Payment Rates for Unusual Medicare Hospital Cases

Grace M. Carter, J. David Rumpel

RAND

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RAND/UCLA/Harvard
Center for Health Care
Financing Policy Research

PREFACE

This report examines the formulas that the Health Care Financing Administration (HCFA) uses to pay for the extra expenses incurred by unusual hospital cases called outliers and recommends changes in these formulas. The research reported here was performed within the RAND/UCLA/Harvard Center for Health Care Financing Policy Research.

SUMMARY

In this report we examine the formulas that the Health Care Financing Administration (HCFA) uses to pay for the extra expenses incurred by unusual hospital cases called outliers and we recommend changes in these formulas. Outlier payments are those made in addition to the regular Diagnosis Related Group (DRG) payment and are designed to reduce hospitals' financial risk and their financial incentives to refuse to serve, or to underserve, exceptionally costly cases. Outlier payments amount to approximately $3 billion annually and can provide significant insurance to hospitals as well as incentives to provide either appropriate or inappropriate care.

There are two kinds of outliers: Day outliers are cases that remain in the hospital longer than a day threshold and cost outliers are cases whose standardized charges exceed a cost threshold. The values of the thresholds depend on the DRG but are set so that only a small proportion of cases qualify for these outlier payments. For each day beyond the day outlier threshold, the outlier payment is a fraction of an estimate of typical daily reimbursement, called in this report the "day outlier payment multiplier." It is currently 0.6. The cost outlier payment formula pays a fraction of the difference between the standardized cost for the case and the cost outlier threshold. The fraction is sometimes called the "marginal cost factor" and is currently 0.75 in most DRGs. When a case exceeds both the day threshold and the cost threshold, it receives the larger amount.

Outlier payments can be viewed as insurance for the hospital against the random event of receiving very expensive cases. Outlier payments should not exceed the marginal cost incurred after a patient crosses the outlier threshold. If reimbursement is set at more than marginal cost, hospitals will have an incentive to provide additional care that is not cost-effective. Further, by reducing the payment rates and paying outlier supplements to more cases, one could improve the amount of insurance provided for the same total outlier payments.

In this report, we describe how the average cost of day outlier cases increases as a function of length of stay (LOS). The increase in costs is the loss that is being insured by day outlier payments and, consequently, the outlier per diem should not exceed the average daily increase in cost. If reimbursement is set to 75 percent of these costs, policymakers will be providing the same coinsurance level to hospitals

with day outliers as to hospitals with cost outliers. Other issues that we consider are the forms of the day outlier per diem and the cost outlier threshold. The cost outlier threshold determines which cases will be paid as outliers and the amount of the payment.

We used a 20 percent random sample of Medicare Provider Analysis and Review records for Prospective Payment System (PPS) discharges in fiscal year 1990. We estimated the cost of each case using the Medicare cost report and standard accounting methodology. For information about hospital characteristics, we used a file provided by HCFA that contained the most up-to-date hospital data available centrally in the fall of 1991.

THE INCREASE IN COST ASSOCIATED WITH A DAY OUTLIER DAY

We used weighted least squares regression to estimate the increase in standardized cost associated with an increase in LOS for day outlier cases. Estimates were created separately for each large day outlier DRG. The cost of the case was positively and significantly related to the number of outlier days.

The extra cost associated with each day outlier day varies across DRGs and is correlated with daily reimbursement. Thus the current form of the day outlier payment correctly accounts for much of the variation across DRGs in cost. An alternative outlier payment formula would replace the geometric mean LOS in the daily reimbursement by the arithmetic mean LOS. Since the arithmetic mean LOS can be approximated by multiplying the geometric mean LOS by 1.38, this alternative would have similar results as long as the day outlier payment multiplier reflects the choice that has been made. Either mean can be used to estimate the resources associated with an outlier day in different DRGs.

We also used weighted regression to estimate the ratio of the extra cost associated with a day outlier day to average daily reimbursement. When daily reimbursement is based on the geometric mean LOS, this ratio is 0.44. These cases are now paid a day outlier per diem at a rate of 0.6 times this daily reimbursement, thus extra costs equal about three-quarters (0.44/0.6) of reimbursement. We estimate that, if one used a payment formula based on the arithmetic mean instead of the geometric mean, average extra costs would equal payments with a day outlier payment multiplier of 0.54. If one used a multiplier of 0.40 and the arithmetic mean, one would be paying approximately 75 percent of costs and thus providing roughly the same

amount of insurance protection to day outlier cases and to cost outlier cases.

SIMULATIONS

We simulated the current PPS outlier policy to examine what effect the current day outlier payment rate has on the profitability of outlier cases and on the profit levels for categories of hospitals. We used this simulation as a base to compare with simulated policies that reduce the outlier per diem to the level of the average extra costs incurred per day and to 75 percent of that level. In each case the cost outlier threshold is reduced to maintain the same total outlier payments. This strategy moves payment from less expensive day outlier cases to more expensive day outlier cases and also increases payment to expensive cases that do not exceed the day outlier threshold.

Under current policy, 38 percent of day outlier payments go to profitable cases. The loss incurred at the time the patient passes the day outlier threshold is more than made up by the profit made on each day outlier day. And, of course, this profit could be an effective incentive to keep these patients in the hospital. The simulated reduction in the day outlier per diem reduces the percentage of outlier payments that go to profitable cases—the greater the reduction in outlier per diem the smaller the outlier payments to profitable cases.

All of the policies provide more outlier payments to hospitals that experience the largest loss. However, the smaller the day outlier per diem, the greater the concentration of outlier payments to unprofitable hospitals—and the lower the financial risk faced by all hospitals.

The reduced day outlier payments reduce the discrepancy in profit across regions. Under current policy the most profitable region (the Mid-Atlantic) enjoys an average profit per case that is $969 more than the least profitable region (the South Atlantic). Under the policy that pays an outlier per diem at 75 percent of incremental cost, the discrepancy is reduced by 24 percent to $738. A reduction in profit disparity occurs for categories of hospitals defined by bed size, teaching status, disproportionate share status, and case mix index.

Replacing the existing cost outlier threshold with fixed loss cost outlier thresholds has little effect on the outcomes that we have examined. In most DRGs, the existing cost outlier threshold is very similar to the one that would be created by a fixed loss policy. Insofar as the

change in thresholds does cause different payments, however, it provides an improved match of outlier payments to loss at the case level.

CONCLUSIONS

The large percentage of day outlier payments that go to profitable cases is contrary to policy intent. We recommend a reduction in the day outlier per diem to the level that would provide the same coinsurance to day and cost outliers. This level can be calculated as a marginal cost factor of 0.75 times the extra costs associated with each outlier day, estimated to be 0.54 times average daily reimbursement (based on the DRG and its arithmetic mean LOS), and is approximately 0.4 times this daily reimbursement. It would also be useful to replace the current formula for the cost outlier threshold with a fixed loss cost outlier threshold.

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1. INTRODUCTION

In this report we examine the formulas that the Health Care Financing Administration (HCFA) uses to pay for the extra expenses incurred by unusual hospital cases called outliers and we recommend changes in these formulas. Outlier payments amount to approximately $3 billion annually and can provide significant insurance to hospitals and mitigate their incentives to underserve costly or long-staying patients. However, if outlier payments are set too high, as recent studies suggest is the case, then outlier payments provide incentives for unnecessary or inefficient care and less than optimal insurance.

HCFA uses a Prospective Payment System (PPS) to pay for hospital stays of Medicare patients. The price paid for most stays is proportional to the weight assigned to the Diagnosis Related Group (DRG) of the stay and is intended to cover the cost of care for a typical patient in the DRG at an efficient hospital. The payment is not intended to cover the cost of each and every patient. Rather, hospitals are expected to lose money on some patients and make money on others so that, on average, payments equal costs. This system puts hospitals at financial risk; they will lose money if they are inefficient or if they receive patients who require more expensive care than average.

Outlier payments are designed to reduce hospitals' financial risk and their financial incentives to refuse to serve, or to underserve, exceptionally costly cases. Financial risk arises from random factors—any hospital may receive more than its share of costly cases just by chance. In addition, some hospitals may consistently receive patients who are more expensive than average for their DRG. Although other parts of the PPS including the continuous refinement of DRGs and special payments for special categories of hospitals (teaching, disproportionate share, sole community providers, and rural referral centers) are intended to address systematic differences across hospitals in costs, outlier payments may also help alleviate remaining differences between a hospital's expected payment per case and the cost of efficiently treating that group of cases.

OUTLIER POLICY

Outlier payment is made in addition to the regular DRG payment. The outlier reimbursement amount covers both operating costs and

the federal share of capital costs. There are two kinds of outliers: Day outliers are cases that remain in the hospital longer than a day threshold and cost outliers are cases whose standardized charges exceed a cost threshold. The values of the thresholds depend on the DRG but are set so that only a small proportion of cases qualify for these outlier payments.

For cases that exceed the day outlier threshold, the day outlier payment formula is based on an approximation to the average federal reimbursement for a day in the same DRG at the same hospital. For each day beyond the outlier threshold, the formula adds to the DRG payment a fraction of the estimated daily federal reimbursement, called in this report the "day outlier payment multiplier." It is currently 0.6. The daily reimbursement is an approximation because it is calculated by taking the case reimbursement for the DRG and dividing it by the geometric mean length of stay (LOS) rather than dividing it by the arithmetic mean LOS.[1]

The cost outlier payment formula uses ratios of cost to charges from the most recent available, settled, cost report for each hospital. The charges for each potential cost outlier case are multiplied by these ratios and adjusted by payment factors to get an estimate of the standardized operating cost of the case and a second estimate of the standardized capital cost of the case. The cost outlier payment formula pays a fraction of the difference between the sum of these standardized costs for the case and the cost outlier threshold. The fraction is sometimes called the "marginal cost factor" and is currently 0.75 in most DRGs and 0.9 in burn DRGs.[2]

When a case exceeds both the day threshold and the cost threshold, it will receive the larger amount from the two payment formulas.

ISSUES CONCERNING OUTLIER PAYMENT PARAMETERS

Outlier payments can be viewed as insurance for the hospital against the random event of receiving very expensive cases (Keeler et al., 1988). The premium for the policy is the reduction in the DRG payment to provide the outlier payments. The insurance payment is, of

[1]The arithmetic mean LOS is just the average LOS—i.e., the sum of the LOS of each case divided by the number of cases. The geometric mean LOS is calculated by first taking the logarithm of the LOS of each case, taking the average of these logarithms, and then exponentiating the resulting average. The geometric mean is always substantially smaller than the arithmetic mean.

[2]The term "marginal cost factor" is sometimes also used for the day outlier payment multiplier.

course, the outlier payment. For cost outliers, the marginal cost factor is the fraction of the hospital's loss that is insured. One minus this multiplier is the coinsurance rate. The day outlier payment multiplier is the product of the fraction of the hospital's loss that is insured and the ratio of the extra cost incurred for each outlier day to the reimbursement for a typical day.

The design of outlier policy requires trading off the benefits of the insurance (protection against financial risk to the hospital, mitigation of access and underservice problems for costly and long-staying patients) against moral hazard—the wasteful overconsumption of insured services (care that is unnecessary or not cost-effective for the outlier patient). Keeler et al. (1988) provide the economic theory underlying this tradeoff.

One conclusion from the insurance model is that outlier payments should not exceed the marginal cost incurred after a patient crosses the outlier threshold. If reimbursement is set at marginal cost or more, hospitals will have an incentive to provide additional care that is not cost-effective.[3] Further, by reducing the outlier payment rates and paying outlier supplements to more cases, one can improve the amount of insurance provided for the same total amount of outlier payments.

Recent studies suggest that the average day outlier per diem exceeds the incremental cost of the day—i.e., the average long-run marginal cost of providing services during an outlier day. Carter and Melnick (1990) used a convenience sample of 105 hospitals. They showed that operating costs are much higher than average during the first part of each stay and then, for most patients, costs drop and remain substantially below average throughout the remainder of the stay. The costs related to surgery almost always occur early in the stay so that days late in the stay incur an even smaller percentage of average costs for surgical cases than for medical cases. In addition, the geometric mean LOS is substantially smaller than the average LOS, and therefore the federal rate divided by the geometric mean LOS is substantially larger than the average federal rate for a day's stay. Finally, by paying the maximum of the day and cost outlier formulas, the least expensive day outlier cases are paid using the day outlier formula. The day outlier payment multiplier of 0.6 is not enough to offset these three effects; Carter and Melnick estimated that day outlier pay-

[3]The physician hospital team values care for the sake of their reputations and morale, and thus they may choose to provide care even when it causes a short-term financial loss to the hospital.

ments for operating costs exceed the operating cost for services delivered during an outlier day by about 20 percent on average.

In this report, we will describe how the average cost of day outlier cases increases with LOS. This per diem increase in cost is the loss that one wishes to insure in a day outlier case. If a day outlier case that stayed 10 days beyond the threshold costs x dollars more than one that stayed one day beyond the threshold, the loss that is being insured in the first case is x dollars higher than the loss in the second case. Thus, the outlier per diem should not exceed the average increase in cost associated with a one day increase in LOS. If reimbursement is set at 75 percent of these costs, policymakers will be providing the same coinsurance level to both day outliers and cost outliers. There is no definitive analysis that tells us how hospitals actually respond to coinsurance levels for day outliers or cost outliers and no compelling reason to expect differential response.

Another issue, in addition to the average level of day outlier payments, concerns how these payments should vary by DRG. One would want daily payments to be proportional to the costs accrued daily by day outlier cases in each DRG. The current day outlier payment formula was developed without information about the costs incurred by day outlier cases and various alternatives have been suggested including replacing the geometric mean LOS by the arithmetic mean or using the same per diem in each DRG. We will show that either the current formula or a similar one using the arithmetic mean LOS accounts for significant variations across DRGs in daily outlier cost. The arithmetic mean LOS does have the advantage of providing a formula that is more easily understood. Anecdotal evidence suggests that many people believe that the current day outlier per diem equals 60 percent of daily reimbursement, when in truth, because the geometric mean LOS is used rather than the average, the current day outlier per diem averages 83 percent of daily reimbursement.

Another issue that we will consider is the form of the cost outlier threshold which determines both which cases will be paid as outliers and the amount of the payment. Keeler et al. (1988) proved that risk is minimized by using a threshold that causes the same fixed loss in all DRGs. Current policy is close to a fixed loss policy in most DRGs but allows larger than average losses in DRGs with exceptionally small weights or with exceptionally large weights.

In this report we will accept the current policy decisions that approximately 5.1 percent of reimbursement should go to outlier payments and that cost outlier cases will receive 75 percent of long-run costs

beyond the threshold. Carter and Farley (1992) consider more extensive changes in outlier policy, including using just cost outlier payments and expanding the size of the outlier pool. This report is intended to help HCFA decide among a limited set of alternatives that were chosen in consultation with the client and based, in part, on results from the earlier study. Therefore, in this report we consider only alternative day outlier payment rates and cost outlier thresholds.

OUTLINE OF REPORT

The next section of this report describes our data and methods. It includes a mathematical description of PPS payments, including outlier payments. In Section 3, we estimate how the costs of the services delivered to day outlier cases increase with LOS and we show how these costs vary with average daily reimbursement in the DRG. We find that current day outlier payments exceed average costs. In Section 4, we report simulations of various changes in outlier policy, including reducing day outlier payments and using a fixed loss policy to set cost outlier thresholds.

2. DATA AND VARIABLE DEFINITIONS

DATA

We used a 20 percent random sample of Medicare Provider Analysis and Review (MEDPAR) records for PPS discharges in fiscal year 1990. We excluded cases in hospitals for which neither a PPS 5 nor a PPS 6 cost report was available. We also excluded cases with zero charges and those with an invalid DRG. Because of difficulties in estimating costs, we excluded hospitalizations in all-inclusive providers.[1] Finally, we excluded a few cases for which information necessary to simulate reimbursement was not available. The result of all these exclusions was an analysis file of 1,824,518 cases at 4,927 PPS hospitals.

We estimated the cost of each FY 1990 MEDPAR case using the Medicare cost report for PPS 6 when it was available, and PPS 5 otherwise. Many of the sample discharges occurred during PPS 7 but that cost report file was not available. Seventy percent of the PPS 6 cost reports were not settled and thus probably slightly overestimate costs.

For information about hospital characteristics, we used a file provided by HCFA that contained the most up-to-date hospital data available centrally in the fall of 1991. It included estimates of all variables necessary to simulate payments under a fully implemented capital PPS. The ratio of operating cost to charges and information about interns and residents should be the data used to determine payment in FY 1990, and the ratio of capital cost to charges should be contemporaneous. Some of the information on disproportionate share percentages may be from a year earlier. We used the wage index associated with each hospital before reclassification by the Medicare Geographic Classification Review Board (MGCRB).

VARIABLE DEFINITIONS

Cost per Case

The method used to estimate the cost of each case is similar to that described in Newhouse et al. (1989) except that capital costs are included. Cost report data are used to generate ratios of costs to

[1] We identified all-inclusive providers from the PPS 5 cost reports.

charges[2] for each of 12 ancillary departments and to estimate the per diem cost of routine care and the per diem cost of care in a special care setting such as an intensive care unit or a coronary care unit.

To estimate ancillary costs for a particular case, ancillary charges for the case in each of 12 departments are multiplied by the appropriate cost-to-charge ratio and then summed. Per diem costs are calculated as the number of days spent in routine care times the routine care per diem plus the number of days spent in special care units times the special care per diem. The total cost of the case is the sum of ancillary costs and per diem costs.

Before calculating per diem cost, routine care and special care per diems were inflated (or deflated) according to the number of months from the center of the hospital's fiscal year until the month of admission. An annual rate of 9.4 percent was used for routine care and 10.9 for special care; these were the annual rates of increase observed from PPS 5 to PPS 6.

Reimbursement

For each case on the MEDPAR file, we estimate the reimbursement that the case would have received under a slightly simplified version of the current PPS for operating costs and the payment system for capital costs planned for the completion of the transition to a fully national capital PPS. The simplification of operating cost payments anticipates the movement to a system with only two rates (for large urban areas and for all other areas) and also excludes the effects of the MGCRB.

The capital payment amount for a case k at hospital i in DRG j, CP_{ijk}, is calculated from the formula:

$$CP_{ijk} = CR \times W_j \times CA_i + CS_{ijk}, \qquad (2.1)$$

where

CR = the national capital payment rate ($356.88),[3]
W_j = the weight for the DRG,
CA_i = the factor describing hospital-specific adjustments to the capital payment rate, and

[2]The ratios exclude the direct costs of medical education.

[3]This is based on the actual payment rate of $415.59 in FY 1992 adjusted to 1990 dollars and to account for an expected 2 percent annual growth in the CMI ($356.88 = 415.59 \times 1.02 \times 1.02/(1.1 \times 1.1014)$).

CS_{ijk} = the capital cost share of the outlier amount due to the case.

The adjustments account for the variation across hospitals in input prices, costs associated with large urban location, the indirect costs of medical education, and caring for a disproportionate share of poor patients.

Similarly, the operating payment amount, OP_{ijk}, is given by:

$$OP_{ijk} = OR_i \times W_j \times OA_i + OS_{ijk}, \quad (2.2)$$

where

OR_i = the operating payment rate,
OA_i = the factor describing hospital-specific adjustments to the operating payment rate, and
OS_{ijk} = the operating cost share of the outlier amount.

Costs associated with large urban areas are usually accounted for in the rate term rather than in the adjustment term as is done for capital. We use two rates: $3335.90 for rural and small urban areas and 1.6 percent higher ($3389.27) for large urban rates. These rates were determined to be approximately budget neutral to actual 1990 payment rates (in the aggregate rather than in each geographic area).

As in the case of capital payments, adjustments account for the variation across hospitals in input prices, indirect costs of medical education, and caring for a disproportionate share of poor patients. The adjustment may be calculated as:

$$OA_i = (PLAB_i \times WAGEINDEX_i + (1 - PLAB_i) \times COLA_i) \times (1 + DSH_i + TEACH_i),$$

where

$PLAB_i$ = fraction of the payment rate that is labor related,[4]
$WAGEINDEX_i$ = the hospital's wage index,

[4]In the annual presentation of the rates, separate amounts are given for the labor-related portions and nonlabor-related portions. The treatment of input prices here is numerically equivalent when PLAB is set equal to the ratio of the labor-related adjusted standardized amount to the sum of the labor- and nonlabor-related adjusted standardized amounts. We chose this presentation because it shows more clearly the similarity between the operating and capital payments.

$COLA_i$ = cost of living adjustment (which is one everywhere except in Hawaii and Alaska),

DSH_i = operating cost payment factor for disproportionate share, and

$TEACH_i$ = operating cost payment factors for the indirect cost of medical education ($TEACH_i = 1.89 \times ((1 + (\text{interns} + \text{residents}) / \text{beds})^{.405} - 1)$).

HCFA based the amounts of the capital payment adjustments, in part, on a regression of cost per case (i.e., operating cost plus capital cost net of direct medical education cost) at each hospital on the factors used to adjust operating payments. The capital adjustment factor, CA_i, is calculated as:

$$CA_i = CAPWAGE_i \times CAPCOLA_i \times (1 + CAPDSH_i + CAPTCH_i) \times CAPLGURB_i, \quad (2.3)$$

where

$CAPWAGE_i$ = $WAGEINDEX_i^{0.6848}$;

$CAPCOLA_i$ = $0.3152 \times (COLA_i - 1) + 1$;

$CAPDSH_i$ = $\exp(0.2025 \times DSHRATIO_i) - 1$, for urban hospitals with more than 100 beds,

= 0.1416 for hospitals with more than 30 percent of income from state / local government for charity care, and

= 0 otherwise;

$CAPTCH_i$ = $\exp(0.2822 \times (\text{interns} + \text{residents}) / \text{avg_daily_census}) - 1$; and

$CAPLGURB_i$ = 1.03 for hospitals in large urban areas,

= 1.00 otherwise.

Most transfer cases are paid a per diem amount equal to the capital and operating payment for a regular case divided by the geometric mean LOS for the DRG, but capped at the regular case payment for cases with LOS greater than the geometric mean LOS for the DRG.

The day outlier payment for a case k at hospital i in DRG j, DO_{ijk}, is given by:

$$DO_{ijk} = MD \times N_k \times ((OR_i \times OA_i + CR_i \times CA_i) \times W_j / G_j), \quad (2.4)$$

where, in addition to the rates and factors defined above,

MD = the day outlier payment multiplier (currently 0.6),

N_k = the number of days beyond the day outlier threshold that the case remained in the hospital, and

G_j = the geometric mean length of stay (LOS) for cases in the DRG for the case.

The term within the outermost parentheses is an approximation to the average reimbursement for a day in this DRG at this hospital. Thus the formula adds to the DRG payment the fraction MD of typical reimbursement for each day beyond the outlier threshold.

The cost outlier payments are more complicated to calculate. Using the most recent available cost report, each hospital is assigned a ratio of operating cost to charges (ROPRCC) and a ratio of capital cost to charges (RCAPCC). The payment factors are used to standardize the charges for the case (CHARGES) to one estimate of standardized operating costs (SOP_COST) and a second estimate of standardized capital costs (SCAP_COST), using the formula:

$$\text{SOP_COST} = \text{ROPRCC} \times \text{CHARGES} / (1 + \text{TEACH} + \text{DSH}),$$

$$\text{SCAP_COST} = \text{RCAPCC} \times \text{CHARGES} / (1 + \text{CAPTCH} + \text{CAPDSH}),$$

where TEACH, DSH, CAPTCH, and CAPDSH are as defined above.

Under current (i.e., FY 1992) policy, a single threshold is chosen as the maximum of either: (1) twice the sum of the federal operating DRG payment and the federal capital DRG payment, each adjusted for input prices and geography, but not for teaching or disproportionate share, or (2) a standard threshold constructed by taking a DRG-independent number ($36,300 in 1990 dollars), partitioning it into capital and operating shares based on the ratio of RCAPCC to the sum of RCAPCC and ROPRCC, adjusting each share for input prices using the same factors used to construct the rates, and then summing the two adjusted shares. Once the single threshold has been chosen, it is compared to the sum of SOP_COST and SCAP_COST, and cases where the summed cost exceeds the threshold can be paid as cost outliers.

For potential cost outliers, the threshold is decomposed into its constituent operating and capital shares and these shares are used as separate thresholds in calculating operating cost outlier payments and capital cost outlier payments:

$$OS_{ijk} = MC \times (SOP_COST - OP_THRESH) \times (1 + TEACH + DSH),$$

$$CS_{ijk} = MC \times (SCAP_COST - CAP_THRESH) \times (1 + CAPTCH + CAPDSH), \quad (2.5)$$

where MC is the payment multiplier for cost outliers which is 0.9 for burn DRGs and 0.75 for all other DRGs. If either OS_{ijk} or CS_{ijk} is negative, it is set to 0.

If the sum of the capital and operating cost outlier payments is greater than the day outlier payment, the cost outlier formulas determine the amount of payment. Otherwise the day outlier payment determines payment amounts.

In addition to existing policy, we also simulated alternative outlier policies. All day outlier payment policies used existing thresholds. Alternatives changed Eq. (2.4) by modifying the value of MD, replacing the geometric mean LOS with the arithmetic mean LOS, or both. Alternative cost outlier policies all used a fixed loss policy in which OP_THRESH and CAP_THRESH are calculated from a fixed loss that is the same in each DRG (FL):

$$OP_THRESH = (OR_i \times W_j + FL \times ROPRCC / (RCAPCC + ROPRCC)) \times (PLAB_i \times WAGEINDEX_i + (1 - PLAB_i) \times COLA_i)$$

$$CAP_THRESH = (CR \times W_j + FL \times RCAPCC / (RCAPCC + ROPRCC)) \times CAPWAGE \times CAPCOLA \times CAPLGURB$$

Profit

In simulations we calculate profit as reimbursement minus covered cost. We estimate the cost of covered services by prorating the total cost of the case using the case's ratio of covered charges to total charges.

Standardized Cost

To analyze the incremental cost of a day outlier day, we wish to control for differences among hospitals in costs associated with factors for which payment is adjusted. We do so by creating a standardized cost using the capital payment adjustments. These factors were based on a regression of total costs on each of the payment factors and are thus the best available estimate of how costs vary with these factors. In particular, standard cost is given by:

$$STDCOST = COST / CA_i,$$

where COST = total cost for the case, and CA_i is defined in Eq. (2.3) above.

Risk

We use the methodology developed by Keeler et al. (1988) to describe the effect of each year's outlier payments on the financial risk faced by all hospitals and groups of hospitals. Risk is estimated by assuming that each case is drawn at random from a hospital-specific distribution of profit. It is defined as the standard deviation of annual profit from Medicare cases expressed as a percentage of annual Medicare revenues at the hospital.

3. THE INCREASE IN COST ASSOCIATED WITH A DAY OUTLIER DAY

As discussed in Section 1, a well-designed insurance program does not pay more than the marginal cost of care and recent work on a convenience sample of hospitals suggests that the average rate of day outlier payments may exceed the cost of the day. We begin this section by developing estimates of the increase in cost associated with an increase in LOS for day outlier cases in each large DRG. Then we analyze how these cost estimates are related to DRG weight and LOS. In particular, does the current outlier per diem formula provide reimbursement proportional to day outlier costs in each DRG? Would a formula using the arithmetic mean LOS rather than the geometric mean LOS provide a closer match of reimbursement and costs? It turns out that the average increase in cost per day in a DRG is approximately proportional to the average daily reimbursement for the DRG and we estimate the constant of proportionality in the third subsection below. We show how a formula similar to the existing formula (or one using the arithmetic mean) can provide reimbursement approximately equal to any policy-specified fraction of incremental costs. The final subsection deals with the sensitivity of our findings to aspects of our methodology.

METHODOLOGY

To estimate the increase in costs associated with each day outlier day, we used a weighted regression of the standardized cost of each case paid with the day outlier formula. We selected cases using the reimbursement equations for current policy described in Section 2.

The form of the regression equation is based on the analysis in Carter and Melnick (1990). A stylized version of the incremental cost curve for a typical DRG is shown in Figure 3.1. The incremental cost for day x is the average cost of services delivered during day x for all patients who stayed in the hospital for at least that long. Thus, the expected total cost for a patient with LOS x is the sum of the incremental cost curve for each day from day 1 to day x. Carter and Melnick found that, for any group of patients in the same DRG (including long-stay cases), the incremental cost curve was well described by a straight line beyond the first few days of the stay. Thus, the form of the expected cost per case curve for day outlier cases in DRG j is a straight line in the number of outlier days. The intercept is the sum

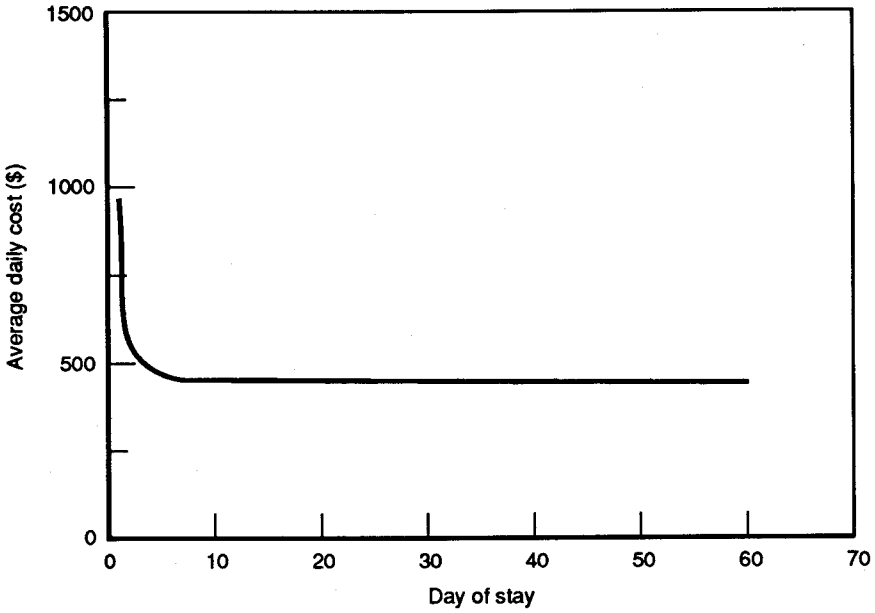

Figure 3.1—Incremental Cost Curve for Cases in a Typical DRG

of the incremental cost curve for each day up through the day outlier cutoff. The slope is the extra standardized cost incurred for each day outlier day in DRG j.

For large DRGs, we used plots to verify that the total cost curve does indeed appear linear in the number of outlier days. We then used the regression method to estimate the average extra cost associated with a day outlier day in each of the 92 DRGs that had more than 50 cases paid as day outliers under current policy in our sample.

Most previous researchers estimating the cost of hospital stays used the logarithm transform of the cost per case to control for heteroskedasticity in their data. We too find that our data are strongly heteroskedastic and consistent with the log transform being variance-stabilizing (i.e, the error variance is approximately proportional to the square of the prediction). For example, the score test (Weisberg, 1985, pp. 135–140) was statistically significant at the 0.0001 level in 17 of the 18 DRGs that had more than 300 day outlier cases in our sample. We cannot use the log transform because we are convinced, both on a priori grounds and because of the data, that the relation-

ship between the cost of the case and the number of outlier days is linear.

If one uses ordinary least squares (OLS) with heteroskedastic data, the resulting coefficients are unbiased, consistent estimates of the true coefficients. They are not, however, statistically efficient estimates. The following iterative procedure provides an approximation to the efficient, maximum likelihood estimates of the coefficients and their standard errors.[1] The first step in the iteration is an OLS regression of the cost of each day outlier case on its number of outlier days. The second step is a weighted regression of the same equation with the weight on the kth observation inversely proportional to the square of the prediction from the previous step. This step can be repeated until convergence occurs. In practice, we found that the results of a third step are very similar to the results of the second step and consequently, we conducted only three steps (i.e., two weighted regressions per DRG).

A general problem with regression techniques is that sometimes the answers can be inappropriately influenced by a small number of unusual cases. We used influence diagnostics to check for this possibility.[2] We found that there were a few cases with very long stays and very low costs that had a substantial effect on the incremental cost estimates in some DRGs. Because we believed that these cases may be data errors and because the cases were atypical anyway, we decided to restrict our regression sample to cases with a LOS of less than 180 days. This restriction removed less than 3 percent of the cases, but it did raise the estimate of the extra cost associated with a day outlier day.

THE COST OF A DAY OUTLIER DAY IN LARGE DRGs

Table 3.1 shows the results of the regressions for all DRGs that had 50 or more cases paid as day outliers in our sample. In all cases, the cost of the case was positively and significantly related to the number of outlier days. The column headed "daily cost" is the coefficient on outlier days and is our estimate of the extra, standardized cost associated with an increase of one in the number of outlier days for a case in the DRG. An approximate t-statistic could be constructed by dividing the daily cost estimate by its standard error estimate, which is shown in the last column of the table. This is always highly signifi-

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[1]See, for example, Kmenta (1971), Chapter 8, especially, Case B, pp. 261 ff.

[2]See, for example, Weisberg (1985), pp. 106 ff.

Table 3.1

Cost Regressions for Large DRGs

DRG	No. of Cases	R^2	Intercept	Daily Cost	S.E.
1	199	0.41	25281	445	38
2	59	0.43	26326	525	77
5	58	0.34	21362	366	66
7	113	0.26	20827	283	44
10	118	0.30	16025	248	35
12	76	0.20	15932	233	53
14	1492	0.31	16222	291	11
15	99	0.46	12190	259	28
24	144	0.16	17348	248	46
75	68	0.35	24587	483	78
76	260	0.28	20292	296	30
79	545	0.30	18275	299	20
82	277	0.23	16861	280	31
87	106	0.26	18530	402	65
88	164	0.34	16880	313	34
89	570	0.28	16719	301	20
96	163	0.23	16745	294	41
104	80	0.48	45682	820	94
105	52	0.69	37668	975	89
106	86	0.54	33064	824	82
108	127	0.66	34744	1104	70
109	53	0.63	22314	1024	107
110	420	0.33	24985	477	33
112	309	0.24	22731	457	46
113	326	0.33	21502	321	25
116	81	0.20	24125	260	56
120	243	0.29	21459	382	38
121	137	0.13	22260	264	56
123	149	0.26	20892	474	65
124	72	0.18	20042	536	131
125	54	0.29	9391	918	192
127	915	0.17	17105	262	19
130	96	0.17	15860	232	51
138	163	0.16	18233	257	45
140	230	0.22	12825	326	40
141	67	0.30	13063	234	43
143	64	0.19	8551	515	128
144	92	0.21	19039	375	74
148	521	0.39	25196	414	22
150	57	0.38	21963	448	75
154	226	0.52	23960	655	41
170	118	0.33	22715	380	49
172	137	0.26	16165	284	40
174	182	0.22	17018	268	38
180	92	0.22	15430	359	69
182	284	0.27	16620	275	27

Table 3.1 (continued)

DRG	No.of Cases	R^2	Intercept	Daily Cost	S.E.
188	96	0.13	18087	326	81
191	67	0.36	26681	651	105
197	88	0.26	22484	301	53
202	65	0.26	17309	289	60
203	117	0.26	15140	295	45
204	66	0.36	19504	432	70
205	61	0.26	16285	267	56
209	345	0.36	20775	318	23
210	365	0.26	19956	256	22
214	89	0.27	21430	387	66
216	54	0.41	17871	459	73
217	286	0.37	21613	365	28
218	52	0.17	19737	227	67
235	77	0.47	13547	360	43
236	135	0.34	14709	270	32
239	222	0.37	15738	275	24
243	114	0.32	13501	287	39
263	356	0.41	20749	379	24
269	62	0.18	20348	276	72
271	96	0.33	15881	315	45
277	111	0.37	15166	286	35
287	86	0.47	19620	262	30
294	122	0.24	15609	234	37
296	560	0.34	15329	259	15
304	58	0.39	19599	576	94
315	219	0.20	22232	271	37
316	152	0.23	18704	300	44
320	293	0.38	15747	299	22
331	54	0.25	15838	294	68
336	117	0.23	15674	308	51
395	113	0.25	15705	324	52
401	60	0.26	21726	405	86
403	149	0.40	16543	410	41
410	175	0.38	11500	630	60
413	62	0.46	15244	315	43
415	303	0.38	23113	392	29
416	467	0.26	18259	320	25
429	178	0.46	12715	238	19
430	353	0.30	13071	285	23
462	54	0.43	19880	465	72
468	737	0.36	22857	394	19
473	138	0.43	23936	571	56
474	331	0.13	61482	450	63
475	376	0.24	25173	395	36
476	62	0.13	21472	169	53
477	157	0.36	17127	279	29

cant and ranges from a low of 3.2 in DRG 476 to a high of 26.5 in DRG 14.

The daily costs shown in Table 3.1 vary substantially across DRGs. Three of the cardiac surgery DRGs (105, 108, and 109) have daily costs close to or in excess of $1,000 per day. At the other extreme, the lowest costs are associated with DRG 476 (prostatic operating room procedure unrelated to the principal diagnosis). This variation demonstrates that a single per diem for each outlier day would not adequately match the losses caused by these day outlier cases. It would introduce additional complexity into the PPS regulatory system to insist that separate costs of day outlier days be estimated for each DRG. In addition, since in many DRGs there are only a few day outlier cases, many of these costs would be estimated poorly. Consequently, we would like to find a formula that would maintain administrative simplicity, allow pooling of data across DRGs, and still allow for payment approximately proportional to the daily costs in each DRG. A natural place to start is with the current payment formula.

The top panel of Figure 3.2 is a scatter plot of the daily cost in each DRG against the ratio of the DRG weight to the geometric mean LOS. The current outlier per diem payment is in proportion to this ratio. The correlation is clearly visible. The percentage of variance across DRGs in daily cost that can be explained by the daily DRG weight (defined as DRG weight divided by the geometric mean LOS) is 0.48. If a regression is performed, one finds that the intercept is not statistically different from 0 ($p > 0.05$).

The bottom panel of Figure 3.2 is a similar scatter plot in which the geometric mean LOS in the daily DRG weight is replaced by the arithmetic mean LOS. The correlation is actually slightly higher here than when the geometric mean LOS is used. The percentage of variance across DRGs in daily cost that can be explained by the DRG weight divided by the arithmetic mean LOS is 0.52, and again, the intercept is not statistically different from 0 ($p > 0.10$). Of all the 92 DRGs in this sample, only one appears as an outlier. This is DRG 116, which is visible in the lower right quadrant of the scatterplot.

The arithmetic mean LOS is very closely and linearly related to the geometric mean LOS. The percentage of variance explained in a regression of the arithmetic mean LOS of a DRG on its geometric mean LOS is 0.94. The arithmetic mean LOS can be approximated by multiplying the geometric mean LOS by 1.38. Thus, although the daily DRG weight created by dividing the DRG weight by the arithmetic mean LOS is a slightly better predictor of relative resource use asso-

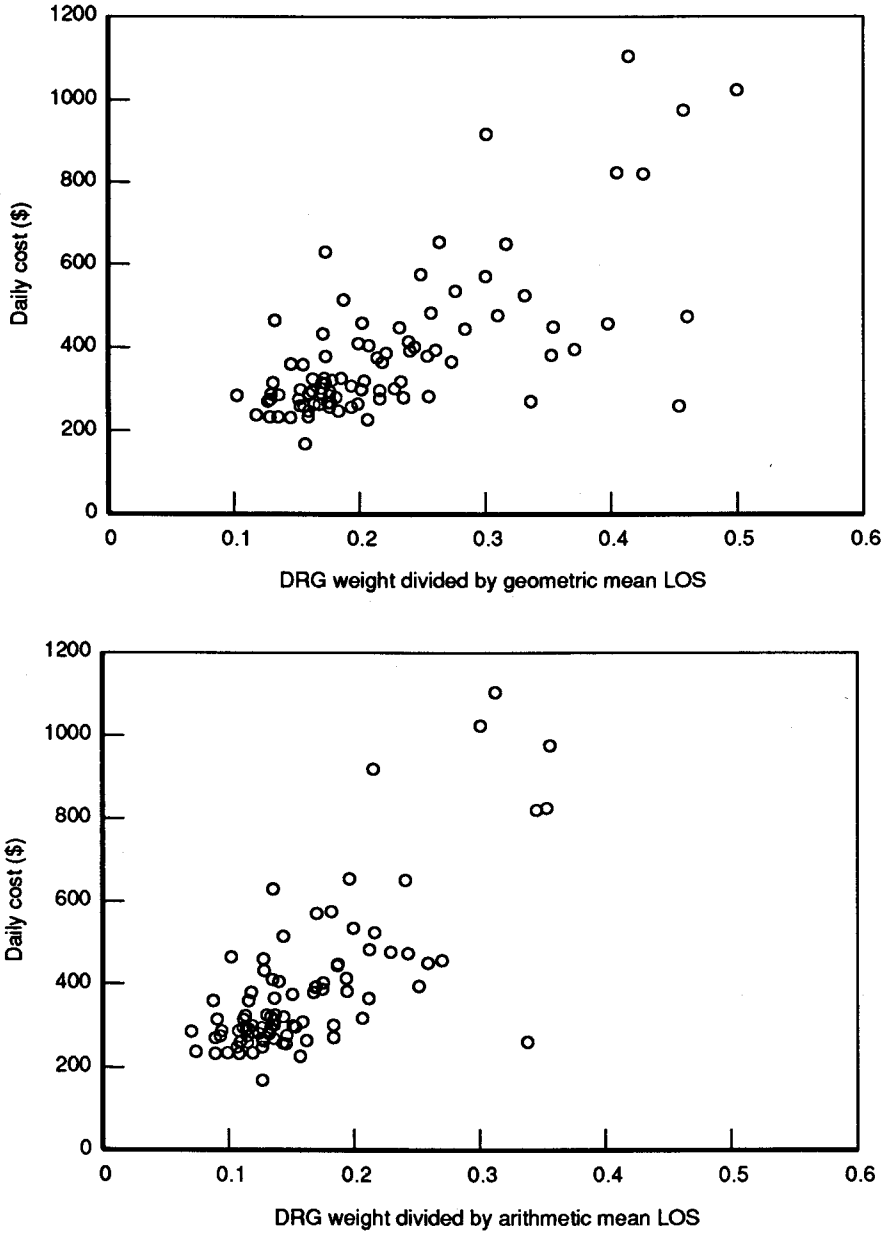

Figure 3.2—Scatterplot of Daily Cost Associated with a Day Outlier Day Versus Daily DRG Weight

ciated with a day outlier day across DRGs, the major difference between using the arithmetic and geometric means is one of scale. As long as the scale multiplier reflects the choice that has been made, either mean can be used to measure the relative resources associated with an outlier day in different DRGs.

THE DAY OUTLIER COST FACTOR IN ALL DRGs

As we have just seen, the extra, standardized cost of a day outlier day in a particular DRG is approximately proportional to the daily DRG weight and therefore to the daily standardized reimbursement in that DRG. This implies that C_{ijk}, the standardized cost of day outlier case k in DRG j in hospital i, can be modeled as either:

$$C_{ijk} = a_j + b \times N_k \times (R \times W_j / G_j) + e_{ijk}, \quad (3.1)$$

or

$$C_{ijk} = a_j + b \times N_k \times (R \times W_j / S_j) + e_{ijk}, \quad (3.2)$$

where

- a_j = the constant term for DRG j,
- b = the day outlier cost factor, i.e., the ratio of the extra cost associated with a day outlier day to average daily reimbursement and does not depend on DRG,
- e_{ijk} = a random error with mean 0 that is independent across cases,
- N_k = the number of days beyond the day outlier threshold that the case remained in the hospital,
- R = the payment rate for a hospital paid at the standardized rate (includes both operating and capital payment rates),
- W_j = the weight for DRG j,
- G_j = the geometric mean LOS for cases in DRG j, and
- S_j = the arithmetic mean LOS for cases in DRG j.

We used an iterative weighted least squares regression to estimate the coefficients of Eqs. (3.1) and (3.2). We used cases paid with the day outlier formula from all DRGs and excluded cases with LOS of more than 180 days. Just as in the regressions for individual DRGs, to account for heteroskedasticity, the weights were set to be inversely proportional to the square of the predictions from the previous iteration and the third iteration was accepted.

Table 3.2 shows the results. The day outlier cost factor when daily reimbursement is based on the geometric mean LOS is 0.4422. These cases are now paid a day outlier per diem at a rate of 0.6 times this daily reimbursement, thus extra costs equal approximately three-quarters (0.4422/0.6) of reimbursement. If one replaced the geometric mean LOS with the arithmetic mean LOS in the calculation of daily reimbursement, the day outlier cost factor increases to 0.6060. This just reflects the fact that the arithmetic mean LOS is larger than the geometric mean LOS; the improvement in fit obtained with the arithmetic mean is so small at the case level that the R-squared is unchanged to two significant digits.

The values of the coefficients in Eqs. (3.1) and (3.2) depend on the identity of the cases that are paid with the day outlier formula.[3] This in turn depends on both the day outlier payment rate and the cost outlier threshold (which determines the cost outlier payment and thus which formula gives the maximum payment). Therefore we estimated the coefficients of Eqs. (3.1) and (3.2) under a series of alternative outlier parameters and report the day outlier cost factor and its standard error in Table 3.3.

The first two rows in Table 3.3 use the current day outlier payment formula to define day outlier cases, i.e., as shown in the first column, cases are paid with a day outlier payment multiplier (MD) of 0.6 and daily reimbursement is based on the geometric mean LOS. As shown in the second column of the table, in the first row we evaluated Eq. (3.1), i.e., we used the geometric mean LOS in the explanatory variable on the right-hand side. In the second row we evaluated Eq. (3.2), i.e., we used the arithmetic mean LOS in the explanatory variable on the right-hand side. The coefficients in the third column were calculated from day outlier cases selected using the current cost outlier thresholds. Thus, the numbers in the first two rows of the table are extracted from Table 3.2 and are repeated here for easy comparison.

The last two rows of Table 3.3 refer to day outlier cases selected using a smaller payment amount for day outliers. Replacing the g.m. LOS with the a.m. LOS in payment reduces day outlier payment per case by about 28 percent. This means that the more expensive day outlier cases would be paid with the cost outlier formula and thus the re-

[3]In analyses that we do not report in detail, we estimated DRG-specific equations for the cost of day outliers under alternative outlier payment policies. In all cases, we found that the linear model of Eqs. (3.1) and (3.2) provided a good description of the variation across DRGs in the extra costs associated with day outlier days.

Table 3.2

Estimates of Day Outlier Cost Factor (Current Policy)

	Regression on Daily Reimbursement Using	
	g.m. LOS	a.m. LOS
Coefficient	0.4422	0.6060
Standard error	0.0044	0.0061
R^2	0.54	0.54

NOTE: Based on 22,029 cases paid with the day outlier formula in a simulation of current outlier policy. Regression also includes 384 dummy variables, one for each DRG in the sample.

Table 3.3

Sensitivity of Day Outlier Cost Factor to Outlier Parameters

Payment Formula	Mean Used in Explanatory Variable in Regression	Cost Factor[a] Current Cost Threshold	Fixed Loss Threshold of $27,000	Fixed Loss Threshold of $23,000
MD = 0.6, geometric	Geometric	0.4422 (0.0044)	0.4411 (0.0043)	NA[b]
MD = 0.6, geometric	Arithmetic	0.6060 (0.0061)	0.6052 (0.0059)	NA
MD = 0.6, arithmetic	Arithmetic	0.5561 (0.0060)	0.5533 (0.0057)	0.5488 (0.0054)
MD = 0.45, arithmetic	Arithmetic	0.5240 (0.0059)	0.5209 (0.0056)	0.5171 (0.0054)

NOTE: With a day outlier payment formula based on MD = 0.6 and g.m. LOS and the current cost threshold, the sample size is 22,029. Changing only to a fixed loss threshold, the sample size becomes 21,796. Using MD = 0.6 and the a.m. LOS, the sample sizes in the order of the columns are: 21,314, 21,061, and 19,724. Using MD = 0.45 and the a.m. LOS, the sample sizes are: 20,743, 20,448, and 19,007.

[a]Standard errors are in parentheses.

[b]Not available.

maining day outlier cases would incur extra costs equal to 0.5561 of daily reimbursement rather than 0.6060. Further reducing the day outlier payment by 25 percent by replacing the multiplier of 0.6 with one of 0.45 reduces the incremental cost factor by less than 6 percent to 0.5240.

The last two columns of Table 3.3 refer to day outlier cases selected using a fixed loss cost threshold rather than the existing threshold policy. The $27,000 threshold was selected to be approximately budget-neutral to the current thresholds. The thresholds in the last column increase cost outlier payments roughly as much as day outlier payments would be reduced by replacing the geometric mean LOS with the arithmetic mean LOS. The results are very insensitive to the definition of cost outliers. They differ by less than half a standard error going from the current cost outlier threshold to the fixed loss threshold in all cases.

Interpolating between the last two rows of the first column of Table 3.3, one can estimate that, using a payment formula based on the arithmetic mean instead of the geometric mean, average costs would equal payments using a payment multiplier of 0.54. If one wished to use a marginal cost factor of 0.75 as is done with cost outliers, one would use a multiplier of 0.75 × 0.54, or approximately 0.4. Table 3.4 summarizes these results and reports similar numbers of the geometric mean LOS.

SENSITIVITY ANALYSES

We have seen that the day outlier cost factor is very insensitive to the definition of cost outlier thresholds and relatively insensitive to the amount that day outlier cases are paid. Here we consider whether the results are sensitive to other aspects of our methodology.

An important question is whether there are important omitted variables. We are estimating the average standardized cost of cases paid with the day outlier formula. Even if there are hospital characteristics whose effect is not well estimated by standardization factors, we

Table 3.4

Day Outlier Payment Multiplier Corresponding to Policy Choices for Marginal Cost Factor and Method of Measuring Mean LOS

Mean LOS Used in Day Outlier Payment Formula	Multiplier	
	MCF=1.0	MCF=0.75
Arithmetic	0.54	0.40
Geometric	0.39	0.30

would not want to measure their effect separately; rather, we want those effects to affect our estimates of the average standardized costs.[4] Thus we need not be concerned about hospital characteristics.

Another important question is whether the day outlier cost factor is the same in all DRGs. Because the costs incurred near the time of surgery are so high (Carter and Melnick, 1990), the extra costs associated with a day outlier day should be a smaller percentage of the average daily reimbursement in surgical DRGs than in medical DRGs. This is actually the case, although the differences may not be large enough to be of policy significance. The day outlier cost factor was from 0.08 to 0.10 more in medical DRGs than in surgical DRGs (depending on exactly which parameters were used to define outlier cases).

There is variance across DRGs even beyond that due to the medical or surgical classification of the DRG. We estimated separate day outlier cost factors for the 92 DRGs with more than 50 day outlier cases in our sample. Although the factors differ (F-statistic = 12.0 with 90 and 18,060 degrees of freedom), the differences may not justify providing separate payment rates for each DRG. The lowest day outlier cost factors were for DRG 116 (factor = 0.15), DRG 315 (factor = 0.22), and DRG 475 (factor = 0.27). The latter DRG has already been divided to improve homogeneity. A total of 8 DRGs had day outlier cost factors more than 2 standard deviations below average (0.442) and below 0.34.[5] The highest factor was for DRG 125 with a factor of 1.15 but a standard error of 0.21. A total of 11 DRGs had factors greater than 0.54 and statistically distinguishable from average.[6] Thus one can identify day outlier factors that differ substantially from average for little more than 19 out of the almost 500 DRGs. (Although we did not test DRGs with fewer than 50 cases, the sample size alone would make it almost impossible to identify their coefficients.)

A similar question is whether the cost increase is really a constant across all LOS. Our analyses are consistent with a linear fit in each of the large DRGs where the data were examined. However, when the data are pooled across all DRGs, there is evidence that the extra cost associated with an extra day declines slightly with LOS. The variation in costs seems too small to be of policy interest, however. For example, when a spline is fit to Eq. (3.1) using current payment

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[4]See Sheingold (1990).

[5]In addition to the three named in the text, the DRGs are: 121, 138, 474, 7, and 112. All had factors above 0.30.

[6]The DRGs are: 125, 271, 410, 430, 462, 105, 108, 109, 154, 191, and 216.

parameters, the extra cost associated with the first 45 outlier days is estimated to be 0.467 of daily reimbursement (rather than the average of 0.442) with the extra costs of later outlier days being lower than average.

Our results are also not strongly affected by our assumption that the error variance is proportional to the square of the prediction. The weighted coefficients typically differed from the first, unbiased OLS coefficients by half a standard deviation—or by 0.003 in the day outlier cost factor.

4. SIMULATIONS

In the last section, we saw that the costs of a day outlier case increase by only about 75 percent of the current day outlier per diem for each additional day outlier day. We simulated the current PPS outlier policy to examine the effect of this policy on the profitability of outlier cases and found that, contrary to policy intent, a substantial fraction of day outlier payments goes to profitable cases. We then simulated a series of alternative policies that we compare to the current policy. The outcomes to be compared consist of the amount of outlier payments that go to profitable cases, the risk protection the policy provides to hospitals, the correlation between profit and loss at the hospital level, and the distribution of profit levels across categories of hospitals.

SIMULATED ALTERNATIVE OUTLIER POLICIES

We consider two kinds of change to outlier policy: a reduction in the day outlier payment rate and the replacement of the current cost outlier threshold formula with one that provides for the same fixed loss in each DRG. We simulated five different ways to reduce the day outlier payment rate in addition to the current day payment rate. The reductions span the range from current policy to a payment rate equal to 75 percent of estimated cost—the rate where day and cost outliers are treated equally. As will be discussed in detail below, the cost outlier threshold has only a modest effect on outcomes and thus we did not provide a full factorial design of 12 simulations (six day outlier payment rates times two cost threshold formulas). Rather, we simulated only two day payment rates with the current thresholds and all six payment rates with the fixed loss threshold.

Our first simulation is of current policy (both current cost outlier threshold and current day outlier payment rates). Our first alternative replaces the geometric mean LOS with the arithmetic mean LOS in the day outlier payment formula and uses a day outlier payment multiplier (MD) of 0.55, thus paying day outlier cases at a rate equal to our estimate of the extra cost associated with each day. It maintains the current formula for the cost outlier threshold, changing the dollar constant to maintain budget neutrality. This simulation shows the effect of changing only the day outlier parameter.

The next alternative maintains the current day outlier payment policy and uses a fixed loss threshold for cost outlier payments. It shows the effect of changing only the cost outlier threshold.

All other simulations combine a fixed loss cost outlier policy with alternative formulas for the day outlier per diems. Consistent with the analysis in the previous section, all these formulas pay less than current policy. The alternatives cover the range from the current payment rate to a per diem equal to 75 percent of estimated costs. In each case, the cost outlier thresholds are adjusted so that the reduced day outlier payments are compensated by increased cost outlier payments.

One simulated alternative replaces the geometric mean LOS with the arithmetic mean in the day outlier payment formula. This alternative provides a substantially lower outlier per diem than current policy, but it still pays more than our best estimate of the extra cost incurred because of an outlier day.

The next three simulations all pay a day outlier per diem equal to an estimate of the extra cost associated with each day outlier day. The first simulation in this series uses the geometric mean LOS and a day outlier payment multiplier of 0.4. The second simulation uses the arithmetic mean LOS and an MD of 0.55. These two simulations have very similar results because of the relationship between the arithmetic and geometric means. The final simulation in this group corrects for the differences in the incremental costs of medical and surgical day outlier days by paying a day outlier multiplier of 0.6 for medical cases and a day outlier multiplier of 0.5 for surgical cases and also uses the arithmetic mean LOS.

As discussed in Section 1, there are reasons to impose coinsurance on the extra costs associated with day outlier days. If the day outlier per diem is set at 75 percent of these costs, day outliers would have the same coinsurance rate as cost outliers. To simulate this case, we chose a payment formula using the arithmetic mean LOS and MD of 0.4. We expect that a simulation using the geometric mean LOS and an MD of 0.3 would provide similar results.

RESULTS

Summary Statistics

Table 4.1 presents a series of summary statistics for all of the simulations including the current outlier policy. The first row shows the percentage of cases that are paid an outlier supplement and the sec-

Table 4.1

Summary Statistics Comparing Current Policy to Outlier Alternatives

Statistic	Current Cost Formula		Fixed Loss Cost Formula					
	Current Day	a.m. MD=0.55	Current Day	a.m. MD=0.6	g.m. MD=0.4	a.m. MD=0.55	a.m. MD=0.6, MD=0.5	a.m. MD=0.4
% outlier	1.89	2.27	1.88	2.19	2.26	2.27	2.25	2.46
Avg. outlier payment per outlier ($)	14114	11878	14148	12242	11898	11894	11910	11010
Avg. outlier payment per case ($)	266	270	266	268	269	270	269	270
Day only	71	33	65	34	29	29	30	18
Both, pay day	71	44	76	52	47	47	46	28
Both, pay cost	85	124	87	121	127	128	128	146
Cost only	40	68	39	61	66	66	66	78
Capital outlier pay	27	28	27	27	28	28	28	28
Avg. reimbursement per case ($)	5597	5598	5597	5597	5597	5598	5597	5597
Avg. profit per case ($)	–224	–223	–224	–224	–224	–223	–224	–224

NOTE: In the next to the last column, MD = 0.6 is used with medical cases and MD = 0.5 is used with surgical cases.

ond row shows the average amount of the supplement received by an outlier case. Changing from the current cost outlier threshold (first column) to a budget-neutral fixed loss threshold (third column) has little effect on either of these statistics. However, with either cost threshold formula, when we reduce the day outlier payment, the number of cases that receive an outlier payment increases and the average payment per outlier decreases. The fourth column reports a simulation where the geometric mean LOS for the DRG in the day outlier payment formula is replaced with the arithmetic mean LOS and the multiplier is unchanged. This allows us to increase the number of outlier cases by 16 percent (from 1.88 percent of cases to 2.19 percent of cases). The next three columns all pay an average day outlier per diem approximately equal to the average extra cost of a day outlier day and thus each pays approximately the same number of outlier cases and the same amount per case. These statistics are similar to the results of the same day payment and the current cost threshold. The last column shows what happens if we require that hospitals pay the same coinsurance amount for day outlier cases as they pay for cost outlier cases. We can increase the number of outlier cases further to 2.46 percent of cases and still pay an average outlier supplement of $11,010. This is an increase in the number of outlier cases of 30 percent over the current policy.

The third row in the table combines the information from the previous two rows to report the average outlier payment per case. It is relatively constant across all of the simulations. The next four rows decompose this outlier payment per case into four categories—payment to cases that exceed: (1) only the day outlier threshold, (2) both day and cost thresholds but are paid the amount from the day outlier formula, (3) both day and cost thresholds but are paid the amount from the cost outlier formula, and (4) only the cost outlier threshold. These four rows add up to the average outlier payment per case (except for rounding). Going from the current cost outlier threshold to a fixed loss cost outlier threshold identifies more day outlier cases as also being cost outliers but has little effect on the amount of money dispensed from each formula. By reducing the day outlier per diem as is done in all the remaining simulations, the amount of money that is paid using the day outlier formula diminishes, of course. The majority of that money is given to cases that exceed both thresholds and that are paid by the cost outlier threshold. Thus, this strategy moves payment from less expensive day outlier cases to more expensive day outlier cases. It also increases payment to expensive cases that do not exceed the day outlier threshold.

Throughout all of the simulations, the average capital outlier payment remained constant, which means that the balance between operating and capital payments to outliers is basically unchanged. It is interesting to note that the percentage of outlier payments that are capital is around 10 percent whereas the percentage of total reimbursement that is capital payment is 8.8 percent.

In the last two rows of Table 4.1, we report the average reimbursement per case and the average profit per case to show that budget neutrality is maintained in all of our simulation alternatives. The small increase in outlier payments is made possible by a similarly small decrease in medical education and disproportionate share payments, which are not reported in the table.

Case-Level Profitability

Table 4.2 shows the cumulative distribution of day outlier payments, cost outlier payments, and total outlier payments under current policy by the amount of profit made on the case. The first row shows that only 2,144 cases made a profit of more than $20,000 and that these cases received 19.8 percent of all day outlier payments and 7.3 percent of all cost outlier payments. Thirty-eight percent of day outlier payments go to profitable cases whereas only 13 percent of cost outlier payments go to profitable cases.

Our findings in Section 3 that the additional costs of a day outlier day average only 75 percent of the current outlier per diem explain how profitable day outlier cases occur. More than 99 percent of day outlier

Table 4.2

Cumulative Distribution of Outlier Payments, by Profit Category of Case (Current Outlier Policy)

Profit Category ($000)	Number of Cases	Day Outlier Payments %	Cost Outlier Payments %	Total Outlier Payments %
> $20	2144	19.8	7.3	14.0
20 to 10	12274	26.5	9.5	18.5
10 to 0	657097	38.2	12.7	26.3
0 to –10	1079214	62.3	21.3	43.1
–10 to –20	56544	82.3	43.0	63.9
–20 to –30	12340	91.9	68.6	81.0
–30 to –40	3256	96.2	83.9	90.4
–40 to –50	971	97.7	91.5	94.8
< –50	678	100.0	100.0	100.0

cases would be unprofitable without the outlier payment. The loss at the time the patient passes the day outlier threshold is more than made up by the profit made on each day outlier day. And, of course, this profit could be an effective incentive to keep these patients in the hospital.

Although the day outlier formula accounts for 78 percent of the payments to profitable outlier cases, some cost outlier cases also turn out to be profitable. There are several reasons for profitable cost outliers. First, cost-to-charge ratios vary by department, and therefore our best estimate of cost from these departmental ratios can be substantially lower than costs estimated from the hospital-wide cost-to-charge ratio. Second, cost-to-charge ratios vary by year, and the ratios used for payment may be several years out of date. Third, many of the cost reports used with the departmental methodology were not yet audited and may contain substantial errors. This third reason may also account for some of the profitable day outlier cases, but the typical bias is for unaudited cost reports to overestimate costs, not underestimate them, and thus we think this effect is small for both categories of outliers.

Day outlier payments to profitable cases have increased recently. In FY 1989, Carter and Farley (1992) found that 29 percent of day outlier payments went to profitable cases whereas we found 38 percent for FY 1990.

Most of the simulated outlier alternatives reduce the day outlier per diem and therefore also reduce the percentage of outlier payments that go to profitable cases. Table 4.3 shows the cumulative distribution of total outlier payments by the same profit categories as Table 4.2. Adding a fixed loss threshold to the current day policy does not change the profit distribution of total outlier payments, because it does not address the cause of most of the problem, which is the day outlier payment rate. The profit distribution for the other simulations that do reduce day outlier payments show a substantial change in the percentage of payment going to profitable cases. For example, the current policy pays 14 percent of outlier payments to cases that earn more than $20,000 whereas the best policy pays only 5.5 percent of payments to these kinds of cases.

The major trend displayed in Table 4.3 is that the more day outlier payments are reduced, within the range of our simulated alternatives, the lower the percentage of total outlier payments being expended on profitable cases. To summarize across alternatives, the

Table 4.3

Cumulative Distribution of Outlier Payments, by Profit Category of Case, for Alternative Outlier Policies

Profit Category ($000)	Current Cost Formula		Fixed Loss Cost Formula					
	Current Day	a.m. MD=0.55	Current Day	a.m. MD=0.6	g.m. MD=0.4	a.m. MD=0.55	a.m. MD=0.6, MD=0.5	a.m. MD=0.4
> $20	14.0	6.9	14.1	7.9	7.4	7.2	7.0	5.5
20 to 10	18.5	9.3	18.5	10.8	9.9	9.5	9.6	7.5
10 to 0	26.3	15.1	26.3	16.8	15.4	15.2	15.2	12.3
0 to –10	43.1	32.1	43.1	32.4	30.9	30.8	30.8	26.4
–10 to –20	63.9	63.2	62.5	61.3	61.4	61.5	61.2	61.5
–20 to –30	81.0	82.4	80.3	81.9	82.3	82.3	82.2	82.6
–30 to –40	90.4	91.1	90.2	91.2	91.2	91.3	91.3	91.5
–40 to –50	94.8	95.0	95.0	95.2	95.2	95.2	95.3	95.2
< –50	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

addition of a fixed loss policy to the current day policy does not change the distribution of total outlier payments at all. The added change of using the arithmetic mean rather than the geometric mean is a substantial improvement and only slightly worse than the four simulation policies that pay approximately estimated cost. The policy that pays 75 percent of cost provides the smallest percentage of payments that go to profitable cases.

Hospital-Level Profitability and Risk

One major purpose of outlier policy is to protect the hospital from the cost of exceptionally expensive cases. Consequently, we present Table 4.4, which displays outlier payments per case by the pre-outlier payment profit category of hospitals. All the policies provide increasing outlier payments as the size of the average pre-outlier loss increases except for the single category of very profitable hospitals (average profit > $1,000 per case). Except for this one category of 300 hospitals, all the policies, including the current policy, help to mitigate the losses that hospitals suffer from PPS. However, the policies that reduce day payments provide more help to the hospitals that are incurring the largest losses. Examining the highest loss category, note that current policy pays a per case amount of $588. If we change the day outlier payment to equal estimated costs, this amount increases to $672. As shown in the remaining columns, this amount increases steadily with the reduction in the day outlier per diem. The end result is that the best case, the one that pays day outliers 75 percent of cost (uses arithmetic mean and MD = 0.4), pays $729 per case to these hospitals—an increase of 24 percent over the current policy.

The reason that the very profitable hospitals receive more outlier payments than some less profitable hospital categories is that teaching hospitals tend to have both high profits (because of the rate of payments for the indirect costs of medical education) and a large number of outlier cases. Hospitals in the very profitable category that do not receive any teaching subsidies are paid outlier payments that average $100 per case. This amount is closer to what would be expected given the trend in the other profit categories. However, the minor teaching hospitals in the profitable category receive $302 per case and this escalates up to $500 per case for major medical education hospitals. The number of cases in teaching hospitals is almost twice as large as the number of cases in this nonteaching category. Therefore, the average payment per case is heavily affected by the medical education hospitals.

Table 4.4

Outlier Payments per Case, by Pre-Outlier Payment Profit Category of Hospital, for Alternative Outlier Policies

Pre-Outlier Profit Category	No. of Cases	No. of Hospitals	Current Cost Formula		Fixed Loss Cost Formula					
			Current Day	a.m. MD=0.55	Current Day	a.m. MD=0.6	g.m. MD=0.4	a.m. MD=0.55	a.m. MD=0.6, MD=0.5	a.m. MD=0.4
> $1000	111315	300	307	256	305	260	253	252	251	227
0 to 1000	440154	1641	167	155	166	155	153	153	153	147
–1000 to 0	737936	1812	224	225	224	223	222	223	223	222
–2000 to –1000	377688	771	349	367	350	366	368	370	370	377
–3000 to –2000	123755	268	491	552	495	546	555	559	555	583
< –3000	33670	135	588	672	600	672	687	689	686	729

Another area where the outlier policy is supposed to help hospitals is in exposure to risk. We calculated the case-weighted and hospital-weighted risk to hospitals for each simulation policy and present these results in Table 4.5.

The risk results again mirror the other results that we have found for the alternative policies. The risk improves slightly for the fixed loss alternative over the current policy. Again we see that reducing the day payments causes a substantial improvement. The four simulations that pay cost are identical. The 75 percent of cost option is again the best, causing a 5 percent reduction in case-weighted risk.

We present Table 4.6 to compare the effects of the alternative polices on the categories of medical, surgical, and other types of cases. Except for minor differences, it appears that none of the policies change the disparity in profit between medical and surgical cases. Under current policy, medical cases receive an average of only $106 in outlier payments whereas surgical cases receive $605 and the small number of cases in DRGs that contain both medical and surgical patients receive an average of $2,182 in outlier payments. These differences are due to the much greater homogeneity of medical DRGs. Modest changes in outlier payment rates cannot remedy these large differences.

Table 4.7 shows the average profit per case under the alternative outlier policies for groups of hospitals defined by geographic classification and census region. The profit picture for rural and small ur-

Table 4.5

Risk Under Alternative Policies

Outlier Policy	Standard Deviation of Annual Profit as a Percent of Annual Revenue	
	Case-Weighted	Hospital-Weighted
Current Cost Formula		
Current day	1.60	2.83
am, MD=0.55	1.54	2.77
Fixed Loss Cost Formula		
Current Day	1.59	2.82
am, MD=0.6	1.54	2.77
gm, MD=0.4	1.54	2.77
am, MD=0.55	1.54	2.77
am, med/surg MD	1.54	2.77
am, MD = 0.4	1.52	2.75

Table 4.6

Profit for Medical and Surgical Cases Under Alternative Outlier Policies

	Current Cost Formula		Fixed Loss Cost Formula					
Type of Case	Current Day	a.m. MD=0.55	Current Day	a.m. MD=0.6	g.m. MD=0.4	a.m. MD=0.55	a.m MD=0.6, MD=0.5	a.m. MD=0.4
Medical	–432	–443	–426	–433	–434	–434	–430	–437
Surgical	221	261	196	217	218	222	208	229
Other	2023	1560	2463	2285	2278	2258	2326	2170
All	–224	–223	–224	–224	–224	–223	–224	–224

ban area hospitals improves somewhat when day outlier payments are reduced whereas that for large urban hospitals gets somewhat worse. However, all of these differences are rather small.

The reduced day outlier payments improve the profit or loss distribution for all except two regions. The Mid-Atlantic region gets brought more into line with the other regions, but the New England region, which is less profitable than average, is also increasingly hurt by increased reductions in the day outlier payment amount. However, the total effect of a reduction in the day outlier per diem is to reduce the discrepancy in profit across regions. Under current policy the most profitable region (the Mid-Atlantic) enjoys an average profit per case that is $969 more than that in the least profitable region (the South Atlantic). Under the policy that pays an outlier per diem at 75 percent of incremental cost, the discrepancy is reduced by 24 percent to $738.

Table 4.8 compares the effects of the alternative outlier policies on the profit for hospitals categorized by selected hospital characteristics. The major effect that the alternative policies have on profit by bed size is a small increase in the similarity of losses. This same reduction in profit disparity appears to hold true for hospitals classified by teaching status, disproportionate share status, and their case mix index.

Cost Outlier Threshold

Replacing the existing cost outlier threshold with fixed loss cost outlier thresholds has little effect on the outcomes that we have examined. In most DRGs, the existing cost outlier threshold is very similar to the one that would be created by a fixed loss policy. Under either of the day payments for which we simulated two cost thresholds, over 85 percent of the cases paid with the cost outlier formula with the current thresholds are also paid with the cost outlier formula with fixed loss thresholds and vice versa. Among the cases that are paid a cost outlier supplement in both simulations, going from one policy to another changes outlier payment by about 13 percent for the average case.

Insofar as the change in thresholds does cause different payments, however, it does provide an improved match of outlier payments to loss at the case level. For example, using the current day outlier policy, the cases paid a cost outlier supplement with the fixed loss and not with the current thresholds averaged a loss of $28,500 before the outlier payment whereas those paid a supplement with the current

Table 4.7

Profit Under Alternative Outlier Policies, by Hospital Location

Hospital Area Characteristic	Current Cost Formula		Fixed Loss Cost Formula					
	Current Day	a.m. MD=0.55	Current Day	a.m. MD=0.6	g.m. MD=0.4	a.m. MD=0.55	a.m. MD=0.6, MD=0.5	a.m. MD=0.4
Rural	–102	–96	–101	–97	–97	–96	–96	–95
Small urban	–355	–343	–355	–346	–344	–343	–344	–338
Large urban	–164	–177	–164	–176	–178	–178	–179	–185
New England	–414	–478	–415	–471	–481	–481	–480	–508
Mid-Atlantic	382	248	381	269	247	247	248	183
S. Atlantic	–587	–565	–586	–569	–566	–565	–565	–555
E.N. Central	–488	–458	–490	–467	–463	–462	–463	–449
E.S. Central	–200	–174	–199	–177	–173	–172	–172	–159
W.N. Central	–211	–179	–212	–186	–181	–181	–182	–167
W.S. Central	–394	–347	–392	–354	–346	–345	–347	–325
Mountain	–34	19	–33	11	19	20	19	41
Pacific	–3	53	–2	44	54	55	53	79
Total	–224	–223	–224	–224	–224	–223	–224	–224

Table 4.8

Profit Under Alternative Outlier Policies, by Hospital Characteristics

Hospital Characteristic	Current Cost Formula		Fixed Loss Cost Formula					
	Current Day	a.m. MD=0.55	Current Day	a.m MD=0.6	g.m. MD=0.4	a.m. MD=0.55	a.m. MD=0.6, MD=0.5	a.m. MD=0.4
Beds								
0–49	–142	–130	–141	–132	–130	–130	–130	–124
50–99	–110	–100	–109	–102	–101	–100	–100	–97
100–199	–269	–257	–267	–260	–259	–258	–258	–255
200–299	–401	–392	–400	–394	–393	–392	–392	–390
300–499	–223	–226	–225	–227	–228	–227	–228	–228
500+	–22	–50	–25	–46	–50	–49	–52	–61
Teaching								
None	–372	–358	–371	–360	–359	–358	–358	–353
Minor	–235	–241	–237	–241	–241	–240	–241	–243
Major	837	770	832	773	763	763	759	733
Disproportionate share								
No	–409	–392	–409	–395	–393	–392	–393	–385
Yes	105	79	104	80	76	76	76	62
CMI < 1	34	28	35	30	30	29	30	27
1.00 ≤ CMI < 1.25	–265	–275	–264	–274	–277	–276	–275	–282
1.25 ≤ CMI < 1.50	–270	–268	–268	–269	–269	–268	–269	–269
1.50 ≤ CMI	–104	–87	–111	–91	–88	–86	–90	–77
Total	–224	–223	–224	–224	–224	–223	–224	–224

policy and not the fixed loss averaged a loss of only $22,100 before the outlier payment. The correlation between reimbursement and cost among the set of cases paid an outlier supplement in either simulation increases from 0.853 to 0.858. (Using the reduced day outlier payment, the similar correlations are 0.879 and 0.887.)

5. CONCLUSIONS

We estimate that each additional outlier day causes the cost of day outlier cases to increase by only about 75 percent of the current day outlier per diem. Under current policy, 38 percent of day outlier payments go to profitable cases. By reducing the day outlier payment rate and paying outlier supplements to more cases, one can simultaneously improve insurance for hospitals and reduce incentives to overserve day outlier cases.

Our estimate of the way that costs increase with each day outlier day was created without actually observing incremental costs. Rather it was built from a regression describing how the total cost of day outlier cases increases with LOS. This model was based on the findings of the only study ever made of incremental costs. All our data explorations showed that this model provides a good approximation to the relationship between LOS and cost per case. In addition, our findings are consistent with the distribution of outlier payments to profitable cases that we observed and with the increase in profitability with number of outlier days observed in Carter and Farley (1992).

Our estimates do share all the failings of the cost accounting methodology and the underlying cost reports. The use of a single per diem for routine care means that variations across cases in nursing costs are not counted (except for special care units). A recent ProPAC-sponsored study compared costs estimated by our methodology to those estimated by sophisticated hospital cost accounting methods in use at 18 hospitals, many of which were large, urban, teaching hospitals (Ashby, 1991). It found that the Medicare Cost Report overestimated the cost of Medicare cases by 4.4 percent. Further, it found that routine and special care costs were overestimated by 12.6 percent and ancillary costs were underestimated by 4.9 percent by the cost report. Thus, we should not consider our results to be exactly precise. However, insofar as biases in our method have been demonstrated, they go in the direction of overestimating the cost of day outlier days and thus increase the argument to reduce day outlier payments.

We estimate that a day outlier per diem roughly equal to 0.55 times the daily reimbursement in a DRG (calculated with the arithmetic mean LOS rather than the geometric mean LOS) would produce outlier payments that, on average, equal the extra costs incurred by day outlier cases. Using a multiple of 0.4 rather than 0.55 would have

hospitals pay the same average level of coinsurance for day outlier cases as they now pay for cost outlier cases.

In addition to reducing inappropriate incentives, a reduction in the day outlier payment rate along with a compensating decrease in cost outlier thresholds would reduce the percentage of outlier payments that go to profitable cases by up to two-thirds. It would move outlier payments from the least expensive day outlier cases to the more expensive day outlier cases and allow additional payments to expensive cases that do not cross the day outlier threshold. It would provide higher outlier payments to hospitals that are losing the most money under PPS and would significantly reduce the disparity in profit across regions found under the current policy.

Replacing the existing cost outlier threshold with fixed loss cost outlier thresholds has little effect on the outcomes that we have examined. Insofar as the change in thresholds does cause different payments, however, it provides an improved match of outlier payments to loss at the case level.

We recommend a reduction in the rate of day outlier payments to approximately 75 percent of the extra costs associated with each outlier day. This could be accomplished by replacing the geometric mean LOS with the arithmetic mean LOS and reducing the day outlier payment multiple to approximately 0.4. At the same time, it would be useful to replace the current formula for the cost outlier threshold with a fixed loss cost outlier threshold. The PPS policy tradition is to implement changes in policy parameters gradually, and thus one might wish to make the total reduction in the day outlier payment rate over a multiyear period. For example, in the first year one might require no coinsurance—setting the day payment rate with the arithmetic mean and a multiple of 0.55 and then impose coinsurance in a subsequent year.

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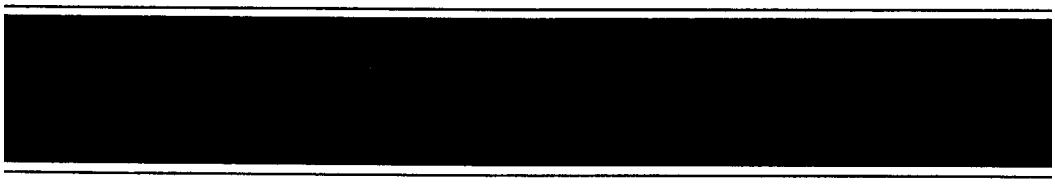
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