NBER WORKING PAPER SERIES

HOSPITAL ADMISSIONS, LENGTH OF STAY, AND CASE-MIX IMPACTS OF PER CASE PAYMENT: THE MARYLAND EXPERIENCE

David S. Salkever

Donald M. Steinwachs

Working Paper No. 2010

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 1986

We wish to acknowledge financial support from the U.S. National Center for Health Services Research under Grant HS 03831. The thoughtful advice and comments of our project officer, Herbert Traxler, of Michael Rosko, and of our colleagues, Richard Frank and Robert Seidman, were gratefully received. Agnes Rupp made major contributions to the development of our data base and approaches to measurement of variables. Alison Jones and Sharon Paul provided skillful programming support and Valerie Waudby helped us prepare the manuscript. The research reported here is part of the NBER's research program in Health Economics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

Working Paper #2010
August 1986

Hospital Admissions, Length of Stay, and Case-Mix Impacts of Per Case Payment: The Maryland Experience

ABSTRACT

Maryland has simultaneously operated per case <u>and</u> per service hospital payment systems since 1976 with varying levels of stringency in setting per case rates. Regression analyses of this experience are used to compare the impacts of these systems on admissions, length of stay, and case-mix costliness for the period July 1, 1976 to June 30, 1981. Our results indicate a positive effect on admissions and negative effects on case-mix and length of stay for the per case payment approach relative to the per service approach. More stringent levels of per case payment are associated with stronger utilization responses.

Professor David S. Salkever
Department of Health Policy and Management
The Johns Hopkins University
624 North Broadway, Room 429
Baltimore, MD 21205

Professor Donald M. Steinwachs
Department of Health Policy and Management
The Johns Hopkins University
624 North Broadway
Baltimore, MD 21205

HOSPITAL ADMISSIONS, LENGTH-OF-STAY, AND CASE-MIX IMPACTS OF PER CASE PAYMENT: THE MARYLAND EXPERIENCE

Although cost containment is a primary objective of prospective hospital payment systems, it is widely recognized that these systems may also impact on utilization (1). These utilization impacts may be fully consistent with the cost-containment goal; an example is reductions in length of stay to eliminate days of inpatient care with little or no health benefits. On the other hand, these impacts could take the form of increases in utilization and thus could undercut cost-containment efforts.

Concern has recently been expressed about perverse utilization impacts of per diem and per service payment systems in which hospitals receive additional revenues for each additional day or specific service (e.g., lab test). This concern is supported by empirical evidence of positive impacts on length of stay (2) and use of ancillary services (3), and by findings of more negative impacts on per diem than per case costs (4). To correct this deficiency of per diem or per service payment systems, per case payment systems have been developed (5,6). The Maryland Guaranteed Inpatient Revenue (GIR) program, the first of these systems, was introduced in 1976. New Jersey introduced a DRG-based system in 1980 and Medicare's Prospective Payment System (PPS) was enacted in 1983. A number of other states and private insurers have subsequently moved to adopt their own per case payment programs {6}.

This paper presents an empirical analysis of the experience under the Maryland GIR program from 1976 to 1981. The Maryland program is of interest for several reasons. First, it has been in effect the longest and has presumably dealt with any operational problems in its start-up phase. Second, the Maryland situation allows us to compare two different approaches to per case payments, as well as a per service payment scheme, since all three systems were in operation in Maryland during our study period. Comparisons among these systems in terms of impacts on admissions, length-of-stay, and case-mix are presented here.

Per Service Rate Regulation in Maryland

The Maryland Health Services Cost Review Commission (HSCRC) began setting rates for all hospitals in Maryland on a per service basis on July 1, 1974. Selected hospitals were first placed by the HSCRC on per case rates (the GIR) in late 1976; during the five years of our study period (July 1, 1976 to June 30, 1981) 22 of the 46 acute care hospitals in our study had experience with per case payments. Medicare and Medicaid waivers took effect on July 1, 1977 and brought all patients in the state under HSCRC rates, including the per case rates for the GIR hospitals.

Per service rates were set on the basis of budgeted volumes and costs in routine care, special care, and ancillary patient service centers. After an initial round of detailed rate reviews (involving examination of hospitals' financial data and comparisons with peer institutions), rates were trended forward annually to reflect inflation in factor costs and adjusted for volume variances. When actual revenues in a year exceeded budgeted revenues because service volumes exceeded projections, variable cost factors of .6 for routine services and .4 for ancillary services were applied to the excess revenue to determine how much the hospital was permitted to retain. An incremental variable cost factor of .7 was applied to revenues due to equivalent admissions (i.e., admissions adjusted for outpatient activity) more than 2 per cent over the projected level. This factor increased to .8 for revenues due to equivalent admissions more than 10 per cent above projected.

When actual revenues fell short of projections because of volume shortfalls, a variable cost factor of .2 was applied to determine the unrecovered fixed costs to be included in the next year's rates. If a hospital experienced a shortfall of more than 5 per cent from its projected equivalent admissions, the incremental variable cost factor increased to .6 and .4 for routine care and ancillary cost services respectively (7). The asymmetry between upward and downward variable cost factors was intended to encourage reductions in unnecessary utilization (8).

Per Case Payments and Incentives

Per service rates were also set for GIR hospitals in the manner just described and were the basis for generating bills to their individual patients or third-party payors. The GIR program superimposed on this process a projected case-mix-adjusted revenue cap per case. If a GIR hospital realized an actual revenue per case below (above) its cap, it received additional (reduced) revenues, via higher (lower) rates in the following year, equal to the relevant variable cost factor times the number of discharges times the difference between the cap and actual revenue per case. For example, assume a hospital's actual revenue exceeded projected revenue and its overall variable cost factor was approximately .5. If its case-mix-adjusted average revenue per case was $500 below its GIR level, and it had 5,000 discharges, it received $500 x 5000 x.5 or $1,250,000 in additional allowable revenue in next year's rates.

The GIR program was intended to create incentives to reduce length of stay and use of ancillary services and to be neutral for changes in the volume of admissions. It is possible, however, that it actually encouraged increased admissions. If a GIR hospital reduced its length of stay and ancillary revenues per case by 5 per cent and simultaneously increased its admissions by 5 per cent (so that actual revenue was about equal to projected), it would receive a GIR "bonus" equal to 3.1 per cent of total revenues (9). Moreover, if these simultaneous changes had little effect on total costs, the 3.1 per cent GIR bonus would all be added net revenue. A per service hospital in the same situation would receive no net revenue bonus at all.

Usually, the GIR level was derived from the hospital's own charges during a base period of its choosing. For this period, live discharges (excluding newborns) were grouped according to a case-mix scheme and average charge per case for each group was computed. Adjustment of these average charges for rate changes between the base and current periods yielded current average charges which were then applied to the current period frequency distribution of live discharges by group to determine the current period GIR level.

In three instances, hospitals were judged by the HSCRC to have excessively high per case costs and were placed on a per case revenue cap that was actually below projected levels based on inflation adjustments and their historical experience. For these three hospitals, which we shall term CAP hospitals, the excess of average charge per case above the cap was deducted from next year's rates while savings below the cap were not added to next year's rates. Thus, the main effect of reducing length of stay or ancillary use was to reduce losses; bonus payments were not made for beating the cap. Reductions in case-mix costliness were also encouraged since the cap for these hospitals was not case-mix-adjusted. Finally, as with the regular GIR, additional admissions could offset some of the negative impacts of reduced length-of-stay or ancillary use on total revenues.

While the constraint on the CAP hospitals was mandatory, the GIR program was phased in on a voluntary basis starting in late 1976. The HSCRC offered inducements for hospitals to go on the GIR, including an extra 1 per cent inflation allowance and additional administrative expenses for a hospital to monitor its own performance. In some instances, the GIR was offered to hospitals as an alternative to a full review of rates which the HSCRC felt would otherwise have been needed because of major service additions, expansions, or out-of-line cost performance.

The strength of these inducements resulted in fairly rapid implementation. Of the 46 non-Federal general acute care hospitals in the State in 1976, six went on the GIR in the latter part of 1976 (including two CAP hospitals), six were added during 1977, six in 1978, three (including one CAP hospital) in 1979, and one in 1980. Six hospitals dropped off the GIR program and returned to per service payment; these were smaller hospitals, generally lacking adequate management information systems. One of the two hospitals put on the cap in 1976 switched to a regular GIR in 1981; the hospital put on the CAP in 1979 switched to the regular GIR in late 1980.

Study Objectives and Approach

The objective of the study from which this paper derives was to assess the impacts of the GIR per case payment system by comparing the experience of Maryland's general acute care hospitals under per case vs. per service payment. Our analysis pertains to the fiscal years 1977-1981 and the 46 hospitals operating throughout this period. We have previously reported on cost, charge and efficiency impacts {10}. The current paper reports estimates of GIR impacts on numbers of admissions, length of stay, and hospital case-mix.

The regression models used for estimating these GIR impacts are based on a standard short-run model of hospital decision-making {11}. The hospital decision-makers are presumed to choose variable input quantities and output prices so as to maximize an objective function based on output quantity, quality, and net revenue. The hospital is subject to constraints imposed by downward-sloping product demand curves, technology, input prices, and fixed capital. Assuming an interior solution to this maximization process, the resulting optimal levels of admissions, length of stay, and case-mix can be related, via the first-order maximization conditions, to the exogenous factors that determine the constraints faced by the hospital. These factors, which appear as independent variables in our regression models, pertain to market demand conditions (e.g., income), input prices (e.g., wages), and the hospital's fixed capital stock. A measure of teaching activity is also included to control for differences in objectives between teaching and non-teaching institutions.

Within the context of this conceptual framework, GIR impacts could be interpreted as evidence of supplier inducement in an imperfect agency relationship; this is analogous to the often-studied inducement effects on the demand for physician services {12}. For example, GIR hospitals may respond to their incentive structures by encouraging staff physicians to admit more patients and to reduce length of stay. This encouragement is translated into induced demand if it affects the staff physicians' recommendations to their patients. Effects of GIR incentives on case mix are less clear since the GIR level will increase as case-mix costliness increases. For some of the hospitals, however, the case-mix categories for calculating the GIR adjustment were fairly broad. Moreover the CAP hospitals did not have their per case payment limit tied to case-mix. In these instances, per case payment may encourage admissions policies oriented toward a less costly case mix. It should also be noted that GIR impacts on case-mix could be the <u>indirect</u> result of GIR impacts on admissions. For example, if per case payments encourage admissions but it is generally easier to shift the demand for admissions in the less costly case categories, a negative impact on case-mix would be observed. In addition, there is the possibility of changes in coding practices if payments depend upon the hospital's case mix. Recent analysis of the Medicare PPS program suggests that this program did encourage hospitals to code patient data more carefully with the result that patients tended to be classified into more costly DRGs {13}. (This phenomenon is referred to as "DRG creep.")

GIR effects could also be observed even without direct "inducement" or "demand manipulation." For example, if per case payment leads to improvements in efficiency that are translated into lower costs to patients, the number of admissions demanded would rise (though the price elasticity of demand is presumably small). Similarly, GIR-induced reductions in waiting time for elective admissions could increase the demand for admissions. We do not attempt in this analysis to determine the precise mechanism by which per case payment may affect our dependent variables. Thus, the importance of "inducement" as an explanation of GIR effects will not be tested.

Dependent_Variable_Measures_and_Trends

Data on numbers of hospital admissions were taken from the Medicare cost reports (MCRs) of the 46 study hospitals. The average length of stay variable was computed from tabulations of the discharge abstract data hospitals are required to submit to the HSCRC. Occasional missing data items were filled in from the American Hospital Association Annual Survey data and statistical reports of the Maryland Hospital Association.

The case-mix measure used in our study was developed for two purposes: (1) to use as an explanatory variable in cost-function regressions and (2) to serve as a dependent variable in examining hospital responses to the financial incentives under Maryland's per case payment arrangements.

Accordingly, we devised a measure that used data on charges for constructing weights for each care category. This approach, which has been used in many hospital cost studies, assumes there is at least a strong correlation between costs and charges for the various types of cases. Given this assumption, we refer to our index as a measure of case-mix costliness {14}.

Our case-mix costliness index is developed from data on the diagnostic classification and charges for all short-stay hospital discharges in Maryland provided by the Maryland Resource Center (MRC) and the HSCRC. The computational method begins by defining a "market basket" set of diagnostic categories. The original Diagnostic Related Grouping (DRG) classification scheme with 383 DRGs is employed and the following nine DRGs are included as the "market basket" set:

074 Diabetes without Surgery without Secondary Diagnosis or with Minor Secondary Diagnosis with Age greater than 35.

075 Diabetes without Surgery with Major Secondary Diagnosis.

121 Disease of the Heart - Acute Myocardial Infarction.

132 Disease of the Heart - Failure (poor function) without Surgery.

158 Hemorrhoids

167 Pneumonia without Surgery with Secondary Diagnosis with Age greater than 30.

264 Disease of the Female Reproductive System with Surgical Procedures (D&C, Visualization, Removal of Fallopian Tubes) without Secondary Diagnosis.

265 Disease of the Female Reproductive System with Surgical

Procedure (D&C, Visualization, Other with Secondary Diagnosis.

266 Disease of the Female Reproductive System with Surgery (Removal of Womb, Repair of Female Reproductive Organ, Other Major).

This set of categories was selected because it includes both surgical and non-surgical cases and because all nine DRGs are common and were reported by all the study hospitals. (Note that obstetrical conditions are absent since several of the hospitals do not have obstetrical units.)

The next step in the computational procedure was to calculate the average charge in 1980 for each of the nine DRGs in each hospital and to average these nine averages within each hospital to compute an overall "market basket" average charge for each study hospital in 1980. This figure was then divided into the actual charge figure for every discharge in every DRG in each of the study hospitals in 1980, so that all 1980 charge data for individual patients were expressed relative to the hospital "market basket" average.

For each of the 383 DRGs, these relative charge figures were averaged across patients within each hospital, and then these hospital-specific averages were averaged across all hospitals reporting at least one patient in that DRG. The result was a statewide average relative costliness figure for each of the 383 DRGs. Finally, these 383 figures were applied to the frequency distribution of discharges in each of the study years in each hospital to compute the case mix costliness index.

It should be noted that the use of an index based on relative weights has one important advantage over a simpler index based on absolute charges. In particular, this index is much less sensitive to variations among DRGs in the distribution of patients across hospitals. Thus, any particular DRG that might happen to be more common in less efficient hospitals will not have a high relative costliness weight simply because of this fact.

Trends in dependent variable values for hospitals grouped according to GIR status are reported in Table 1. Comparing the LOS results in the last two rows of the table, we observe a more rapid rise in the 1977-79 period for non-GIR hospitals and a slower decline in 1979-81. The latter result is due to a very sharp decline in LOS (12.03 percent) in the CAP hospitals in 1979-81.

Case-mix index values moved downward for all groups of hospitals in 1977-79. In the 1979-81 period, case-mix rose slightly in the non-GIR hospitals but declined slowly for most of the hospitals on per case payment. If per case payment induces "DRG creep," it is not evident from these data.

Admissions increased throughout the study period for most groups of hospitals. The growth for GIR hospitals tended to be below that of other hospitals in the 1979-81 period; however this may have been due in large part to environmental factors such as slower population growth in Baltimore City (where many of the GIR hospitals are located). Results from our multiple regression analyses (reported below) controlling for these environmental factors provide some evidence of the expected positive GIR effect on admissions.

Explanatory Variables

A listing of explanatory variables is shown in Table 2. The input price measure is the average nursing wage level in the area where the hospital is located (NWAGE). Measures of the hospital's capital-stock are bed-days available (BDDYS) (i.e., average bed complement x 365) and the ratio of special care to total beds (SPECTRO). As a measure of teaching activity, we also include the number of approved residency positions per bed in the hospital (POSBED) {15}. (Data on numbers of residents actually filling these positions were not available for the full study period.)

Other explanatory variables include county population characteristics presumed to influence product-demand conditions (MEDAGE, HSIZE, HINC, PUBASST, and MCARE) and the estimated service area population (HPOP), which is the county population multiplied by the ratio of acute care beds in the hospital to acute care beds in the county {16}. To control for possible substitution or complementarity effects of other available health care resources, ACRATIO and MDPOP are included {17}.

The independent variables expressed in dollars (HINC and NWAGE) were deflated by a cost-of-living index. Index values were computed for the Baltimore area, for the

Washington suburban area in Maryland, and for all other parts of the state. While this deflation procedure controls for general economy-wide inflation, dummy variables for individual years are also included. Effects of technological change or other year-specific changes affecting all hospitals should be picked up by these dummy variables.

Three pairs of GIR variables were included. For all hospitals on the GIR for at least six months in a fiscal year, a GIR dummy (GIRSTAT) was set equal to 1.0. The coefficient of this variable measures the one-time impact of going on the GIR. To allow for the possibility that the initial GIR impact changed over time, the number of months during which the hospital was on the GIR (TIME) was included.

Differences between teaching and non-teaching hospitals in GIR impacts are captured by the coefficients of GIRTEACH and TIMTEACH. Such differences might be expected because clinical decisions in teaching hospitals are more likely to rest with physicians who are salaried hospital employees and, therefore, arguably more sensitive to the hospital's financial incentives.

The third pair of variables, also analogous to GIRSTAT and TIME, are CAP and CAPTIME. These only take on non-zero values for the three hospitals whose per case payment limit was not based on their own past experience because their cost per case figures were deemed excessive. For these hospitals, the per case payment limit imposed a more stringent financial constraint.

In addition, to capture the impact of going off the GIR system, the dummy variable ONOFF was set equal to 1.0 for each year in which a previously GIR hospital was off the system. Similarly, CAPOFF = 1 for 1981 for the two hospitals that went off the CAP; otherwise it equals zero.

Finally, note that other recent studies based on the same conceptual framework have assumed that case mix is exogenous {18}. This assumption may be justified on the grounds that case mix essentially reflects the facilities and services available at the hospital and that these are fixed in the short run. Alternatively, one might argue that case mix measures exogenous demand characteristics that are analogous to demographic and socio-economic characteristics of the population. While we obviously do not generally maintain the exogenous case mix assumption in our study, some length of stay models are estimated with our case mix variable (DRGMIX) included as a regressor.

Functional Form and Estimation Method

All regressions are estimated with the dependent and continuous independent variables entered in logarithmic form. Exceptions are POSBED, SPECRTO, TIME, TIMTEACH, and CAPTIME which are entered in linear form because of zero values for many data points.

To control for possible correlation of regression disturbances for the same hospital over time, we have employed the fixed-effects method of least-squares regression with pooled data. This method involves the inclusion of dummy variables for each hospital in the sample (save one if a constant term is also included). Coefficient estimates obtained with this method will not be biased by omitted hospital-specific characteristics that are stable over the study period. This is important in that these hospital characteristics may have been correlated with the GIR variable (since hospitals were not randomly selected for the GIR program). Bear in mind, however, that this method does not take into account autocorrelation due to auto-regressive disturbances, and that it is somewhat inefficient since any information from cross-sectional variation is not used in estimating the regression coefficients. Thus, it is a rather conservative method of measuring GIR effects in the sense that it will tend to yield less significant coefficient estimates than other methods which are more susceptible to omitted variable bias (19).

Length of Stay Regression Results

Estimated length of stay regressions with GIRSTAT, TIME and ONOFF included to capture overall average GIR effects are shown in Table 3. Regression (1) includes DRGMIX as an explanatory variable while regression (2) does not. In both instances, the three GIR variables do not approach statistical significance individually; joint F-tests of these variables are also insignificant. Among the other explanatory variables, BDDYS, HPOP, and DRGMIX have the most significant coefficients; these results seem plausible since they indicate that increases in bed complement (holding population constant), decreases in market area population (holding bed complement constant) and increases in case-mix costliness raise length of stay. The Medicare variable (MCARE) coefficient also becomes significantly negative when DRGMIX is dropped, presumably reflecting a negative partial correlation between DRGMIX and MCARE. (The zero-order correlation between these two variables is, however, +0.223.)

While the overall GIR results were not significant, regressions including other GIR variables indicated the possibility of more substantial length-of-stay effects for some groups of hospitals. When each of the eight GIR variables was entered as the sole GIR variable in our regression, with DRGMIX included, a significantly negative coefficient (-0.00253) with a (one-tailed P = 0.0137) was obtained for CAPTIME. When DRGMIX was excluded, significantly negative coefficients were obtained for CAPTIME and for TIMTEACH. (Coefficient values were -0.00296 and -0.00083 respectively while corresponding one-tailed P-values were 0.0053 and 0.0868.)

Results obtained when GIR variables are entered stepwise are shown in Table 4. In the first column of the table, with DRGMIX included, CAP enters with a significantly positive coefficient while the negative CAPTIME coefficient increses in magnitude. Since CAP only changed from 0 to 1 for one hospital over the study period, while it changed for

1 to 0 for two hospitals in 1981, its positive coefficient may be picking up the persistence of length-of-stay reductions as hospitals went off the CAP.

This accords with the result in column 2 that when CAPOFF is included, the positive CAP coefficient diminishes in size and becomes insignificant. A similar difference is observed when DRGMIX is not included in the regression (columns 3 and 4) but the positive CAPOFF coefficient does not become clearly insignificant.

Case-Mix Regression Results

As in the length of stay analysis, overall GIR effects as measured by the coefficients for GIRSTAT, TIME, and ONOFF in Table 5 are clearly not significant, though in this case all have negative signs. Among the other included variables, BDDYS and SPECRTO have highly significant positive coefficients; the former result suggests that increases in bed complement were accompanied by additions of equipment and more sophisticated treatment facilities. The availability of alternative facilities (ACRATIO) also has a positive impact on the case-mix index. The population variable (HPOP) is strongly negative, suggesting that as the demand for beds increases, reductions in length of stay are accompanied by relatively greater increases in less costly admissions. The Medicare and public assistance variables are also significantly negative.

When GIR variables are included one at a time in the case-mix regressions (Table 6), only the CAPTIME coefficient is strongly negative. This parallels the analogous length-of-stay result described above. The negative TIME coefficient implies a negative overall GIR effect but it is clearly less significant.

In the stepwise case-mix regressions shown in Table 7, CAPTIME continues to be significantly negative. Both CAP and CAPOFF are strongly positive. For the two hospitals going off the CAP in 1981, the values of CAPTIME in 1980 were 18 and 42. With the former value, the coefficients in column 3 of Table 7 imply virtually no change in DRGMIX from 1980 to 1981; with the latter value for CAPTIME, DRGMIX rises by about .05 when the hospital went off the CAP. Thus, the question of reversibility of the CAP effect is left in doubt by these findings.

Results_of_the_Admissions_Regressions

The admission regression in Table 5 shows significant coefficients for all three included GIR variables; a joint F-test of these variables was also significant. Two of these coefficients (for TIME and ONOFF) are in the hypothesized direction while the negative GIRSTAT coefficient is not. One possible explanation for this unexpected result is the non-random process by which hospitals were selected into the GIR. If a hospital had an unusually low volume of admissions in a particular year and this caused a large increase in unit costs and rates, this could have encouraged HSCRC staff to propose putting a hospital on the GIR.

Among the other explanatory variables, the bed complement, teaching activity, and market area population variables all had highly significant positive coefficients. The negative MCARE and SPECRTO coefficients were nearly significant.

Inclusion of GIR variables one at a time in the admissions regression yielded significant positive coefficients (as hypothesized) for TIME, TIMTEACH, and CAPTIME (Table 6). When additional GIR variables were entered stepwise (Table 7, columns 1 and 2), the positive CAPTIME result seems most robust.

Overview of Results and Concluding Remarks

In comparing the results of the various regressions and alternative specifications of the GIR variables, several conclusions emerge. First, the time-related GIR variables (TIME, TIMTEACH, and CAPTIME) tend to be more significant and to display coefficients with the expected sign than is true for the other GIR variables (GIRSTAT, GIRTEACH, CAP). Since the latter variables are more likely to be picking up unobservablle factors relating to selection into a particular payment status, and since it is plausible to assume that hospital responses to per case payment will be gradual (and thus time-related), rather than instantaneous, we view our results as providing fairly strong support for the general hypothesis that admissions, case-mix, and length of stay will be influenced by per case payment incentives.

Second, the estimated per case payment effects are strongest for the hospitals under the tightest fiscal constraint, that is, the CAP hospitals. In particular, CAPTIME coefficients are all highly significant, with expected signs, and large in magnitude. CAPTIME coefficients as large as .0025 (as shown in Tables 4 and 7) combined with a mean CAPTIME value for CAP hospitals of 26 months, imply an impact of about 7 per cent on the dependent variables. As we have previously observed, the greater impact on the CAP hospitals probably reflects a differential response of non-profit hospitals to financial incentives. Threats of substantial biases under a stringent payment mechanism (the CAP) appear to evoke a stronger response than do opportunities to earn positive net revenues (under the GIR in general).

Third, the results of our admissions analysis support the general proposition that per case payment systems are not immune from the possibility of perverse utilization responses. Thus, simply switching from per diem (or per service) to per case payments may not yield dramatic reductions in total costs and "unnecessary" utilization. Provision for utilization monitoring systems, such as the PROs under the Medicare PPS, may also be a key element of a successful cost control strategy. Comparison of per case versus per diem (or per service) systems should also extend to quality concerns if the per case limits are stringent. This point is amply illustrated by recent discussions of the Medicare PPS.

Finally, while our results may support more general conclusions about the relative merits of per case and per service payment systems, it is important to take note of a number of qualifications. First, the generalizability of our results to other states may be limited. When compared to experience in other states, the per service payment system in Maryland appears to be fairly stringent. Thus, the difference in incentives between the GIR and non-GIR hospitals might be less pronounced in comparison with the overall pressures for unit cost control imposed by the Maryland system on both GIR and non-GIR hospitals. Second, absence of clear overall GIR effects may be due in part to the fact that the length of time on the GIR for hospitals in the study was fairly short (averaging a little over two years). Subsequent research is now under way with a longer time frame of cost impacts. Third, the weak overall effects may reflect the conservative statistical procedures we have employed. The fixed-effects model tends to produce lower significance levels since it excludes information from cross-sectional variation in estimating the parameters of interest. This also makes estimation of differences in impacts among groups of hospitals more difficult. While it is necessary to use a number of GIR variables, to test for these differences in impacts (CAP vs. non-CAP, teaching vs. non-teaching), many of these variables will be strongly correlated with one another. Our ongoing research with a longer time series of data for Maryland will yield more powerful tests and also allow us to compare per-case and fixed-budget payment approaches.

Notes and References

1. Donna Kinzer and Michael Warner, "The Effect of Case-Mix Adjustment on Admission-Based Reimbursement," Health Services Research 18, 2 (Part I) (Summer 1983): 209-225.

2. Nancy L. Worthington and Paula Piro, "The Effects of Rate Setting Programs on Volumes of Hospital Services," Health Care Financing Review , 4, 2 (December 1982): 47.66.

3. James B. Lewis, "The Impact of the Maryland Health Services Cost Review Commission on Inpatient Ancillary Utilization," Sc.D. Thesis, Department of Health Policy and Management, The Johns Hopkins School of Hygiene and Public Health, Baltimore, Maryland (November 1985).

4. Glenn Melnick, John Wheeler, and Paul Feldstein, "Effects of Rate Regulation on Selected Components of Hospital Expenses," Inquiry 18, 4 (Fall 1981): 240-246.

5. Robert Seidman and Richard Frank, "Hospital Responses to Incentives in Alternative Reimbursement Systems," Journal of Behavioral Economics 14, (Winter 1985): 155-180; Graham Atkinson and Jack Cook, "Regulation: Incentives Rather the Command and Central," in Mancur Olsen (ed.), A New Approach to the Economics of Health Care (Washington, D.C.: American Enterprise Institute, 1981).

6. Fred Hellinger, "Recent Evidence on Case-Based Systems for Setting Hospital Rates," Inquiry 22, 1 (Spring 1985): 78-91.

7. Maryland Health Services Cost Review Commission,

Inflation Adjustment System (u.d.), Section II.D.

8. Maryland Health Services Cost Review Commission, Design of the Modified GIR and the Capitation Payment System for Application in Maryland. Report prepared under HCFA Contract 500-80-0044, 1982. See, in particular, Appendix D: "Methodology for Computing Prospective Rate Adjustments Under the Guaranteed Inpatient Revenue Program."

9. Assuming that the hospital's revenues are evenly split between routine and ancillary departments, its variable cost factor for the first 2 per cent increase in admissions would be 0.5; for the next 3 per cent increase its variable cost factor would be .7. The weighted average of these two factors is 0.62; applying it to the 5 per cent difference between actual revenue and allowable revenue under the GIR yields a bonus of 3.1 per cent.

10. Salkever, David S., Donald M. Steinwachs, and Agnes Rupp, "Hospital Cost and Efficiency Under Per Service and Per Case Payment in Maryland: A Tale of the Carrot and the Stick", Inquiry 23, 1, (Spring, 1986): 56-66, Rupp, Agnes, Donald M. Steinwachs, and David S. Salkever, "The Effect of Hospital Payment Methods on the Pattern and Cost of Mental Health Care", Hospital and Community Psychiatry, 35, 5, (May, 1984):456-459, and Rupp, Agnes, Donald M. Steinwachs, and David S. Salkever, "Hospital Payment Effects on Acute Inpatient Care for Mental Disorders", Archives of General Psychiatry, 45, (June, 1985): 552-555.

11. Sloan, Frank, Roger Feldman and A. Bruce Steinwald, "Effects of Teaching on Hospital Costs," Journal of Health Economics 2, 1, (March 1983): 1-28.

12. Wilensky, Gail Roggin and Louis F. Rossiter, "The Magnitude and Determinants of Physician-Initiated Visits in the United States" in J. Van der Gaag & M. Perlman (eds.) Health, Economics, and Health Economics , North-Holland Publishing Company, 1981 and Pauly, Mark V. Doctors and Their Workshops , National Bureau of Economic Research Monograph, The University of Chicago Press, 1980.

13. Carter, Grace M. and Paul B. Ginsburg. The Medicare Case Mix Index Increase: Medical Practice Changes, Aging, and DRG Creep , Rand Corporation Report R-3292-HCFA, June 1985.

14. Because the HSCRC substantially restricted internal cross-subsidization in its rate-setting policies, the correlation between costs and charges for specific services should be much higher in Maryland than elsewhere during this study period. This makes more tenable our assumption that our case-mix index based on charges in fact measures the costliness of the hospital's case mix.

15. Hospital characteristics such as bed size and teaching programs may also be influenced by payment systems. Thus, GIR effects with our short-run model may differ from longer-term effects if the GIR system impacts on these

characteristics. There is also a potential econometric problem of simultaneity bias if these hospital characteristics are influenced by the disturbance term; however, the short time period covered by our study and the inclusion of hospital-specific dummy variables to control for omitted but stable hospital-specific effects should mitigate this problem considerably.

16. Note that this measure increases as the hospital increases its bed stock (unless there are no other hospitals in the county) and decreases as other hospitals in the county expand their bed stock.

17. Lower values of ACRATIO and higher values of MDPOP are indicative of greater availability of other health care resources. With HPOP and BDDYS already included in our regressions, we assume in effect that physicians are distributed among hospital service areas within the county in proportion to HPOP while non-acute beds (e.g., ECF's, chronic care hospitals) are distributed in proportion to BDDYS.

18. Edmund R. Becker and Frank A. Sloan, "Utilization of Hospital Services: The Role of Teaching, Case Mix and Reimbursement," Inquiry 20:3 (Fall 1983) 248-257; Frank A. Sloan and Edmund R. Becker, "Internal Organization of Hospitals and Hospital Costs," Inquiry 18:3 (Fall 1981) 224-239; and Sloan, Feldman and Steinwald, op. cit..

19. See R. Pindyck and D. Rubinfeld, Econometric Models and Economic Forecasts , 2nd edition (New York: McGraw Hill, 1981), Chapter 9 and Y. Mundlak, "On the Pooling of Time Series and Cross Section Data," Econometrica 46 (January, 1978): 69-85.

20. Evidence of negative impact on cost per case in Maryland was somewhat weaker. See Craig Coelen and Daniel Sullivan, "An Analysis of the Effects of Prospective Reimbursement Programs on Hospital Expenditures," Health Care Financing Review 2, 3 (Winter 1981):1-40.

21. Recent evidence, however, suggests that our conclusions at least generalize to the experience in one other state, New Jersey. Rosko and Broyles report that the introduction of per case payment in that state produced decreases in length of stay and cost per case; however, most of the cost savings from these impacts were offset by a significant increase in numbers of admissions. Michael P. Rosko and Robert W. Broyles, "Does Prospective Payment Contain Hospital Costs?" Paper presented at the Western Economic Association Conference, San Francisco, July 1, 1986.

TABLE 1: Percent Changes in Average Dependent Variable Values by GIR Status: 1977-79 and 1979-81

GIR Status	LOS		Case-Mix		Admissions	
	1977-79	1979-81	1977-79	1979-81	1977-79	1979-81
CAP (n=3)	+5.14	-12.03	-5.50	-1.94	+3.62	+0.28
On GIR Since 1977 (n=3)	+0.37	-0.86	-9.80	-1.09	+5.68	+9.15
On GIR Since 1978 (n=5)	-2.36	+3.85	-6.19	0	+1.16	+2.94
On GIR Post-1978 (n=5)	+5.40	-0.12	-6.86	-2.11	+5.60	-3.57
On-Off (n=6)	-0.14	+2.85	-6.25	0	+1.66	-3.36
Non-GIR (n=24)	+4.08	-0.37	-5.00	+1.05	+2.97	+4.70
Total (n=46)	+2.33	-1.92	-6.93	0	+3.70	+1.44

Table 2: Definitions of Explanatory Variables

Name	Definitions	Name	Definitions
BDDYS	Acute care bed-days available in the hospital	MDPOP	Ratio of patient-care physicians in office-based practice to population in the county
SPECRTO	Ratio of special care beds to total acute care beds in the hospital	NWAGE	General duty nurse wage in the area, deflated
POSBED	Positions in approved residency programs per available acute care bed-day in the hospital	GIRSTAT	=1 if a hospital is on the GIR for at least six months of the fiscal year; =0 otherwise
DRGMIX	Case-mix costliness index value for the hospital	GIRTEACH	=1 if GIRSTAT =1 and the hospital has any appro residency programs; =0 otherwise
MEDAGE	Median age of county population	TIME	Time in months from date the hospital went on the GIR to the midpoint of the fiscal year (if GIRSTAT = 1); =0 otherwise
HSIZE	Mean number of persons per household in country	TIMTEACH	=GIRTEACH * TIME
HINC	Median county household income, deflated	CAP	=1 if GIRSTAT =1 and the hospital's per case rate is based on an external CAP
PUBASST	Ratio of county AFDC, general assistance, and SSI recipients to county population	CAPTIME	Time in months from the date the hospital went on the CAP to the midpoint of the fiscal year (if CAP = 1); =0 otherwise
MCARE	Ratio of county Medicare aged and disabled enrollees in Part A or Part B to county population	ONOFF	=1 if the hospital was not on the GIR for six months of the fiscal year but had been previously; =0 otherwise
HPOP	Estimated population in hospital market area	CAPOFF	=1 if CAP =0 for the current fiscal year and CAP =1 for any previous fiscal year
ACRATIO	Ratio of acute care bed days to total bed days available in the county		

Table 3: Regression Results for Length of Stay

Indep. Vbles.[a]	(1) Coeff.	(1) P[b]	(2) Coeff.	(2) P[b]
GIRSTAT	0.02511	0.2019	0.02333	0.2445
TIME	-0.00063	0.3266	-0.00080	0.2237
ONOFF	0.03612	0.2383	0.02963	0.3411
BDDYS	0.36721	0.0000	0.40695	0.0000
SPECTRO	0.17464	0.6548	0.33520	0.3952
POSBED	-54.23213	0.6283	-90.06446	0.4278
NWAGE	-0.07097	0.8271	0.03182	0.9230
MDPOP	-0.00752	0.9284	-0.01096	0.8978
ACRATIO	-0.04633	0.8192	0.02153	0.9164
HPOP	-0.19466	0.0553	-0.23492	0.0223
MCARE	-0.33555	0.1487	-0.46442	0.0460
PUBASST	0.10997	0.1929	0.03775	0.6441
HINC	0.11585	0.6627	0.18857	0.4844
HSIZE	-0.26006	0.3915	-0.31710	0.3048
MEDAGE	0.23904	0.6843	0.42038	0.4807
DRGMIX	0.36682	0.0063		

[a] All regressions reported here and in subsequent tables include separate intercepts for each hospital and each year. All continuous dependent and independent variables are expressed as logarithms except for SPECRTO, POSBED and GIR-related time variables.

[b] All P-values reported here and below are two-tailed.

Table 4 : Length-of-Stay Regression Results for GIR Variables
(Two-tailed P values in parentheses)

	(1)	(2)	(3)	(4)
CAPTIME	-0.00404 (0.0021)	-0.00401 (0.0057)	-0.00466 (0.0004)	-0.00473 (0.0012)
CAP	0.11108 (0.0210)	0.07090 (0.2791)	0.12963 (0.0070)	0.10664 (0.1005)
CAPOFF		-0.05002 (0.4618)		-0.03334 (0.6251)
GIRSTAT		0.00122 (0.9690)		0.00088 (0.9779)
GIRTEACH		0.01264 (0.7546)		0.00488 (0.9043)
TIME		0.00078 (0.5439)		0.00036 (0.7826)
TIMTEACH		-0.00093 (0.5237)		-0.00043 (0.7702)
ONOFF		0.03171 (0.2824)		0.02398 (0.4196)

Table 5: Regression Results for Admissions and Case-Mix

Dep. Vble.	Admissions		Case-Mix	
Indep. Vbles.	Coeff.	P	Coeff.	P
GIRSTAT	-0.05137	0.0153	-0.00485	0.6742
TIME	0.00172	0.0133	-0.00045	0.2338
ONOFF	-0.07320	0.0259	-0.01770	0.3237
BDDYS	0.48333	0.0000	0.10834	0.0349
SPECRTO	-0.64140	0.1220	0.43772	0.0550
POSBED	331.296	0.0060	-97.68440	0.1363
NWAGE	0.23930	0.4889	0.28022	0.1409
MDPOP	-0.01773	0.8431	-0.00937	0.8489
ACRATIO	-0.25825	0.2314	0.18501	0.1189
HPOP	0.37223	0.0006	-0.10975	0.0630
MCARE	-0.35942	0.1401	-0.35132	0.0091
PUBASST	-0.02370	0.7822	-0.19689	0.0000
HINC	0.21715	0.4429	0.19823	0.2027
HSIZE	-0.08927	0.7828	-0.15547	0.3822
MEDAGE	-0.29600	0.6360	0.49436	0.1510

Table 6: Results for Single GIR Variables with P < 0.2 in Admissions and Case-Mix Regressions

Dep. Vble.	Admissions		Case-Mix	
Indep. Vbles.	Coeff.	P	Coeff.	P
TIME	0.00121	0.0333	-0.0078	0.1849
TIMTEACH	0.00146	0.0249		
CAPTIME	0.00254	0.0419	-0.00132	0.0487
ONOFF	-0.06035	0.0374		

Table 7 : Admission and Case-Mix Regression Results for GIR Variables (Two-tailed P values in parentheses)

Dep. Vble.:	Admissions		Case Mix		
Indep. Vbles.					
CAPTIME	0.00215 (0.0829)	0.00273 (0.0737)	-0.00191 (0.0137)	-0.00194 (0.0116)	-0.00210 (0.0113)
CAP		-0.07337 (0.2910)	0.08397 (0.0157)	0.10103 (0.0055)	0.11075 (0.0036)
CAPOFF		-0.03471 (0.6331)	0.04799 (0.2030)	0.06542 (0.0952)	0.06539 (0.0978)
GIRSTAT	-0.03738 (0.0491)	-0.04452 (0.1914)			0.00480 (0.7966)
GIRTEACH		0.00883 (0.8396)		-0.02093 (0.1169)	-0.03330 (0.1616)
TIME		0.00108 (0.4378)			-0.00099 (0.1948)
TIMTEACH	0.00136 (0.0474)	0.00022 (0.8875)			0.00121 (0.1664)
ONOFF	-0.07422 (0.0180)	-0.06885 (0.0312)			-0.01717 (0.3280)