of only 54 additional DRGs. It is a viable PPS refinement, and in fact, several changes to the HCFA grouper that were implemented in FY 1991 were based on the New York grouper.

Urban and rural case mix

The urban-rural cost differential has often been attributed to systematic differences in patient severity of illness across hospital groups that are not accounted for by the current DRG system. If the cost of treatment increases as the level of severity increases, failure to adequately consider severity in patient classification would underpay hospitals with high proportions of more severe cases. Adjusting for severity of illness would lead to greater hospital payment equity and eliminate any incentives for a hospital to discriminate against Medicare patients with certain diseases or certain social or economic characteristics.

The Queens study examined the ability of the current HCFA DRG system, the Yale refined DRGs, and eight other case classification systems to account for severity of illness (Queens University, 1991). They estimated the differences in average DRG case weight between urban and rural hospitals for four of the case-mix measurement systems: current DRGs, the Yale refined DRGs, the Acuity Index Method (developed by Iameter [1988]), and DRGScale (developed by Systemetrics/McGraw Hill [Conklin et al., 1984]). They found that, using the Yale refined DRGs, the average urban case weight was 16.2 percent higher than the average rural case weight. For the current HCFA grouper, the difference was 15.5 percent. The differences for the Acuity Index Method and the DRGScale were intermediate. The Queens study suggests that severity variation within DRGs is unlikely to account for differences in cost between urban and rural settings.

Table 3 shows that implementing either the New York or Yale refined DRG system would change the average case-mix index for urban and rural hospitals by approximately 1 percent. Similarly to the Queens study, these results suggest that most of the difference in cost between urban and rural hospitals is not attributable to within-DRG differences in average patient severity. As is shown later in this article, DRG refinement does affect payment-to-cost ratios as expected, but the magnitude of the effect is small.

Table 3
Average urban and rural hospital case-mix indexes

Hospitals	1991 HCFA grouper	New York grouper	Yale refined grouper
Large urban	1.041	1.043	1.046
Other urban	1.033	1.030	1.031
Rural	0.870	0.869	0.863

NOTES: HCFA is Health Care Financing Administration. DRG is diagnosis-related group. Data used are fiscal year 1989 Medicare cases from the Medicare Provider Analysis and Review file.

SOURCE: HCFA, Bureau of Data Management and Strategy: Data development by Office of Research.

Payments to outlier cases

Outliers are cases that have either an extremely long length of stay (LOS) (in relation to the geometric mean LOS for the DRG) or extraordinarily high costs. Outlier policy recognizes that hospitals cannot be expected to balance these unusually costly cases with cases that exhibit lower-than-average costs. Therefore, outlier payments are a form of insurance for hospitals, providing some protection against these high-cost cases.

By law, outlier payments must comprise between 5 and 6 percent of case-level DRG payments and are funded by separate reductions to the urban and rural standard rates. The threshold at which a case qualifies for day-outlier payments increased from the lesser of 20 days or 1.94 standard deviations from the mean DRG LOS in FY 1984 (the first year of PPS), to the lesser of 32 days or 3 standard deviations from the mean DRG LOS in FY 1992. The corresponding threshold for cost outliers increased from the greater of 1.5 times the case-level DRG payment or $12,000 in FY 1984, to the greater of 2 times the case-level DRG payment or $44,000 in FY 1992. The outlier thresholds rose because of increases in both cost per case and the number of high-cost cases. Higher thresholds increase the losses that must be incurred before a case qualifies to receive outlier payments.

By law, outlier payments are required to approximate the marginal cost of care beyond the outlier threshold. The marginal cost factor is currently 60 percent for day outliers and 75 percent for cost outliers. Day outliers are paid a per diem amount for each covered day of care beyond the LOS threshold. The per diem amount is 60 percent of the case-level DRG payment divided by the average LOS for that DRG. Cost outliers are paid 75 percent of the difference between the hospital's cost for the discharge and the cost threshold.

In FY 1989, HCFA implemented several changes in the way that outlier payments were calculated in an effort to better target outlier payments to the expensive cases where hospital losses were greatest. First, the marginal cost factor for cost outliers was increased from 60 to 75 percent (90 percent for cost-outlier burn cases.) Second, hospital-specific cost-to-charge ratios replaced a single national average cost-to-charge ratio in computing the costs against which the marginal cost factor is applied in deriving cost-outlier payments. Third, instead of paying outlier cases that qualified as both day and cost outliers as day outliers, they were paid the greater of the day- or cost-outlier payment.

In this issue of the *Review*, Carter and Farley assess the effects of the FY 1989 changes in outlier payment policy. They conclude that, although the FY 1989 changes to outlier policy succeeded in reducing financial risk to hospitals, continued evaluation and implementation of other improvements would increase the effectiveness of outlier policy.

Outlier payment refinements

Table 4 presents outlier payment-to-cost ratios, the number of outlier cases, and outlier payments per outlier case for current law, the proposed New York grouper, and potential refinements to the outlier policy. The outlier payment-to-cost ratio indicates the proportion of the cost of the entire stay that is covered by the PPS payment, including outlier payments. The outlier payment-to-cost ratios differ from the payment-to-cost ratios used elsewhere in this article in that they are not normalized and include only outlier cases. The four types of outlier cases (day-only, paid-as-day, etc.) are defined in terms of how each case qualifies to become an outlier and whether it is paid as a day or cost outlier.

The first two simulations in Table 4 show the impact on outlier payments and cases of moving from the current-law urban-rural standard rates and the HCFA grouper to the single-rate PPS with the New York grouper. Consistent with eliminating urban-rural differences in the standard rates, all of the single-rate outlier policy options use a single offset to the rate to fund the outlier payments.

The New York grouper improves patient classification, thereby reducing the number of cases that become outliers because they have higher-than-average costs within DRGs. As a result, outlier thresholds are lowered by 1 day and $1,000, allowing the next stratum of high-cost cases to qualify as outliers while maintaining the same level of total outlier payments.

The New York grouper has a modest beneficial effect on outlier policy, but clearly there is room for further improvement. For example, as a result of the large increase in the cost threshold over time, hospitals currently incur a much higher loss before outlier payments begin than they incurred at the outset of PPS. In addition, there are large differences in the degree of protection provided to different types of outlier cases.

Our analysis of outlier refinements evaluates the impact of five changes in outlier policy. Three of the changes are intended to expand protection against financial loss: increasing the outlier pool from 5 to 10 percent of DRG payments, increasing the marginal cost factor from 75 to 80 percent, and substituting a fixed-loss threshold of $10,000 for the current method of setting the cost-outlier threshold. Currently, the cost threshold is the greater of a dollar amount set annually or 2.0 times the DRG rate for the case.

Increasing the outlier pool to 10 percent and raising the marginal cost factor to 80 percent would lower the

Table 4

Outlier simulations

Simulation and type of outlier case	Average payments divided by costs	Outlier cases	Average outlier payment per outlier case
Simulation 1[1]			
Total	0.5647	183,115	$12,215
Day only, paid as day	0.6247	90,541	6,245
Day and cost, paid as day	0.6996	20,010	23,858
Day and cost, paid as cost	0.5553	25,539	30,162
Cost only, paid as cost	0.4599	47,025	9,008
Simulation 2[2]			
Total	0.5883	183,695	12,200
Day only, paid as day	0.6468	94,587	6,192
Day and cost, paid as day	0.7315	20,996	24,909
Day and cost, paid as cost	0.5676	24,707	30,039
Cost only, paid as cost	0.4768	43,405	8,991
Simulation 3[3]			
Total	0.5792	552,186	8,097
Day only, paid as day	0.6163	96,486	1,970
Day and cost, paid as day	0.6665	63,720	9,576
Day and cost, paid as cost	0.6000	139,265	17,173
Cost only, paid as cost	0.5323	252,715	5,061

[1]Simulation 1 uses current-law urban-rural standard rates and Health Care Financing Administration (HCFA) grouper. Thresholds are geometric mean length of stay (LOS) plus the lesser of 29 days or 3 standard deviations for day outliers and the greater of $35,000 or 2.0 times the Federal rate for cost outliers.

[2]Simulation 2 uses single-rate prospective payment system with the New York grouper and a wage index that distinguishes between rural counties with greater or less than 25,000 population. Thresholds are geometric mean LOS plus the lesser of 28 days or 3 standard deviations for day outliers and the greater of $34,000 or 2.0 times the Federal rate for cost outliers.

[3]Simulation 3 is simulation 2 with the addition of the arithmetic mean as the per diem payment rate for day outliers, the fixed-loss cost outlier threshold methodology, a marginal cost factor of 80 percent, a 10 percent outlier pool, and the elimination of standardization of costs for indirect medical education and disproportionate share. Thresholds are geometric mean LOS plus the lesser of 18 days or 3 standard deviations for day outliers and $11,000 plus the Federal rate for cost outliers.

SOURCE: HCFA, Bureau of Data Management and Strategy: Data development by Bureau of Policy Development.

outlier thresholds and provide greater protection for expensive cases. Changing the cost threshold to a fixed-dollar amount over the DRG rate would help to prevent the situation in which cases with large losses receive no outlier payments at all. The fixed-loss policy provides greater protection for DRGs with high relative weights, for which 2.0 times the DRG rate could result in very heavy losses before the triggering of outlier payments. This payment method resembles insurance with a fixed deductible and a copayment (the marginal cost factor). It provides the same protection against significant losses on any given case, while not creating any incentives to keep patients longer than medically necessary (Keeler, Carter, and Trude, 1988).

A fourth change is aimed at eliminating the possibility of making profits on large numbers of day-outlier cases by reducing the per diem payment made for such cases. A ProPAC-funded study found that, on average, the per diem payment for day-outlier cases was 120 percent of the costs per day for outlier days beyond the day threshold (Carter and Melnick, 1990). Additional HCFA-funded research (Carter and Rumpel, 1992) concluded that basing the day-outlier per diem on the arithmetic mean instead of the geometric mean LOS and reducing the marginal cost factor to 0.55 from 0.60 would more accurately match day-outlier payments and costs. HCFA implemented these changes in FY 1993 (*Federal Register*, 1992).

A final change intended to provide more equal protection for each type of outlier case, especially cost outliers, involves eliminating the standardization of costs for IME and DSH in determining whether a case exceeds the cost-outlier threshold. Under current policy, to determine whether a case qualifies as a cost outlier, charges are reduced by the hospital's cost-to-charge ratio and then divided by one plus the sum of the hospital's IME and DSH factors. The effect is to increase the cost-outlier threshold for cases in teaching and DSH hospitals. Eliminating this standardization of costs would focus outlier payments on the most expensive cases, regardless of the type of institution that treats the case. Under this policy, outlier payments to teaching and DSH hospitals would clearly increase. However, their IME and DSH payments would decrease because outlier payments would be excluded from the payment base upon which IME and DSH payments are calculated.

Simulation 3 in Table 4 displays the combined effects of the five outlier refinements. The number of cases receiving outlier payments increases from 183,695 under the 5-percent pool to 552,186 under the 10-percent pool. As a result of the lower thresholds, the cases that qualified for outlier payments in the 5-percent pool receive higher payments in the 10-percent pool, but the average payment per case decreases because of the large number of new cases. The new cases have lower costs or shorter stays and receive lower payments than the other cases because they exceed the thresholds to a lesser degree. Overall, the average outlier case receives payments that are 58 percent of costs, compared with slightly less than 59 percent without these refinements. Hence, the new cases under the 10-percent pool incur significant losses before payment is received.

These outlier-policy changes also reduce the wide disparity in outlier payment-to-cost ratios across types of outlier cases. In simulation 2, the ratios range from 0.48 for cost only, paid as cost, to 0.73 for day and cost, paid as day. The refinements in simulation 3 reduce the range to 0.53-0.67. Greater payment equity among types of outlier cases helps meet the goals of eliminating profits on outlier cases and focusing outlier payments on cases with the heaviest losses.

Moving to the arithmetic mean LOS for the day-outlier per diem and eliminating the standardization of costs for IME and DSH are responsible for most of the reduction in variation across types of outlier cases. The arithmetic mean lowers the per diem payment and decreases the outlier payment-to-cost ratio for cases paid as day outliers. However, day and cost, paid as day-outlier cases, still have the highest ratio, followed by day-only, paid as day cases. Also, the change results in a shift away from cases paid as day outliers toward cases paid as cost outliers. Outlier payment-to-cost ratios for cases paid as cost outliers increase, largely because of the elimination of the standardization of costs for IME and DSH. The level of loss that must be suffered before payment is received for these cases is reduced, although outlier payment-to-cost ratios are still lowest for cost-only, paid as cost cases.

Simulations of case-level refinements

The effects of the case-level refinements on the normalized payment-to-cost ratios are shown in Table 5. An adjusted baseline single-rate system is shown in column 2, and the effects of the New York grouper, the rural wage-index modification, and the five outlier payment refinements follow in the succeeding columns. The refinements were added to the simulations cumulatively, so that the final column (column 5) shows the combined effects of all the case-level refinements.

The adjusted baseline single-rate system in column 2 of Table 5 differs from the baseline single-rate system in column 4 of Table 1 in the treatment of SCHs and RRCs. In Table 1, the simple single-rate system, these hospital groups received no special treatment. In Table 5, SCHs are paid the higher of the single rate or an FY 1987 hospital-specific rate. Consistent with current law, which terminates the special provision for MDHs in 1993, MDHs receive no special treatment. The main effect is a higher payment-to-cost ratio for SCHs (from 0.9900 to 1.0284). RRCs and MDHs have slightly lower ratios, as do all rural hospitals that receive no special treatment. These declines essentially reflect the budget-neutrality effects of the special provision for SCHs.

Column 3 of Table 5 shows the effects of adding the New York grouper to the baseline single-rate system. The results confirm what was shown in the patient classification analysis: The redistribution across urban and rural areas is small. Separating the most resource-intensive cases into new DRGs does redistribute

Table 5
Normalized payment-to-cost ratios, by hospital groups for single-rate systems with refinements to the case-level diagnosis-related group payment adjustments

Hospital group	(1) Number of hospitals	(2) Adjusted baseline single-rate system	(3) Baseline with New York grouper	(4) New York grouper wage-index[1]	(5) New York grouper wage-index outlier
National average	4,907	1.0000	1.0000	1.0000	1.0000
All urban	2,620	0.9967	0.9974	0.9951	1.0000
Large urban	1,275	0.9901	0.9937	0.9915	0.9993
Other urban	1,345	1.0044	1.0017	0.9993	1.0000
Rural	2,287	1.0197	1.0155	1.0292	0.9999000
Urban bed size					
0-99 beds	607	0.9548	0.9549	0.9499	0.9340
100-199 beds	776	0.9894	0.9873	0.9849	0.9788
200-299 beds	582	0.9705	0.9715	0.9684	0.9707
300-499 beds	488	1.0072	1.0072	1.0052	1.0140
500 beds or more	167	1.0278	1.0317	1.0304	1.0462
Rural bed size					
0-49 beds	1,132	1.0491	1.0450	1.0155	0.9744
50-99 beds	696	1.0357	1.0326	1.0227	0.9881
100-149 beds	238	1.0329	1.0286	1.0488	1.0197
150-200 beds	108	1.0104	1.0056	1.0386	1.0110
More than 200 beds	112	0.9739	0.9689	1.0231	1.0067
Teaching status					
Non-teaching	3,876	0.9804	0.9770	0.9777	0.9655
Minor teaching	856	0.9979	0.9989	0.9984	1.0001
Major teaching	175	1.0857	1.0964	1.0950	1.1388
Current disproportionate-share status					
Non-DSH	3,534	0.9658	0.9629	0.9637	0.9551
DSH URB with 100 beds or more	975	1.0485	1.0532	1.0508	1.0662
DSH URB with fewer than 100 beds	97	1.0507	1.0553	1.0519	1.0463
DSH rural	301	1.0930	1.0919	1.1123	1.0864
Special category urban					
URB TCH and DSH	517	1.0598	1.0673	1.0650	1.0877
URB TCH and no DSH	437	0.9762	0.9754	0.9736	0.9754
URB no TCH and DSH	555	1.0250	1.0237	1.0212	1.0202
URB no TCH no DSH	1,111	0.9348	0.9308	0.9280	0.9202
Special category rural					
NON-MDH/SCH/RRC/RECLASS	1,207	1.0425	1.0393	1.0311	0.9992
MDH	501	1.0284	1.0251	0.9984	0.9598
SCH	352	1.0209	1.0175	1.0090	0.9730
RRC	203	0.9958	0.9898	1.0471	1.0253
SCH and RRC	24	0.9544	0.9513	0.9916	0.9685

[1]This uses a wage index that distinguishes between rural counties with more or less than 25,000 popuplation.

NOTES: DSH is disporportionate-share hospital. URB is urban. TCH is teaching. MDH is Medicare-dependent hospital. SCH is sole community hospital. RRC is rural referral center. RECLASS is reclassified rural hospital. HCFA is Health Care Financing Administration.

SOURCE: HCFA, Bureau of Data Management and Strategy: Data development by Office of Research.

payments from other urban to large urban areas, reflecting the location of the most serious cases.

Column 4 adds a wage index that distinguishes between rural counties with populations of greater or less than 25,000 to the simulation in column 3. In the New York grouper simulation, the payment-to-cost ratios vary widely across rural bed-size groups. The relationship is consistently inverse, with the largest rural hospitals having the lowest payment-to-cost ratios (0.9689 for those with more than 200 beds), and the smallest rural hospitals having the highest payment-to-cost ratios (1.0450 for those with fewer than 50 beds). Adding the wage-index refinement provides greater payment equity by bringing most of the bed-size ratios closer to 1. The larger hospitals tend to have higher wages and be located in more populous areas. They have higher wage indexes and more discharges than the smaller hospitals, whose wage indexes are lower.

Overall, the wage-index refinement redistributes payments from urban areas to rural areas, as the higher payments of large rural hospitals with higher wage indexes are not offset by the lower payments of small rural hospitals with lower wage indexes. The rural payment-to-cost ratio rises from 1.0155 to 1.0292.

Column 5 combines the system in column 4 with an outlier policy that includes: a 10-percent pool, a marginal cost factor of 80 percent, a fixed-loss cost threshold, the use of the arithmetic mean to determine the per diem rate for day outliers, and no standardization of costs for IME and DSH. The outlier refinements redistribute payments from rural to urban hospitals, with large urban areas benefiting the most and other urban areas showing a slight increase in payments. Large rural hospitals (more than 200 beds) do not maintain their payment levels, showing that even the largest, most sophisticated rural hospitals have considerably fewer outliers than urban hospitals. The urban bed-size effect is consistent, with the small hospitals losing and the large hospitals gaining.

The major teaching hospitals show the largest increase in payments because outlier cases are disproportionately located in these hospitals. Also, no longer standardizing costs for IME and DSH means that more cases in major teaching hospitals qualify as outliers, and both old and new cases receive higher payments. Because the major teaching hospitals and the majority of outlier cases are located in large urban areas, the payment-to-cost ratio of hospitals located in such areas increases from 0.9915 to 0.9993.

Comparing just the large-urban, other-urban, and rural payment-to-cost ratios in this simulation, the case-level refinements appear to produce an equitable single-rate system. Unfortunately, this perception is dispelled by looking at other major hospital groups, which reveal that the urban-rural location category masks significant inequities. Although major teaching hospitals constitute only 4 percent of total hospitals, they represent 14 percent of total payments and have a payment-to-cost ratio of 1.1388. Non-teaching hospitals, which represent 79 percent of total hospitals but only 47 percent of total payments, have payment-to-cost ratios of 0.9655. The proportion of total payments and high payment-to-cost ratios of major teaching hospitals contribute to significant inequities for non-teaching hospitals. This consequence is particularly evident in large urban areas. The overall payment-to-cost ratio approaches 1.0000, however, 70 percent of major teaching hospitals are located in large urban areas where their high payment-to-cost ratios obscure the low ratios of small urban hospitals (0.9340) and non-teaching or non-DSH hospitals (0.9202). This disparity also exists for DSH versus non-DSH hospitals. The payment-to-cost ratio for urban DSH hospitals with 100 beds or more is 1.0662 and for rural DSH hospitals is 1.0864, while the ratio for non-DSH hospitals is 0.9551.

A comparison of Table 5, columns 4 and 5, shows that the disparity for teaching and DSH hospitals was magnified by the outlier refinements. Eliminating the IME and DSH standardization for cost outliers contributes significantly to the effect. However, the change in standardization for cost outliers had the beneficial effect of equalizing the protection provided to cost- and day-outlier cases. For this reason, the outlier changes are retained, and efforts to further improve the distribution of payment-to-cost ratios is sought by modifying the IME and DSH adjustments.

Teaching and disproportionate-share adjustments

The objectives of our re-examination of the IME and DSH adjustments are to set the adjustments at a level supported by the cost data and to bring the payment-to-cost ratios of teaching and DSH hospitals into line with those of other hospital groups without disturbing the urban-rural balance achieved with the case-level refinements. The task is complicated by the fact that teaching and DSH hospitals tend to be concentrated in urban areas, so that straightforward reductions in the IME and DSH adjustments to empirically supportable levels will lower the urban payment-to-cost ratios below 1.

To analyze interactions between urban-rural location and the IME and DSH adjustments, cost regressions were run with and without controls for urban-rural location. The results, which are discussed in more detail later in this article, indicated that the IME coefficient is much less sensitive to urban-rural location than is the DSH coefficient. As a result, our initial analysis concentrated on refinements of the DSH effect. This work was used to specify the set of hospitals that would be eligible for DSH payments in the single-rate system.

Analyses were conducted to address the following questions: What types of hospitals (by size and location) merit a DSH adjustment based on cost relationships? Is there some threshold level of DSH activity below which DSH status has no cost impact? An investigation of variation in the DSH effect by a more detailed breakdown of city size failed to find a consistent, systematic relationship and is not reported here.

In the regression used in these analyses, the dependent variable, Medicare cost per case, and most of the independent variables are expressed in logarithms. The dependent variable is standardized by the case-mix index (New York grouper) and a wage index that distinguishes between counties with populations of greater or less than 25,000. The regression model does not control for outlier payments and the teaching and DSH variables are expressed as the logarithm of 1 plus the IME and DSH measures.

Location is controlled for by including dummy variables for large urban, other urban, and rural areas. In testing for DSH effects, the magnitude of such effect is allowed to vary across urban and rural hospitals of different sizes. In testing for a DSH threshold, the magnitude of the DSH effect is also allowed to vary across the range of values of the DSH percentage.

Whose costs support disproportionate share?

PPS makes additional payments to hospitals that serve a disproportionate share of low-income patients. Hospitals qualify to receive DSH payments depending upon the extent to which they serve low-income patients and hospital size and geographic location (urban or rural). Service to low-income patients is proxied by the DSH percentage, which is the sum of two ratios: the proportion of Medicare days provided to Medicare

Table 6

Estimated disproportionate-share cost effects controlling for location

Variable	Beta	T	Significance
Disproportionate-share categories			
Urban with 100 beds or more	0.173	5.0	.0001
Urban with fewer than 100 beds	−0.189	−3.5	.0004
Rural with 100 beds or more	−0.115	−2.1	.0351
Rural with fewer than 100 beds	−0.289	−7.4	.0001
Location categories			
Large urban	0.108	9.4	.0001
Other urban	0.063	5.5	.0001
Residents-to-average-daily-census ratio	0.307	9.8	.0001

NOTE: $N = 4{,}963$; $R^2 = 0.168$; $F = 144.6$.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data development by Office of Research.

Table 7

Disproportionate-share (DSH) effects, by category of DSH percentage for urban hospitals with 100 or more beds

Variable	Hospitals	Beta	T	Significance
DSH percentage[1]				
.05-.10	469	0.033	2.0	.0462
.10-.15	352	0.021	1.2	.2421
.15-.25	598	0.031	2.0	.0483
.25-.35	201	0.056	2.8	.0076
.35-.45	98	0.063	2.4	.0165
.45-.55	71	0.077	2.5	.0142
.55 or higher	143	0.094	4.0	.0001
IME (indirect medical education)	—	0.303	9.6	.0001

[1]All DSH effects are relative to 309 hospitals with DSH percentages in the 0-.05 range.

NOTE: $N = 4{,}963$; $R^2 = 0.168$; $F = 32.4$

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data development by Office of Research.

beneficiaries who are eligible for Supplemental Security Income (SSI) and the proportion of total days provided to Medicaid recipients. The DSH-percentage criteria vary for urban hospitals with more or fewer than 100 beds, for rural hospitals with fewer than 100 beds, 100-499 beds, and 500 or more beds, and for SCHs and RRCs. The formula for computing the amount of the DSH adjustment also varies according to these criteria. Approximately 1,559 hospitals currently receive this adjustment, 73 percent (1,149) of which are urban hospitals with 100 beds or more.

Two recent studies (U.S. Congressional Budget Office, 1990; Sheingold, 1990) examined the costs of hospitals that serve a disproportionate share of low-income patients. Both studies found higher costs related to DSH only for urban hospitals with 100 beds or more. Rural hospitals and urban hospitals with fewer than 100 beds do not have higher costs than comparable non-DSH hospitals.

Our regression results (Table 6) are consistent with those of CBO and Sheingold in showing distinct differences in the relationship between DSH percentage and cost in urban and rural areas. For urban hospitals with 100 beds or more, the DSH coefficient is positive and significant. For urban hospitals with fewer than 100 beds and all rural hospitals, it is negative and significant. That is, as the percentage of low-income patients increases, costs decrease. The largest negative effect occurs for rural hospitals with fewer than 100 beds. The reason for the inverse relationship of DSH to cost among some hospital groups is unknown and requires more extensive analysis. However, it may be related to factors such as the patient demographic and clinical characteristics of a hospital market area or the intensity of service provided.

Is there a threshold?

Under current law, urban hospitals with 100 beds or more must have a DSH percentage of at least 15 percent to qualify for DSH payments. Higher thresholds apply to the other categories of DSH hospitals. The CBO study found that urban hospitals with 100 or more beds receive payments that are significantly higher than warranted by the increased costs attributable to low-income patients. Specifically, they found no justification for DSH payments for hospitals with DSH percentages below a threshold of 35 percent. An adjustment of 5 percent for hospitals with a DSH percentage of 35 to 55 percent and 9 percent for those with more than 55 percent was supported by the data. The corresponding current-law adjustments are about 14.5 percent for hospitals with DSH percentages of 35 percent and 26.5 percent for those with percentages of 55 percent.

Similarly to CBO, we grouped urban hospitals with 100 beds or more into 8 categories to test for a threshold effect while controlling for location and bed size. The results (Table 7) show a positive cost effect that strengthens gradually as the DSH percentage rises. The coefficient for hospitals with a percentage greater than 0.55 is close to that which CBO estimated, although the coefficients for the other groups exceed CBO's estimates. Contrary to CBO's findings, there is no clear threshold. Although the DSH coefficient is insignificant for hospitals with DSH percentages between 0.10 and 0.15, it is significant and positive for hospitals with percentages between 0.05 and 0.10. Additionally, the t-statistics of the remaining groups are similar and do not indicate a threshold effect.

Several differences between our analysis and CBO's may account for the different findings. We used 1988 cost data, case-mix indexes based on the New York grouper, a wage index that split rural State areas based on whether county population was more or less than 25,000, and the resident-to-daily-census ratio as the measure of teaching activity. CBO used 1987 cost data, the HCFA grouper, a wage index with statewide rural areas, and the resident-to-bed ratio as the measure of teaching activity.

Estimation of adjustments

Based on the preceding analysis, we estimated a DSH effect for all urban hospitals with 100 beds or more. The resident-to-daily-census ratio was used to estimate the IME effect (Phillips, 1993). Because the regression equation used to estimate the IME and DSH effects is in double logarithmic form, the IME and DSH adjustments can be expressed as

Payment adjustment = (1 + X)**beta − 1.

X is either the IME or DSH variable, which is raised to the beta power, and beta is the regression coefficient of either the IME or DSH variable.

The key choice in estimating the IME and DSH factors is whether to include variables for urban-rural location in the estimating equation. On the one hand, the purpose of this analysis has been to build a single-rate system that does not recognize urban-rural cost differences. On the other hand, if the regression model does not control for urban or rural location, the extent to which teaching and DSH hospitals are located in urban areas will be reflected in higher IME and DSH coefficients because location is also positively related to higher operating costs.

This approach will build an urban adjustment into the system that will be paid only to hospitals who qualify for IME and DSH payments. Payment disparities will result as major teaching and high DSH hospitals are relatively overpaid and non-teaching and non-DSH hospitals are relatively underpaid. To attempt to avoid this outcome, the regression model should control for the effects of urban-rural location when determining the level of the IME and DSH adjustments.

As shown in Table 8, when the regression does not control for urban-rural location, the IME coefficient is 0.369. When urban-rural location is included in the regression, the IME coefficient falls to 0.306. The mean IME adjustments for all 1,031 teaching hospitals implied by our 2 regressions are 6.9 and 5.7 percent. Under current law, the mean IME adjustment is 10.0 percent. For the 175 major teaching hospitals, the average adjustment under current law is 30 percent. For this group, the adjustments implied by the regression coefficients in Table 8 are 18 and 15 percent.

Table 8 also shows that the DSH coefficient is more sensitive to the inclusion of urban-rural variables than the IME coefficient. The DSH coefficient falls from 0.464 to 0.216 when the urban-rural variables are added to the cost equation. Under current law, the 975 urban hospitals with 100 beds or more that qualify for DSH payments receive an average payment adjustment of 13.4 percent. For this group of hospitals, our regressions would generate average DSH adjustments of 12.9 and 5.8 percent. The 1,970 hospitals eligible for DSH payments based on our analysis (all urban hospitals with 100 beds or more) would receive mean DSH adjustments of 8.2 and 3.7 percent.

The coefficients of the large-urban and other-urban-area dummy variables are 0.140 and 0.093. The coefficients for large and other-urban areas imply that costs of hospitals in these areas are 15 and 9.4 percent higher than those of rural hospitals.

Table 8

Indirect medical education (IME) and disproportionate-share hospital (DSH) regression coefficients and corresponding mean payment factors

	Regression coefficients		Payment factors	
Variable	(1)	(2)	(3)	(4)
IME	.369 (11.4)	.306 (9.7)	6.9	5.7
DSH, urban with 100 beds or more	.464 (15.9)	.216 (6.6)	8.2	3.7
Large urban	—	0.140 (15.9)	—	15.0
Other urban	—	0.093 (10.9)	—	9.4
Number of observations	4,984	4,962		
R^2	0.109	0.156		

NOTES: The numbers in parentheses under each regression coefficient are t-statistics. The payment factors in column 3 are derived from the regression equation that does not include the large-urban and other-urban location variables. The payment factors in column 4 are derived from the regression equation that includes the large-urban and other-urban location variables (column 2). The large-urban payment factor is $[(e^{0.140} - 1) * 100]$. The other-urban payment factor is $[(e^{0.093} - 1) * 100]$.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data development by Office of Research.

Simulation results

Regression analysis and payment simulations were used in concert to determine the combination of IME, DSH, and urban-rural payment adjustments that would yield the best payment system. Because of potential non-linearities and interactions among the variables, regression analysis alone will not necessarily yield a set of payment-to-cost ratios that demonstrate the desired balance among the hospital groups.

Table 9 reports the results of four simulations, in addition to the baseline case that incorporates all the case-level refinements (repeated from Table 5, column 5.) Columns 2, 3, and 4 are derived from the IME and DSH regressions already discussed. The simulation in column 2 uses IME and DSH factors based on the regression excluding urban-rural variables. Columns 3 and 4 are derived from the regression that includes urban-rural variables. In column 3, the urban-rural effects are ignored for payment purposes, whereas in column 4, the regression estimates of urban-rural effects are built into payments. As discussed later, the final simulation modifies the simulation in column 3 by paying a 3-percent payment add-on to hospitals in large urban areas.

The simulation in column 2 of Table 9 uses IME and DSH adjustments that incorporate urban-rural effects indirectly. The payment-to-cost ratios of the major teaching hospitals drop from 1.1388 to 1.0238, a reduction that is expected based on a comparison of the mean IME adjustment level under current law (30 percent) and the regression excluding urban-rural variables (18 percent). Corresponding to this reduction, the payment-to-cost ratio of non-teaching hospitals increases from 0.9655 to 0.9893, as payments are redistributed from teaching to non-teaching hospitals.

Compared with the teaching payments, which were reduced by 50 percent, DSH payments actually increase by 39 percent. One reason is that, as already noted, the

Table 9

Normalized payment-to-cost ratios, by hospital groups for single-rate systems with refinements to the indirect medical education (IME) and disproportionate-share hospital (DSH) payment adjustments

Hospital group	Number of hospitals	(1) Base simulation	(2) Simulation A[1]	(3) Simulation B[2]	(4) Simulation B1[3]	(5) Simulation B2[4]
National average	4,907	1.0000	1.0000	1.0000	1.0000	1.0000
All urban	2,620	1.0000	1.0001	0.9949	1.0165	0.9973
Large urban	1,275	0.9993	0.9865	0.9834	1.0272	0.9992
Other urban	1,345	1.0000	1.0138	1.0085	1.0039	0.9950
Rural	2,287	0.9999	0.9994	1.0301	0.9029	1.0162
Urban bed size						
0-99 beds	607	0.9340	0.9298	0.9583	0.9384	0.9584
100-199 beds	776	0.9788	0.9993	0.9917	1.0144	0.9935
200-299 beds	582	0.9707	0.9879	0.9824	1.0043	0.9850
300-499 beds	488	1.0140	1.0136	1.0073	1.0294	1.0090
500 beds or more	167	1.0462	1.0101	1.0015	1.0300	1.0056
Rural bed size						
0-49 beds	1,132	0.9744	0.9801	1.0101	0.8854	0.9966
50-99 beds	696	0.9881	0.9946	1.0251	0.8985	1.0114
100-149 beds	238	1.0197	1.0199	1.0512	0.9213	1.0370
150-200 beds	108	1.0110	1.0151	1.0462	0.9170	1.0322
More than 200 beds	112	1.0067	0.9909	1.0212	0.8951	1.0075
Teaching status						
Non-teaching	3,876	0.9655	0.9893	0.9980	0.9740	0.9950
Minor teaching	856	1.0001	1.0061	1.0018	1.0175	1.0028
Major teaching	175	1.1388	1.0238	1.0028	1.0497	1.0113
Current disproportionate-share status						
Non-DSH	3,534	0.9551	0.9737	0.9902	0.9678	0.9901
DSH URB with 100 beds or more	975	1.0662	1.0410	1.0123	1.0560	1.0132
DSH URB with fewer than 100 beds	97	1.0463	0.9647	0.9943	0.9728	0.9931
DSH rural	301	1.0864	1.0313	1.0629	0.9316	1.0486
Special category urban						
URB TCH and DSH	517	1.0877	1.0408	1.0119	1.0578	1.0138
URB TCH and no DSH	437	0.9754	0.9789	0.9903	0.9997	0.9954
URB no TCH and DSH	555	1.0202	1.0374	1.0122	1.0482	1.0108
URB no TCH no DSH	1,111	0.9202	0.9582	0.9726	0.9725	0.9746
Proposed disproportionate-share status						
Non-DSH	2,937	0.9847	0.9830	1.0132	0.9100	1.0025
DSH URB with 100 beds or more	1,970	1.0036	1.0040	0.9969	1.0212	0.9994
Special category urban						
URB TCH and DSH	885	1.0352	1.0124	1.0023	1.0312	1.0057
URB no TCH and DSH	1,085	0.9561	0.9914	0.9888	1.0061	0.9900
URB no TCH no DSH	532	0.9393	0.9356	0.9643	0.9482	0.9647
Special category rural						
Non-MDH/SCH/RRC/RECLASS	1,207	0.9992	1.0038	1.0345	0.9068	1.0206
MDH	501	0.9598	0.9698	0.9996	0.8761	0.9862
SCH	352	0.9730	0.9749	1.0048	0.8807	0.9913
RRC	203	1.0253	1.0140	1.0451	0.9160	1.0311
SCH and RRC	24	0.9685	0.9722	1.0020	0.8783	0.9886

[1]Simulation A differs from the base simulation in the teaching and DSH adjustments, which are derived from the regression that does not include the large-urban and other-urban location variables (Table 8, column 3).

[2]Simulation B differs from the base simulation in the teaching and DSH adjustments, which are derived from the regression that includes the large-urban and other-urban location variables (Table 8, column 4). However, no payment adjustments are made for hospitals in large urban and other urban areas.

[3]Simulation B1 differs from Simulation B in that hospitals in large urban and other urban areas receive payment adjustments based on the regression that includes the large-urban and other-urban location variables (Table 8, column 4).

[4]Simulation B2 differs from Simulation B in that hospitals in large urban areas receive a payment adjustment of 3 percent.

NOTES: MDH is Medicare-dependent hospital. SCH is sole community hospital. RRC is rural referral center. TCH is teaching. URB is urban. RECLASS is reclassified rural hospital. The base simulation includes the refinements to the patient classification system, wage index, and outlier policy, together with current-law adjustments for teaching and DSH. This simulation is identical to that shown in Table 5, column 5.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data development by Office of Research.

number of urban hospitals with 100 beds or more receiving DSH payments increases from 975 (451 large-urban and 524 other-urban) to 1,970 (1,025 large-urban and 945 other-urban). Secondly, the mean DSH payment percentage for the 975 hospitals decreased only slightly from the current level to that based on the regression excluding urban-rural variables (13.4 to 12.9 percent). In contrast, there is a large decline in the teaching adjustment.

An important aspect of the column 2 simulation is the redistribution from large urban areas to other urban areas. Other urban areas are more than compensated for the loss in teaching payments by the increase in DSH payments and the redistribution of IME payments. Large-urban hospitals receive 64 percent of current IME payments, and other-urban hospitals receive 34 percent, therefore, the large-urban hospitals lose relatively more payments. Large urban areas receive 56 percent of current DSH payments, and other urban areas receive 41 percent. This distribution of IME and DSH payments, combined with the increase in total DSH payments, results in a payment-to-cost ratio for other urban areas that increases from 1.0000 to 1.0138. In contrast, the reduction in teaching payments to large urban hospitals is greater than the increase in DSH payments; therefore, these hospitals experience a reduction in their payment-to-cost ratio from 0.9993 to 0.9885.

Rural hospitals' payment-to-cost ratio does not change overall because of two offsetting factors. They lose DSH payments, but they gain from the redistribution of payments that were formerly targeted for teaching hospitals and are now spread more evenly across hospitals via a higher standard rate.

The simulation in column 3 displays the effect of using the regression including urban-rural variables to estimate the IME and DSH levels. However, no additional payments are made to urban hospitals. Controlling for urban-rural location results in lower IME and DSH coefficients and payments. Both large-urban and other-urban payment-to-cost ratios should decrease and rural ratios should increase. This does in fact occur, with hospitals in large urban areas moving from 0.9885 to 0.9834, other-urban hospitals from 1.0138 to 1.0085, and rural hospitals from 0.9994 to 1.0301. When the cost differential between large-urban, other-urban, and rural area hospitals is not explicitly recognized, and payments to the predominantly urban teaching and DSH hospitals are reduced, rural hospitals are overcompensated and large urban hospitals are undercompensated.

Simulation 4 recognizes all the variables in the regression that includes urban-rural variables as payment adjustments and includes the large urban and other urban area add-ons of 15 and 9.4 percent, which are implied by the regression. The result is gross underpayment of rural hospitals (0.9029) and overpayment of large urban hospitals (1.0272). This outcome exemplifies why the tools of regression and simulation are both necessary in the construction of a single-rate system. The cost differential between large urban, other urban, and rural areas exists, however, recognizing it to the level estimated in the regression results in sizable payment disparities.

To address the underpayment of large urban hospitals found in simulation 3, simulation 5 includes a large-urban add-on of 3 percent, along with the IME and DSH adjustments from simulations 3 and 4. Add-ons ranging from 2 percent to 4 percent were tested. The greatest payment equity between large-urban, other-urban, and rural hospitals was found with a 3-percent add-on. In addition to the urban-rural location categories, other major hospital groups also exhibited payment-to-cost ratios more closely clustered around 1.0000 than with any other system. The primary example is the payment-to-cost ratio of major teaching hospitals of 1.0113, compared with the value for non-teaching hospitals of 0.9950.

Conclusion

The analysis described in this article examines changes in PPS payment adjustments that would be needed to balance relative Medicare payments and costs among major groups of urban and rural hospitals as a result of the elimination of the separate urban and rural standardized payment amounts. Under a single standardized payment and current-law adjustments, we found that there was a need to redistribute payments from rural to urban hospitals.

We first explored refining the core group of case-level payment adjustments: the DRG classification system, outlier payment policy, and the wage index. Refinements to these adjustments achieved overall balance among hospitals classified by broad urban and rural location categories, but failed to remove significant disparities for key hospital groups within these areas. In particular, the relative payments of major teaching hospitals and DSH hospitals were too high.

Our attempts to revise IME and DSH payments without disturbing the overall urban-rural balance achieved by the case-level refinements were greatly complicated by the fact that teaching and DSH hospitals are concentrated in urban areas. Indeed, we concluded that a small percentage add-on for all hospitals in large urban areas needed to be combined with modifications in the IME and DSH payment adjustments. Even so, the best payment system we devised still contained greater disparities than one might wish.

Our analysis suggests areas where future refinement efforts may hold promise for improvement. Wage-index refinement, particularly for urban hospitals, might offer more choices for balancing payments between teaching, DSH, and other types of urban hospitals. To the extent that the higher costs of certain urban hospitals are wage-related, but not captured by the current HCFA wage index, a refined wage index might reduce the need for an across-the-board urban payment differential. We did not find anything definitive in this area (De Lew, 1992), but current work, especially that being conducted by ProPAC, may bear more fruit.

Another area in which our results might be improved with further analysis is outlier policy. Eliminating the standardization of outlier costs by IME and DSH aggravated, but was not totally responsible for, the payment disparities for teaching and DSH hospitals. We opted to eliminate the IME and DSH standardization because it helped equalize our treatment of cost- and day-outlier cases by raising the outlier payment-to-cost ratio of cost outliers. Further analysis of the interactions between outlier, IME, and DSH payments might offer different policy choices than the ones presented here.

In contrast, further refinements in DRG classification to better capture differences in patient severity, while possibly desirable in their own right, appear to offer little benefit in improving overall payment equity.

Finally, attempts to evaluate the equity of the relative distribution of payments in PPS are always subject to the limitations of the cost data that are used as the basis of comparison. We have discussed the limitations of our approach, as well as the limitations of the PPS5 data that we used. Future research on ways to improve the methods and data available would make a valuable contribution to studies of this kind.

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