Prospective payment system and other effects on post-hospital services

by Frank D. Gianfrancesco

The effects of the prospective payment system and other factors on the use of post-hospital services were investigated for four groups of diagnostically related Medicare discharges. Effects on specific services and total Medicare payments were analyzed at the beneficiary level using a Tobit regression technique. The utilization data base consisted of more than 30,000 discharge episode records for the years 1981-86. The post-hospital period for each Medicare beneficiary encompassed the 60 days following discharge from the hospital. Influences on both the level and timing of health care services during this period were appraised. The influence of the prospective payment system was measured through the financial impact and risk that it imposed on the discharging hospital.

Introduction

Under Medicare's prospective payment system (PPS), hospitals are paid a predetermined amount per Medicare discharge. This departure from cost-based reimbursement may give hospitals an incentive to economize on inpatient services. During the several studies conducted to investigate the early effects of PPS on hospital inpatient use, it was found that shorter lengths of stay were induced (Guterman and Dobson, 1986; Feder, Hadley, and Zuckerman, 1987; and Gianfrancesco, 1987). Shortened lengths of stay and other reductions in inpatient care induced by PPS may, in turn, have resulted in a more intensive use of post-hospital services. Later evidence, however, suggests that the initial effects of PPS on inpatient care may have been transitory (Prospective Payment Assessment Commission, 1988; Gianfrancesco, 1988). Changes in the use of post-hospital services under PPS may have also been brought about by changes in hospital case mix. For example, evidence exists that PPS (or the tighter peer review that accompanied it) initially encouraged lower admission rates, implying higher proportions of more serious cases. Such cases are likely to consume larger volumes of post-hospital care.

Effects of PPS and other factors on post-hospital care were estimated by applying a Tobit regression technique to discharge episode data for the years 1981-86. This period consists of approximately 3 pre- and 3 post-PPS years. Efforts were made to control for differences in use because of changes in hospital case mix. This was in part achieved through separate analyses of specific diagnostic groups. Post-hospital use of services was investigated for four diagnostic categories: pneumonia; stroke; hip replacement, arthritis; and hip replacement, fracture. To further control for changes in hospital case mix, indicators of case severity were specified in the regressions.

The following types of post-hospital care were analyzed at the beneficiary level: care in skilled nursing facilities (SNFs), home health services, non-inpatient physician services, use of durable medical equipment (DME), and rehospitalizations. Total post-hospital care per discharge, measured in Medicare payments per discharge, was also subjected to analysis. Beneficiary use of post-hospital services was appraised for the 60-day period following discharge from the hospital; PPS and other effects on both the level and timing of each service were estimated.

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Earlier evidence

Several studies have been done in which the effects of PPS on post-hospital care were investigated. For the most part, these provide only indirect evidence in that no attempts were made to link the various health care services to hospital stays. Also, the evidence is essentially descriptive, relying on pre- and post-PPS comparisons. The following summarizes the findings from these studies.

Guterman and Dobson (1986) reported statistics on the use of SNF, home health, and hospital outpatient services for the period before the Tax Equity and Fiscal Responsibility Act (TEFRA) through the first year of PPS. When measured in real terms, annual rates of increase for SNF and home health services for the first PPS year (1983-84) exceeded those for the pre-TEFRA period (1973-82). However, they were lower than those for the TEFRA year (1982-83). Annual rates of increase for outpatient hospital and physician services were markedly lower for the first PPS year than for the pre-TEFRA period.

DesHarnais et al. (1987) looked at the destination of Medicare patients upon discharge from the hospital. The proportions of cases discharged to SNFs, home health care, and rehospitalization were investigated. Actual proportions for the first PPS year were compared with predicted values extrapolated from 1980-83 trends. Although the actual proportions were all greater than the predicted, the difference was statistically significant only for home health care.

A similar study was undertaken by Long et al. (1987). The principal difference between this and the preceding study is that some attempt was made to hold constant the effects of case mix on post-hospital use of services. In their findings, Long et al. showed that changes in the proportions of cases discharged to SNFs and home health care were positive and considerably larger in the first PPS year than in the preceding years (1980-83). No tests for statistical significance were made.

Lewis et al. (1987) focused on changes in the composition of SNF admissions under the PPS. Three data samples, all from southern California, were compared. These included two pre-PPS samples (1980 and 1982-83) and one for the first PPS year (1984). Their findings contained evidence of a dramatic increase during the first PPS year in the proportion of SNF admissions that were Medicare beneficiaries.

In another study, Lyles (1986) investigated the impact of PPS on nursing home use in Oregon. Although SNFs were included, the nursing home data were mostly for intermediate care facilities. Changes in use that occurred during 1982-83 were compared with changes that occurred during 1983-84. The percent change in total admissions was considerably greater during the 1983-84 period, and the percent change in total patient days was considerably lower.

Fisher (1987) compared pre-PPS (1982) and post-PPS (1985) distributions of physician charges among the various health care settings. The results were that physician inpatient charges declined significantly as a percent of the total, and those in other settings increased.

A study by Weinberger, Ault, and Vinicor (1988) focused on a single diagnosis, diabetes mellitus. Post-hospital use of services was compared for two cohorts of patients, one pre-PPS (1981) and the other, post-PPS (1983-84). The results were that there were more clinic visits, emergency room visits, and hospital readmissions among the post-PPS cohort.

Of the earlier studies of post-hospital care under PPS, that by the RAND Corporation is the most thorough (Neu and Harrison, 1988). This study was based on 1981 and 1984-85 samples of Medicare beneficiaries. Post-hospital use of SNF and home health services was compared for the two periods. SNF services were directly linked to the hospital stay (i.e., that qualifying beneficiaries for Medicare coverage), and the home health services linked to the hospital stay varied, depending on what post-hospital period (60 or 190 days) was specified. Also, to limit the effects of changes in hospital case mix between 1981 and 1984-85, post-hospital use of the services mentioned was investigated separately for selected diagnosis-related groups (DRGs). (Changes in the DRG composition of the Medicare hospital population seem to have accounted for most of the changes in post-hospital care between the two periods.) The proportions of cases within each DRG using SNF or home health services were generally higher under PPS. However, SNF days per beneficiary were considerably lower, whereas home health visits per beneficiary were considerably higher. It was also revealed from these findings that there was little correlation between the use of SNF and the use of home health services.

A major limitation of the studies just mentioned is that they are essentially descriptive, and no attempt was made to define and test for a structural relationship between PPS and the use of post-hospital care. The author of this study provides a conceptual framework for understanding the effects of PPS on these services and tests this framework using regression techniques.

Conceptual framework

PPS was perceived as having two potentially conflicting effects on the substitution of post-hospital care. The first arises from its financial impact on the discharging hospital. Under PPS, a hospital may experience an increase or decrease in its overall operating ratio, depending on whether it incurs a Medicare gain or loss.[1]

The incentive to economize on inpatient care and substitute post-hospital services was reasoned to be negatively related to this financial impact. Hospitals experiencing decreases in their overall operating ratios would have more incentive to substitute post-hospital services, and those experiencing increases would have less incentive. Although this symmetrical behavior is inconsistent with profit maximization, hospitals for the most part are not profit maximizers. They are more accurately described as quantity or quality maximizers whose financial objectives may be simply to break even. If this is the case, then a financial gain under PPS would relax the incentive to substitute post-hospital care whereas a financial loss would intensify it.

The second effect of PPS derives from the financial risk that it imposes on the discharging hospital. Financial risk is greater for hospitals that are more dependent on Medicare patient volumes. Any change in payment policy under PPS would have larger effects on the overall operating ratios of these institutions relative to those of hospitals that are less Medicare dependent. Therefore, the range over which a hospital's overall operating ratio can vary under PPS depends on the relative importance of its Medicare business. The effect of PPS on a hospital's overall operating ratio depends on both the size of the hospital's Medicare gain or loss and the relative importance of its Medicare business. Therefore, a hospital with a large Medicare gain or loss and low Medicare dependence can experience the same financial impact as one with a small gain or loss and high dependence. However, the range of potential increase or decrease in its overall operating ratio is greater for the hospital that is more dependent on Medicare. Hospitals more dependent on Medicare and, thereby, at greater risk from PPS, may be more inclined to economize on inpatient services so as to reduce the possibility of large negative financial impacts.[2] To the extent that post-hospital services substitute for inpatient care, their use would be positively influenced by the risk that PPS imposes on the discharging hospital. Under the cost-based reimbursement that preceded PPS, Medicare dependence did not have risk implications of the kind described here.

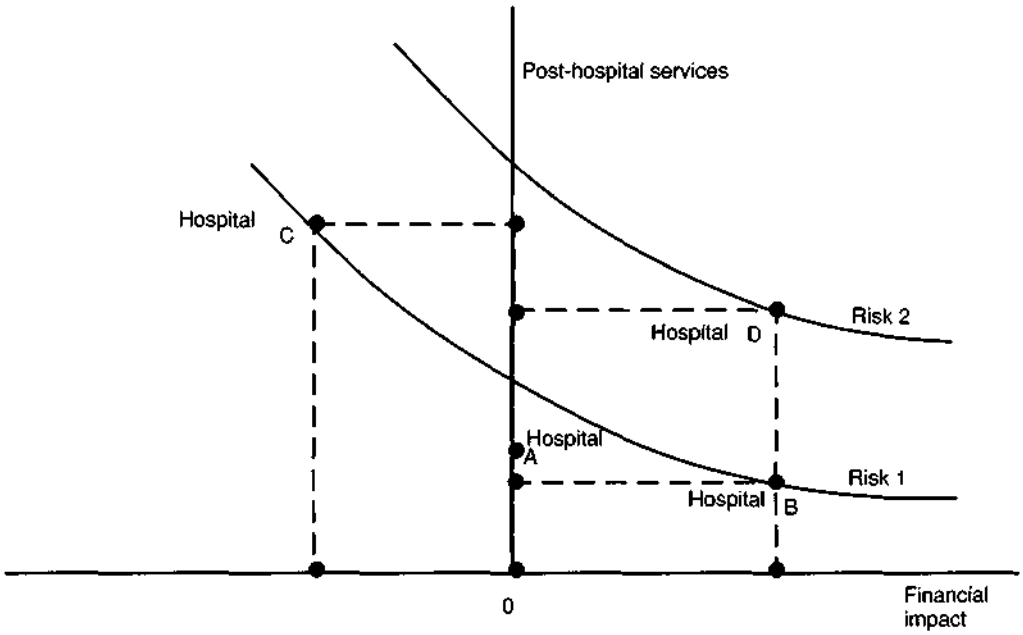
Shown in Figure 1 is the assumed relationship between the use of post-hospital care and the influence of PPS on the discharging hospital. Post-hospital use is measured on the vertical axis, and the financial impact of PPS is measured on the horizontal axis. Differing levels of risk

[1] A hospital's overall operating ratio is calculated as (total revenue − total cost)/total revenue, and the increase or decrease in this ratio attributable to a Medicare gain or loss is (Medicare revenue − Medicare cost)/total revenue.

[2] This behavior is consistent with risk aversion.

Figure 1

Assumed relationship between use of post-hospital services and the effects of the prospective payment system on the discharging hospital



SOURCE: Gianfrancesco F., Abt Associates, Inc., Cambridge, Massachusetts, Dec. 1988.

imposed by PPS are represented by curves Risk 1 and Risk 2, with the latter reflecting the higher risk associated with greater Medicare dependence. The downward slopes of these curves indicate the negative relationship between the use of post-hospital care and the financial impact of PPS. In the absence of PPS—i.e., under cost-based reimbursement—there would be no effects on hospital operating ratios, and Medicare dependence would pose no risks of the kind described here. Hospital A represents this situation. Different situations under PPS are represented by hospitals B, C, and D.

Hospitals B and C are characterized by the same Medicare dependence and face the same risk from PPS. However, the actual financial impact of PPS differs for each (because of differences in efficiency, for example). Hospital B experiences an increase in its overall operating ratio, and hospital C experiences a decrease. The assumed incentives are such that C substitutes more post-hospital care than B. Alternatively, hospitals B and D experience the same financial impact of PPS but face different risks, hospital D being more dependent on Medicare. Because of this greater risk, D also substitutes more post-hospital care than B. Thus, the impact of PPS on the use of post-hospital care is assumed to depend on the net effect of these two potentially conflicting influences.

Data

The principal data used in this study are from the Tracer Discharge Episode Files constructed by Abt Associates, Inc. (as part of the *Prospective Payment and Analytic Support Studies* performed under contract for the Health Care Financing Administration (HCFA). There were four episode files to draw from, each containing health service use and other data for diagnostically related Medicare discharges. The diagnostic groups represented by the files are pneumonia, stroke, hip replacement, and hernia. Episodes for the hernia group showed little post-hospital care and, for this reason, were excluded from the analysis. Each of the three remaining groups contained multiple DRGs. To attain a higher degree of within-group homogeneity, one or two DRGs were selected from each group. Hip replacement cases were also divided into two subgroups: arthritis-related and fracture-related. The resulting four groups consist of the following DRGs or DRG parts:

- Pneumonia: DRGs 89 and 90 (all primary diagnoses).
- Stroke: DRG 14 (all primary diagnoses).
- Hip replacement (arthritis): DRG 209 (all principal procedures from the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM), beginning with 715).
- Hip replacement (fracture): DRG 209 (all ICD-9-CM principal procedures beginning with 80-829).

The effects of PPS and other factors on post-hospital use were analyzed separately for each of these groups. The selection of specific DRGs or DRG parts enabled better control, though still imperfect, for temporal and cross-sectional variations in hospital case mix.

Each of the four diagnostic groups consisted of several thousand episodes. These occurred within the period 1981-86, which consists of approximately 3 pre-PPS and 3 post-PPS years. Specifically, there were 8,815

pneumonia episodes, 6,993 stroke, 7,138 hip replacements (arthritis), and 9,713 hip replacements (fracture). Episodes were constructed by first selecting random samples (pneumonia and stroke) or the universe (hip replacement) of hospital discharges from each year's 5-percent Medicare provider analysis and review (MEDPAR) extract file.[3] Using each beneficiary's hospital stay as a starting point, use of other health care services was determined for the 60 days following discharge and for the 60 days preceding admission. These determinations were made by linking to MEDPAR records beneficiary claims data contained in other files.

Several types of health service use data were contained in each episode record, including inpatient hospital use from the MEDPAR files (for all stays during the episode); SNF use from the SNF stay files; home health use from the Home Health Agency Bill Record Files; physician, DME, and all other noninstitutional use from the 5-percent Part B Payment Record files; and hospital clinic and emergency room use from the 5-percent Part B Outpatient Bill Records files. Use was measured in physical units when available and otherwise in charges. Provider charges and Medicare payments were indicated for all services. Clinic and emergency room visits were excluded from the analysis because extremely low mean values and wide year-to-year fluctuations made the data highly suspect.[4]

As indicated, an episode is defined to begin 60 days before the admission date for the sampled hospital stay and to end 60 days after the discharge date. Use data were recorded for the focal hospital stay, for the 60- and 30-day periods before the admission date and for the 7-day, 14-day and 60-day periods after the discharge date. This breakdown enabled measurement and analysis of the timing as well as the volume of post-hospital care.

In addition to use data, the episode records contained descriptive information pertaining to the beneficiary and the discharging hospital. Other data, however, were also necessary to construct measures of PPS influence and, in general, to more fully specify the regression models. These data were taken from Medicare Cost Reports, the PPS Impact File, surveys of the American Hospital Association, the Area Resource File, the 1981-86 Basic Economic Activity Area (BEAA) Quarter Per Capita File, and other sources available at Abt Associates, Inc.

Measures of post-hospital service use

Several measures of post-hospital service use were analyzed. These reflect both the volumes of services consumed during the 60-day period following discharge and their timing. PPS may have affected not only the level of post-hospital care but also its timing. Hospitals at greater risk and experiencing financial losses under PPS, as argued, would be more likely to substitute post-hospital services for inpatient care. This substitution might be reflected in more immediate as well as higher levels of use. In contrast, hospitals at lower risk and experiencing financial gains would be less likely to substitute post-hospital care, and this would have the opposite effect on the level and timing of these services. The following measures were subjected to analysis.

Skilled nursing facility days—total SNF days used by each beneficiary during the post-60-day period.

Skilled nursing facility timing—the timing of SNF use measured by the ratio of SNF days in the post-14-day period to those in the post-60-day period.

Home health visits—total home health visits used by each beneficiary within the post-60-day period.

Home health timing—the timing of home health use measured as described previously.

Physician charges—total noninstitutional physician charges for each beneficiary during the post-60-day period. All charges were expressed in 1981 dollars and standardized for cross-sectional differences. A Consumer Price Index was available for each county and each year (1981-86) from Abt's Area Resource File. This enabled deflation of all charges to their 1981 levels. Deflated charges were then divided by the 1984 Medicare wage index (applicable to each county) to adjust for cross-sectional differences in prices. The county used in making these adjustments was the beneficiary's county of residence.

Physician timing—the timing of physician charges measured as described previously.

Durable medical equipment charges—total DME charges for each beneficiary within the post-60-day period. All charges were expressed in 1981 dollars as described previously.

Durable medical equipment timing—the timing of DME charges measured as described previously.

Rehospitalization days—total rehospitalization days per beneficiary within the post-60-day period.

Rehospitalization timing—the timing of rehospitalization days as measured previously.

Medicare payments—total Medicare payments for each beneficiary for all post-hospital services used during the post-60-day period. Total payments were expressed in 1981 dollars and adjusted for cross-sectional differences as described previously.

Table 1 contains, for each of the four diagnostic groups and each of the years 1981-86, mean quantities of the just mentioned services used during the 60 days following hospital discharge. Medicare payments for post-hospital services generally increased during the period, as did home health visits and physician and DME charges. Patterns for SNF and rehospitalization days are mixed, varying by diagnostic group. It is impossible, however, to determine from the descriptive evidence if and to what extent trends in post-hospital use were influenced by PPS.

Regression model

To isolate the effects of PPS and other factors for each diagnostic group, Tobit regression models were estimated for the several measures of post-hospital use. Because high proportions of beneficiaries did not use specific post-hospital services, the data contained a large number of

[3]Beneficiaries represented in the MEDPAR extract file correspond to those in other 5-percent files.

[4]Mean post-hospital clinic and emergency room visits were generally between 0.05 and 0.10. This is unrealistic and sharply contrasts with the mean values observed for other post-hospital services (Table 1).

Table 1

Mean values of individual use of post-hospital service during 60-day period following hospital discharge, diagnostic group: 1986

Diagnostic group and service	1981	1982	1983	1984	1985	1986
Pneumonia			Mean value			
Skilled nursing facility days	0.7	0.8	0.6	0.6	0.9	0.8
Home health visits	1.2	1.3	1.7	2.1	2.2	2.2
Physician charges	32	37	43	49	55	56
Durable medical equipment charges	23	28	37	46	57	59
Rehospitalization days	1.2	1.6	1.5	1.3	1.3	1.4
Medicare payments	$503	$613	$646	$692	$739	$813
Stroke						
Skilled nursing facility days	4.5	4.6	5.3	5.2	4.7	4.0
Home health visits	3.5	4.7	5.4	6.2	6.4	6.2
Physician charges	36	42	45	50	55	59
Durable medical equipment charges	25	32	41	50	52	53
Rehospitalization days	2.9	3.5	3.6	3.9	4.0	4.4
Medicare payments	$1,100	$1,357	$1,550	$1,704	$1,745	$1,825
Hip replacement, arthritis						
Skilled nursing facility days	1.0	1.1	1.1	1.1	1.3	1.2
Home health visits	2.1	3.1	4.1	4.8	5.1	5.3
Physician charges	29	29	37	40	45	44
Durable medical equipment charges	11	15	18	25	32	28
Rehospitalization days	1.1	1.2	1.1	.9	1.0	1.2
Medicare payments	$465	$580	$634	$672	$746	$811
Hip replacement, fracture						
Skilled nursing facility days	7.6	8.1	8.9	8.8	7.9	7.5
Home health visits	3.7	5.0	5.4	6.2	6.6	6.6
Physician charges	41	47	41	55	55	61
Durable medical equipment charges	20	31	27	37	45	41
Rehospitalization days	1.3	1.7	1.3	1.4	1.4	1.7
Medicare payments	$868	$1,046	$1,040	$1,200	$1,224	$1,351

SOURCE: Tracer Discharge Episode Files (1981-86), Abt Associates, Inc., Cambridge, Massachusetts.

observations with zero values and were not normally distributed. The application of standard regression techniques (ordinary least squares) to such data would have generated biased results. A Tobit regression model corrects for these data characteristics (Maddala, 1983).

The principal explanatory variables reflect the risk and financial impact imparted by PPS on the discharging hospital. These effects, which could have potentially conflicting influences on the use of post-hospital care, were captured by the following measures.

Financial impact

The financial impact of PPS on the discharging hospital was measured by the increase or decrease in its overall operating ratio that it was projected to experience under the fully implemented PPS. To obtain a more accurate measure of financial impact, the projected ratio was calculated assuming that the hospital did not modify its costs and patient volumes in response to PPS.[5] If the discharge occurred prior to the implementation of PPS or was from a hospital not subject to PPS, this measure had a value of zero, reflecting cost-based reimbursement. Operating ratio increases under PPS were assumed to dampen incentives to substitute post-hospital care and decreases, to reinforce incentives.

Risk

PPS risk faced by the discharging hospital was captured by its (1984) ratio of Medicare discharges to total discharges, that is, its Medicare dependence. If a hospital was not subject to PPS or a discharge occurred prior to its implementation, this measure was given a value of zero. In the absence of PPS (under cost-based reimbursement), Medicare dependence has no risk implications. Greater Medicare dependence was expected to positively influence the use of post-hospital services.

In addition to the effects of PPS on the discharging hospital, several other factors were expected to influence beneficiaries' use of post-hospital services. The measures specified in the regression models to capture these influences are summarized in the following.

Case severity

Differences in case severity among the beneficiaries in each diagnostic group were captured by a set of variables reflecting each beneficiary's use of health care services in

[5]The impact of PPS on each hospital's overall operating ratio is (Medicare revenue − Medicare cost)/total revenue. Medicare revenues were based on payments that would exist under the fully implemented PPS and on pre-PPS (TEFRA period) patient volumes, e.g., lengths of stay. Medicare costs reflect pre-PPS patient volumes and costs per day. The use of pre-PPS values allows for a more accurate assessment of the financial impact of PPS because it adjusts for hospital behavioral responses to PPS that would obscure this effect.

Table 2

Individual use of post-hospital skilled nursing facility care: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	SNF days	SNF timing	SNF days	SNF timing	SNF days	SNF timing	SNF days	SNF timing
Prospective payment system								
Risk	—	—	***25.846	**.360	—	—	***13.954	***.303
	—	—	(9.034)	(5.633)	—	—	(15.869)	(14.745)
Financial impact	—	—	—	—	*–30.997	*–1,489	*–17.029	*–.38
	—	—	—	—	(3.086)	(3.657)	(3.274)	(3.240)
Case severity								
Pre-adm HOSP days	**2.156	—	—	—	—	—	**.559	*.011
	(3.603)	—	—	—	—	—	(4.947)	(3.587)
Pre-adm SNF days	***.779	***.024	—	—	***.746	***.034	***.435	***.008
	(35.761)	(33.235)	—	—	(13.157)	(14.306)	(31.780)	(19.824)
Pre-adm HH visits	—	—	—	—	*.007	—	***.344	**.005
	—	—	—	—	(3.750)	—	(12.906)	(5.625)
Pre-adm PHYS charges	***1.731	***.049	*.850	—	—	—	***.518	***.011
	(11.178)	(8.552)	(2.937)	—	—	—	(7.106)	(6.482)
Pre-adm DME charges	—	—	—	—	*.331	*.012	***–.613	***–.012
	—	—	—	—	(3.726)	(2.797)	(19.099)	(13.853)
Demand								
Age	***1.500	***.048	***1.222	***.020	***1.649	***.069	***1.025	***.020
	(63.853)	(58.333)	(81.856)	(75.918)	(141.290)	(127.154)	(271.895)	(205.912)
Sex (1 = male)	—	—	***–7.730	***–.103	***–12.866	***–.590	—	**–.057
	—	—	(12.789)	(7.430)	(47.370)	(50.241)	—	(4.010)
RaceA	—	—	—	—	*–6.689	—	**6.344	**.122
	—	—	—	—	(2.695)	—	(5.188)	(3.819)
RaceB	—	—	—	—	**–14.637	*–.554	—	**–.207
	—	—	—	—	(4.765)	(3.283)	—	(4.989)
Income	—	—	—	—	—	—	***.882	***.024
	—	—	—	—	—	—	(10.768)	(15.738)
Geographic								
Isolation	—	—	—	—	—	—	—	—
Rural-Urban Migr	—	—	—	—	**5.038	**.188	**2.944	*.044
	—	—	—	—	(5.739)	(4.100)	(5.956)	(2.636)

See footnotes at end of table.

the 60-day period preceding the focal hospital stay. The more serious cases within each diagnostic group were reasoned to consume relatively high levels of care in the pre-60-day period, thus, the rationale for using these measures as indicators of case severity. To adjust for the effects of supply constraints on the levels of these services, each beneficiary's use of a service during the pre-60-day period was divided by the average pre-60-day use of that service for all beneficiaries within the same diagnostic group and State and with the same year of discharge. Case severity was expected to exert a positive influence on post-hospital care.

Demand

The use of post-hospital care may also be explained by other beneficiary characteristics that influence demand. These include age, sex, race, and income. A positive relationship was expected between age and post-hospital use, whereas the effects of sex and race were uncertain. Race was included to capture cultural, social, and economic influences on the use of post-hospital services. Although the relationship between income and post-hospital use was expected generally to be positive, it would also depend on the type of care. Some types of care might be inferior substitutes for others and, thus, would bear a negative relationship with income.

Geographic

Measures were included to capture geographic effects on the use of post-hospital services. These were based on a county classification developed for all U.S. counties by the Appalachian Regional Commission. Counties were ranked (1-10) according to geographic isolation, where 1 is the least isolated (central metropolitan) and 10 the most isolated (rural). Rankings were determined primarily by population size, density and concentration, and worker commuting patterns. A higher ranking for a beneficiary's

Table 2—Continued

Individual use of post-hospital skilled nursing facility care: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	SNF days	SNF timing	SNF days	SNF timing	SNF days	SNF timing	SNF days	SNF timing
Supply								
HOSP stays per bene	—	—	—	—	*128.075	—	—	—
	—	—	—	—	(2.597)	—	—	—
SNF admissions per bene	***7,649.340	*279.382	***8,813.320	***154.926	***4,296.330	***194.112	***5,715.08	***133.397
	(35.107)	(3.552)	(89.099)	(89.904)	(38.390)	(40.352)	(203.411)	(217.003)
HH visits per bene	*–28.225	—	—	—	—	—	—	***–.399
	(2.926)	—	—	—	—	—	—	(9.303)
PHYS charges per bene	**.105	—	—	—	—	—	—	***.002
	(3.321)	—	—	—	—	—	—	(17.180)
DME charges per bene	—	—	—	—	*.069	**.003	***.092	*.001
	—	—	—	—	(3.137)	(3.816)	(16.951)	(3.741)
Hospital								
Beds	*.015	—	—	—	—	—	—	—
	(2.819)	—	—	—	—	—	—	—
Teaching	*5.152	—	—	—	—	—	—	—
	(2.893)	—	—	—	—	—	—	—
Number of services	**–1.858	—	—	*.018	—	—	—	*.011
	(4.111)	—	—	(2.781)	—	—	—	(3.317)
Occupancy	—	—	—	**–.227	—	—	—	**–.130
	—	—	—	(4.315)	—	—	—	(3.993)
Profit	—	—	**8.231	—	—	—	—	—
	—	—	(3.888)	—	—	—	—	—
Nonprofit	—	—	—	*.093	—	—	—	—
	—	—	—	(2.899)	—	—	—	—
Trend	none	none	decreasing	none	none	none	none	decreasing

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.01 level.

NOTES: Chi square is in parentheses. For complete definitions of terms used in this table, see section entitled "Definition of terms."

SOURCE: Tracer Discharge Episode Files (1981-86), Medicare Cost Reports, American Hospital Association surveys, the Area Resource File, the Prospective Payment System Impact File, the (1981-86) Basic Economic Activity Area Quarter Per Capita Files, and other data sources available at Abt Associates, Inc., Cambridge, Massachusetts.

county of residence was believed to generally imply less access to post-hospital care. However, certain types of post-hospital care, such as home health services, may be relatively more available in remote areas because of the scarcity of others. For these, the effects of geographic isolation on post-hospital use might be positive.

The ratio of the beneficiary's to the discharging hospital's county ranking was included to measure the degree of rural-urban migration for hospital inpatient services. It was expected that higher levels of post-hospital use would be associated with beneficiaries who migrated to more urban areas for their hospital care. Such patients demonstrate a greater willingness and ability to overcome geographic barriers to obtain health care services. There were also reasons for suspecting a negative relationship. Physicians located in urban areas far removed from their rural patients might be less able to schedule post-hospital care because of unfamiliarity with the local services available to these patients.

Supply

Supply measures were specified for each type of post-hospital care. These were beneficiary average use rates at the BEAA or State level. In the absence of direct measures of the availability of each service, such aggregate measures of use were judged to be reasonable proxies for the supply constraints facing beneficiaries. Beneficiaries located in States or BEAAs with more abundant supplies were expected to use higher levels of post-hospital care and to obtain quicker access to these services. Although the geographic and supply variables were expected to be correlated, this correlation is far from perfect. The geographic measures are at the county level, whereas the supply measures are at the broader State and Basic Economic Activity Area levels. Also, the supply of health care services does not depend solely on such geographic factors as population density. Some rural areas have relatively abundant supplies (e.g., some of the

Table 3

Individual use of post-hospital home health services: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	HH visits	HH timing	HH visits	HH timing	HH visits	HH timing	HH visits	HH timing
Prospective payment system								
Financial impact	**–20.238	***–.965	—	—	***–23.261	***–.762	—	—
	(5.182)	(9.307)	—	—	(11.813)	(12.116)	—	—
Risk	—	—	—	—	—	—	—	*–.116
	—	—	—	—	—	—	—	(3.337)
Case severity								
Pre-adm HOSP days	***.987	***.032	—	—	—	—	***–.655	***–.015
	(7.412)	(6.586)	—	—	—	—	(12.450)	(7.192)
Pre-adm SNF days	—	—	—	—	—	*–.014	—	**–.006
	—	—	—	—	—	(2.881)	—	(4.472)
Pre-adm HH visits	***1.551	***.040	***.931	***.017	***.386	***.005	***.544	***.009
	(396.528)	(221.815)	(104.007)	(75.593)	(59.152)	(12.291)	(90.467)	(28.457)
Pre-adm PHYS charges	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Pre-adm DME charges	***.695	***.019	***.438	***.008	**.443	***.011	***.457	***.013
	(56.878)	(35.715)	(22.919)	(15.352)	(35.360)	(20.608)	(42.010)	(43.386)
Demand								
Age	***.402	***.013	**.003	***.467	***.009	—	***–.185	***–.009
	(75.348)	(65.412)	(5.311)	(85.683)	(35.561)	—	(24.080)	(72.071)
Sex (1 = male)	—	—	**–2.136	—	***–9.105	***–.185	—	—
	—	—	(5.218)	—	(166.851)	(67.176)	—	—
RaceA	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
RaceB	—	—	**6.856	***.257	***6.590	*.149	***8.948	**.131
	—	—	(6.141)	(14.216)	(7.213)	(3.499)	(15.149)	(4.029)
Income	—	—	—	—	*.323	***.018	—	—
	—	—	—	—	(2.854)	(8.395)	—	—
Geographic								
Isolation	—	—	—	—	—	—	—	*.008
	—	—	—	—	—	—	—	(2.672)
Rural-Urban Migr	***3.288	***.127	*1.934	—	***2.367	***.076	***2.576	***.057
	(8.206)	(9.827)	(2.631)	—	(8.330)	(8.243)	(11.346)	(6.719)

See footnotes at end of table.

North Central States), and others have relatively poor supplies (e.g., some of the Appalachian States). The supply measures also served as instrumental variables controlling for interdependence among the various types of care used by each beneficiary. For example, the volume of home health services consumed by a Medicare beneficiary may, to the extent that they are complements, depend on the volume of SNF services consumed. Both quantities depend on the supply of each type of care available to the beneficiary.

Hospital

Hospital characteristics may also influence the quality and quantity of inpatient services and, in turn, affect post-hospital use. Several hospital measures were specified to capture these effects. The discharging hospital's size (beds), teaching status, and scope (number) of services were expected to be positively related to the quality of inpatient care. Higher quality inpatient care may suggest a lesser need for post-hospital services. Type of hospital control may also influence post-hospital use of services because of differing incentives to economize on inpatient care. For-profit hospitals were expected to be more sensitive to PPS and other financial incentives affecting the use of these services.[6] Lastly, hospitals with high occupancy rates may also be more inclined to substitute care in other settings because tighter capacity constraints might induce such hospitals to economize on inpatient services.

Trends

The final variables included in the regression models were a set of binaries reflecting each year during the

[6]The incentive of for-profit hospitals is obvious. PPS revenues are undiminished if post-hospital care is substituted for some inpatient services, thus enabling them to earn higher profits.

Table 3—Continued

Individual use of post-hospital home health services: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	HH visits	HH timing	HH visits	HH timing	HH visits	HH timing	HH visits	HH timing
Supply								
HOSP stays per bene	***–169.728	***–6.945	—	—	***–134.003	***–3.573	**–62.702	**–2.122
	(15.992)	(21.690)	—	—	(16.966)	(11.407)	(4.628)	(6.401)
SNF admissions per bene	—	—	—	—	—	—	—	*–12.531
	—	—	—	—	—	—	—	(2.836)
HH visits per bene	***34.336	***1.013	***46.647	***.828	***50.347	***1.187	***47.153	***.642
	(61.557)	(43.919)	(100.322)	(56.568)	(213.299)	(111.810)	(240.510)	(53.464)
PHYS charges per bene	***.049	***.001	***.071	***.001	**.104	***.003	***.107	***.002
	(8.162)	(7.133)	(16.622)	(9.184)	(69.034)	(62.470)	(94.380)	(50.731)
DME charges per bene	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Hospital								
Beds	—	—	***.007	—	—	*–.0001	***.010	***.0002
	—	—	(8.800)	—	—	(6.234)	(34.473)	(13.229)
Teaching	—	—	—	**.041	—	—	*–.993	—
	—	—	—	(4.351)	—	—	(2.997)	—
Number of services	—	—	—	—	**–.439	—	***–.679	**–.012
	—	—	—	—	(5.996)	—	(14.986)	(5.518)
Occupancy	—	—	**5.578	—	***9.350	***.249	***7.993	***.169
	—	—	(4.112)	—	(21.718)	(14.566)	(19.337)	(10.411)
Profit	—	—	**3.569	—	—	*.079	**2.338	—
	—	—	(3.919)	—	—	(2.870)	(3.917)	—
Nonprofit	—	—	—	—	***–3.714	**–.077	—	—
	—	—	—	—	(11.124)	(4.597)	—	—
Trend	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.01 level.

NOTES: Chi square is in parentheses. For complete definitions of terms used in this table, see section entitled "Definition of terms."

SOURCE: Tracer Discharge Episode Files (1981-86), Medicare Cost Reports, American Hospital Association surveys, the Area Resource File, the Prospective Payment System Impact File, the (1981-86) Basic Economic Activity Area Quarter Per Capita File, and other data sources available at Abt Associates, Inc., Cambridge, Massachusetts.

1981-86 period. These measures captured trends in post-hospital use. For example, there appears to have been a movement, which pre-dates PPS, away from inpatient hospital care to care in other settings.

Before the models were estimated, some adjustments to the data were made. Steps were taken to better ensure that each episode record centered on the focal hospital stay. To reduce the possibility that the focal stay was in fact a rehospitalization, all records that showed a hospital stay within the 30-day period preceding the focal stay were excluded. Also, records were excluded if subsequent hospitalizations were judged unlikely to have been related to the focal stay. A frequency analysis of primary diagnoses or of principal procedures was performed for rehospitalizations. Diagnoses or procedures with low relative frequencies were assumed to be unrelated to the focal stay. A relative frequency of 0.02 was used as a cutoff. This was purely a matter of judgment based on observed distributions. A better approach was not available at the time. In any case, this method, though crude, should have reduced the possibility that a rehospitalization was for an illness unrelated to the focal hospital stay.

Finally, records were excluded if the patient died in the hospital or within the post-60-day period. The inclusion of such records would distort the relationship between case severity and the use of post-hospital services. Use would be misleadingly low for the most severe cases (i.e., those who died). Although the exclusion of deaths can also create bias if case severity is imperfectly measured, it was felt that this was a lesser problem.

Regression results

Tobit regression results for each of the five types of post-hospital care and for post-hospital Medicare

Table 4

Individual use of post-hospital physician services: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	PHYS chrgs	PHYS timing	PHYS chrgs	PHYS timing	PHYS chrgs	PHYS timing	PHYS chrgs	PHYS timing
Prospective payment system								
Financial impact	—	—	*–59.546	—	***–246.426	***–.548	***–190.839	—
	—	—	(3.073)	—	(9.931)	(7.912)	(18.246)	—
Risk	—	—	—	—	*49.002	**.173	—	*.075
	—	—	—	—	(2.792)	(5.602)	—	(2.879)
Case severity								
Pre-adm HOSP days	—	—	—	—	—	—	**2.620	—
	—	—	—	—	—	—	(4.687)	—
Pre-adm SNF days	—	—	—	—	—	**.007	—	—
	—	—	—	—	—	(4.211)	—	—
Pre-adm HH visits	**–1.047	*–.003	*–.753	—	—	*–.003	—	—
	(5.126)	(3.599)	(3.695)	—	—	(2.584)	—	—
Pre-adm PHYS charges	***25.490	***.038	***16.673	***.041	***30.948	***.047	***20.941	***.030
	(1,035.67)	(217.572)	(415.209)	(211.101)	(489.033)	(195.769)	(512.178)	(149.140)
Pre-adm DME charges	—	—	**.944	—	—	—	—	—
	—	—	(6.170)	—	—	—	—	—
Demand								
Age	—	—	*–.337	—	***1.589	***.005	*.523	***.003
	—	—	(2.915)	—	(8.606)	(14.258)	(3.482)	(18.002)
Sex (1 = male)	**–6.898	**–.021	—	—	—	—	**–14.372	***–.071
	(4.526)	(3.840)	—	—	—	—	(5.893)	(19.286)
RaceA	—	—	**–21.664	—	—	—	—	—
	—	—	(5.757)	—	—	—	—	—
RaceB	—	—	***–35.432	—	—	—	—	—
	—	—	(12.019)	—	—	—	—	—
Income	—	—	—	—	**4.442	—	**2.840	*.006
	—	—	—	—	(4.156)	—	(5.042)	(2.795)
Geographic								
Isolation	—	**–.006	—	—	—	***.015	—	—
	—	(4.722)	—	—	—	(10.075)	—	—
Rural-Urban Migr	—	—	—	—	—	***.075	—	—
	—	—	—	—	—	(10.671)	—	—

See footnotes at end of table.

payments are presented in Tables 2 through 7.[7] Regression models were estimated separately for each of the four diagnostic groups.

Effects

PPS affected the level and timing of post-hospital SNF services for stroke, hip replacement (arthritis), and hip replacement (fracture). Post-hospital SNF care relating to pneumonia does not seem to have been affected. The coefficients of PPS financial impact and risk variables, when significant, have signs predicted by the conceptual framework. The significance and negative sign of the PPS financial impact variable suggests that the incentive to substitute post-hospital SNF care was dampened or reinforced depending on whether the discharging hospital experienced an increase or decrease in its overall operating ratio. This effect of PPS on both the level and timing of post-hospital SNF care was observed for hip replacement (arthritis) and hip replacement (fracture). The positive sign of the PPS risk variable suggests a stronger tendency among hospitals more dependent on Medicare (i.e. at greater risk) to substitute post-hospital SNF care for inpatient services. For stroke and hip replacement (fracture), this tendency is reflected both in more post-hospital SNF days and in their more immediate use following discharge.

Post-hospital home health services were more weakly affected by PPS. Pneumonia and hip replacement (arthritis) show results consistent with the conceptual framework. For these diagnoses, only the financial impact variable is significant. Both the level and the timing of post-hospital home health services were negatively

[7] R^2 for the several regression equations was generally low, ranging below 0.20. This is not unusual for very large samples of individual-level data. Undoubtedly, most of the variation in post-hospital use of health care services is explained by individual characteristics for which measures were unavailable.

Table 4—Continued

Individual use of post-hospital physician services: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	PHYS chrgs	PHYS timing	PHYS chrgs	PHYS timing	PHYS chrgs	PHYS timing	PHYS chrgs	PHYS timing
Supply								
HOSP stays per bene	***–507.087	***–1.709	***–574.391	***–1.588	—	***–3.379	***–1,054.06	***–2.559
	(12.053)	(12.666)	(13.373)	(8.277)	—	(15.081)	(214.229)	(19.411)
SNF admissions per bene	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
HH visits per bene	***–43.714	—	*–28.980	**–.130	—	—	—	—
	(7.076)	—	(2.955)	(4.869)	—	—	—	—
PHYS charges per bene	***.716	***.001	***.674	***.001	***.961	**.001	***.612	*.0004
	(128.916)	(45.221)	(116.993)	(15.222)	(49.984)	(4.120)	(54.476)	(3.641)
DME charges per bene	**.168	*.0004	***.329	***.001	***.692	—	***.345	*.0005
	(5.176)	(3.559)	(18.438)	(11.617)	(16.230)	—	(10.946)	(3.776)
Hospital								
Beds	—	***–.0001	—	—	*.032	—	*.023	—
	—	(8.985)	—	—	(2.956)	—	(3.200)	—
Teaching	**6.970	**.024	—	**–.023	**12.599	—	—	—
	(4.322)	(5.123)	—	(4.705)	(3.942)	—	—	—
Number of services	—	—	—	—	—	—	***–4.002	**–.008
	—	—	—	—	—	—	(9.356)	(5.192)
Occupancy	—	—	—	*.061	—	—	**26.173	—
	—	—	—	(3.298)	—	—	(3.737)	—
Profit	—	—	—	—	*29.366	—	—	***.062
	—	—	—	—	(3.268)	—	—	(6.673)
Nonprofit	*8.142	—	**10.290	—	—	*–.049	—	*.033
	(3.407)	—	(4.764)	—	—	(2.709)	—	(3.348)
Trend	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.01 level.

NOTES: Chi square is in parentheses. For complete definitions of terms used in this table, see section entitled "Definition of terms."

SOURCE: Tracer Discharge Episode Files (1981-86), Medicare Cost Reports, American Hospital Association surveys, the Area Resource File, the Prospective Payment System Impact File, the (1981-86) Basic Economic Activity Area Quarter Per Capita File, and other data sources available at Abt Associates, Inc., Cambridge, Massachusetts.

affected when the discharging hospital experienced an increase in its overall operating ratio and positively affected when the hospital experienced a decrease. The level and timing of post-hospital home health services for stroke patients appear to have been unaffected by PPS. Although the PPS risk variable is significantly related to the timing of post-hospital home health services for hip replacement (fracture), its coefficient has the wrong sign.

Post-hospital physician services were most affected by PPS for him replacement (arthritis). For this diagnosis, PPS financial impact and risk variables are significant and have the predicted signs for both the level and the timing of these services. The financial impact of PPS on the discharging hospital also has the predicted negative effect on the levels of post-hospital physician care relating to stroke and hip replacement (fracture). For this latter condition, the timing of these services was also affected in the predicted positive way by the risk that PPS imposed on the discharging hospital.

The effects of PPS on post-hospital use of DME appear to have been limited to pneumonia. For this condition, however, the effects of PPS seem strong. PPS financial impact and risk variables are significant and have the predicted signs for both the level and the timing of DME services.

Results for rehospitalizations are the weakest. The only effect of PPS consistent with the conceptual framework was observed for stroke. Here, the PPS risk variable is significant and has the predicted positive sign for the timing of rehospitalizations. Although the PPS financial impact variable is significantly related to the timing of rehospitalizations for pneumonia, its coefficient has the wrong sign.

Post-hospital Medicare payments for stroke, hip replacement (arthritis), and hip replacement (fracture) were significantly affected by PPS. All observed effects are in the direction predicted by the conceptual framework. For stroke, the PPS financial impact variable

Table 5

Individual use of post-hospital durable medical equipment: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	DME chrgs	DME timing	DME chrgs	DME timing	DME chrgs	DME timing	DME chrgs	DME timing
Prospective payment system								
Financial impact	**–308.213	**–.454	—	—	—	—	—	—
	(3.885)	(5.657)	—	—	—	—	—	—
Risk	**3.761	*.004	—	—	—	—	—	—
	(3.988)	(3.706)	—	—	—	—	—	—
Case severity								
Pre-adm HOSP days	***21.528	***.027	—	—	—	**–.010	—	**–.010
	(10.120)	(11.549)	—	—	—	(5.266)	—	(4.599)
Pre-adm SNF days	—	—	—	—	—	—	**–1.760	*–.004
	—	—	—	—	—	—	(5.104)	(3.323)
Pre-adm HH visits	***7.310	***.011	***4.413	***.009	—	—	***1.719	—
	(20.402)	(33.245)	(13.446)	(20.465)	—	—	(8.334)	—
Pre-adm PHYS charges	*6.436	—	—	—	**2.865	*.008	—	—
	(2.751)	—	—	—	(4.312)	(3.354)	—	—
Pre-adm DME charges	***66.803	***.051	***25.010	***.030	***15.996	***.047	***19.279	.034
	(1,594.030)	(640.147)	(499.376)	(228.454)	(490.012)	(363.651)	(896.166)	(357.854)
Demand								
Age	***2.590	***.003	***2.723	***.006	—	—	***–1.483	***–.008
	(11.000)	(13.754)	(13.222)	(19.607)	—	—	(16.375)	(57.245)
Sex (1 = male)	***43.547	**.038	**–30.382	—	***–30.018	***–.099	—	***–.057
	(7.313)	(4.062)	(5.819)	—	(17.941)	(16.922)	—	(6.735)
RaceA	—	—	—	—	—	—	*30.186	—
	—	—	—	—	—	—	(3.160)	—
RaceB	—	—	***119.625	***.237	—	—	***98.003	—
	—	—	(9.685)	(10.574)	—	—	(18.507)	—
Income	—	—	—	—	—	—	—	*.009
	—	—	—	—	—	—	—	(3.369)
Geographic								
Isolation	***–15.616	***–.017	***–13.692	***–.024	—	—	***–5.578	***–.013
	(13.755)	(11.981)	(15.897)	(14.191)	—	—	(11.779)	(7.913)
Rural-Urban Migr	—	—	—	—	***2.367	—	*12.997	—
	—	—	—	—	(8.330)	—	(3.055)	—

See footnotes at end of table.

and the risk variable are both significant, whereas only the financial impact variable is significant for hip replacement (arthritis) and hip replacement (fracture). PPS does not appear to have affected post-hospital Medicare payments for pneumonia.

The observed effects of PPS on the level and timing of post-hospital services are generally consistent with the conceptual framework. That significant effects were not observed in all instances does not undermine the validity of these findings. Each diagnosis and post-hospital service represents a different population for which PPS effects can be measured. It is not unreasonable to assume that the substitutability of a post-hospital service for inpatient hospital care and, therefore, the ability of PPS to influence this substitution varies depending on the diagnosis and type of service.

Other influences on post-hospital care

Case severity

Case severity was gauged by each beneficiary's use of health care services during the 60-day period prior to hospitalization. These variables were usually positively related to the post-hospital use of a particular service, suggesting the greater health care needs of more serious cases. Those instances where negative values were observed are likely explained by substitution among the various services. By far, the strongest positive relationships were observed between the pre- and post-hospital use of the same service. For example, if a beneficiary consumed a relatively large volume of home health services prior to hospitalization, that beneficiary was also likely to consume a relatively large volume of

Table 5—Continued

Individual use of post-hospital durable medical equipment: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	DME chrgs	DME timing	DME chrgs	DME timing	DME chrgs	DME timing	DME chrgs	DME timing
Supply								
HOSP stays per bene	—	—	**1,373.100	**2.337	—	—	**593.332	—
	—	—	(5.311)	(4.435)	—	—	(4.426)	—
SNF admissions per bene	—	—	—	—	*4,779.050	—	—	***-20.008
	—	—	—	—	(2.694)	—	—	(8.483)
HH visits per bene	**-176.444	**-.197	—	—	***132.596	***.463	—	—
	(4.579)	(4.048)	—	—	(14.026)	(14.605)	—	—
PHYS charges per bene	***.889	***.001	***.824	***.001	***.764	***.003	***.947	***.002
	(8.199)	(9.716)	(12.383)	(9.292)	(34.408)	(40.562)	(74.351)	(44.368)
DME charges per bene	***2.264	***.002	***1.648	***.003	***1.733	***.005	***1.534	***.003
	(37.066)	(26.948)	(32.551)	(24.078)	(113.882)	(80.192)	(123.688)	(70.966)
Hospital								
Beds	—	*-.0001	—	—	—	*.0001	—	*.0001
	—	(2.768)	—	—	—	(3.099)	—	(2.904)
Teaching	***46.432	***.052	—	—	*-11.178	—	**-11.271	**-.033
	(7.438)	(6.729)	—	—	(3.422)	—	(3.856)	(4.233)
Number of services	—	—	—	—	—	*-.011	**-4.301	—
	—	—	—	—	—	(2.958)	(6.217)	—
Occupancy	—	—	—	—	—	***.189	**34.808	—
	—	—	—	—	—	(6.811)	(3.849)	—
Profit	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Nonprofit	—	—	—	—	—	***-.146	—	—
	—	—	—	—	—	(14.659)	—	—
Trend	Increasing	None	Increasing	None	Increasing	Increasing	Increasing	Increasing

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.01 level.

NOTES: Chi square is in parentheses. For complete definitions of terms used in this table, see section entitled "Definition of terms."

SOURCE: Tracer Discharge Episode Files (1981-86), Medicare Cost Reports, American Hospital Association surveys, the Area Resource File, the Prospective Payment System Impact File, the (1981-86) Basic Economic Activity Area Quarter Per Capita File, and other data sources available at Abt Associates, Inc., Cambridge, Massachusetts.

these services in the post-hospital period. This finding suggests that the use of specific post-hospital services is largely explained by patterns that existed prior to hospitalization.

Demand

Measures of age, sex, race, and income were included to capture demand effects. Beneficiary age, as expected, usually had a positive influence on the post-hospital use of a service. The more notable exceptions are the negative relationships often observed for stroke and to a lesser extent, for hip replacement (fracture). The effects of beneficiary sex are mixed. For example, males had more rehospitalization than females had, but seem to have had a less intensive use of the other post-hospital services. Males also had higher post-hospital Medicare payments for pneumonia and hip replacement (fracture), suggesting a more intensive overall use of post-hospital services for these diagnoses. Black people clearly use more post-hospital home health services and DME than white people did; other effects of race are less noteworthy. The effects of income are usually positive, particularly those pertaining to hip replacement (fracture). Rehospitalizations only show a negative relationship with income. The overall use of post-hospital care, as gauged by Medicare payments for these services, seems to have been unaffected by income.

Geographic

The most noteworthy effect of geographic isolation is its negative impact on the post-hospital use of DME for pneumonia, stroke, and hip replacement (fracture). Type of geographic setting, however, seems to have had no effect on the overall use of post-hospital care as measured by Medicare payments for these services. Access to post-hospital services clearly seems to have been greater for rural residents who migrate to more urban areas for their

Table 6

Individual use of post-hospital rehospitalization days: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	RHSP days	RHSP timing	RHSP days	RHSP timing	RHSP days	RHSP timing	RHSP days	RHSP timing
Prospective payment system								
Financial impact	—	*1.001	—	—	—	—	—	—
	—	(2.817)	—	—	—	—	—	—
Risk	—	—	—	**.356	—	—	—	—
	—	—	—	(4.148)	—	—	—	—
Case severity								
Pre-adm HOSP days	***1.136	—	—	—	**.334	—	**.558	—
	(15.161)	—	—	—	(3.811)	—	(5.764)	—
Pre-adm SNF days	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Pre-adm HH visits	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Pre-adm PHYS charges	***.433	**.027	—	—	—	—	—	—
	(7.720)	(3.986)	—	—	—	—	—	—
Pre-adm DME charges	***.414	***.020	—	*–.012	—	—	—	—
	(27.398)	(8.517)	—	(2.951)	—	—	—	—
Demand								
Age	—	—	***–.009	***.309	—	—	**.118	—
	—	—	(11.855)	(13.618)	—	—	(3.979)	—
Sex (1 = male)	***2.242	**.131	—	—	***4.085	***.219	***4.227	*.130
	(10.866)	(4.326)	—	—	(13.454)	(7.111)	(12.660)	(2.663)
RaceA	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
RaceB	**–4.680	—	—	—	—	—	—	—
	(4.078)	—	—	—	—	—	—	—
Income	—	*–.037	—	—	**–.734	**–.052	—	—
	—	(3.406)	—	—	(4.841)	(4.596)	—	—
Geographic								
Isolation	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Rural-Urban Migr	—	—	—	—	**2.925	**.211	—	**–.164
	—	—	—	—	(4.314)	(4.050)	—	(4.556)

See footnotes at end of table.

inpatient hospital care. This result is particularly evident for both of the hip replacement categories and for home health services.

Supply

The supply of a particular type of post-hospital care, as would be expected, invariably had a positive effect on individual use of that service. Relationships with other types of post-hospital care also are often significant, and they vary between positive and negative. Positive relationships, such as those between physician services and DME, suggest that services are complements. Negative relationships, such as those between home health services and hospital days, suggest that services are substitutes.

Hospital

When significant, the effects on post-hospital care of hospital size (beds) and teaching status are most often positive. To the extent that these characteristics are indicative of higher quality hospital care and, therefore, a lesser need for post-hospital services, the expectation was that their influence would be negative. The positive relationships are likely explained by the fact that hospital size and teaching status also correlate with the treatment of more serious cases; the case severity measures did not fully capture these effects. In most instances where significant, the number of services (another measure of the quality of hospital care) does have the anticipated negative effect on post-hospital services. Occupancy, an indicator of the discharging hospital's capacity constraint,

Table 6—Continued

Individual use of post-hospital rehospitalization days: Tobit regression results, 1981-86

Variable	Pneumonia		Stroke		Hip replacement, arthritis		Hip replacement, fracture	
	RHSP days	RHSP timing	RHSP days	RHSP timing	RHSP days	RHSP timing	RHSP days	RHSP timing
Supply								
HOSP stays per bene	—	—	—	—	—	—	*86.211	*4.842
	—	—	—	—	—	—	(3.750)	(2.735)
SNF admissions per bene	*–504.295	—	—	—	—	**–67.174	—	—
	(3.220)	—	—	—	—	(3.831)	—	—
HH visits per bene	—	—	—	—	—	—	***17.947	**.748
	—	—	—	—	—	—	(14.240)	(5.567)
PHYS charges per bene	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
DME charges per bene	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Hospital								
Beds	**–.005	**–.0004	—	—	—	—	—	—
	(4.727)	(4.350)	—	—	—	—	—	—
Teaching	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Number of services	—	—	—	—	*–.509	—	—	—
	—	—	—	—	(2.931)	—	—	—
Occupancy	*3.481	—	—	—	**8.151	—	—	—
	(2.924)	—	—	—	(5.751)	—	—	—
Profit	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
Nonprofit	—	—	**–2.942	**–.132	—	—	—	—
	—	—	(3.825)	(4.846)	—	—	—	—
Trend	None	None	None	None	Increasing	Increasing	None	None

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.01 level.

NOTES: Chi square is in parentheses. For complete definitions of terms used in this table, see section entitled "Definition of terms."

SOURCE: Tracer Discharge Episode Files (1981-86), Medicare Cost Reports, American Hospital Association surveys, the Area Resource File, the Prospective Payment System Impact File, the (1981-86) Basic Economic Activity Area Quarter Per Capita File, and other data sources available at Abt Associates, Inc., Cambridge, Massachusetts.

was expected to positively influence the use of post-hospital care. With the exception of some negative effects on the timing of SNF services, which escape explanation, results are consistent with expectations. The most noteworthy finding relating to type of hospital control is that for-profit status, when significant, is always positively related to the use of post-hospital services.

Trend

With the exception of rehospitalizations and SNF care, trends in the use of post-hospital services were generally positive. This overall tendency is reflected by the increasing trends in post-hospital Medicare payments for all four diagnoses.

Conclusion

The author investigated the effects of PPS and other factors on the use of post-hospital care. Individual use of each of several types of post-hospital care was analyzed separately for four diagnostic groups. Effects on both the level and the timing of use were estimated for a 60-day period following discharge from the hospital.

Of those studied, the types of post-hospital care that appear to have been most affected by PPS are SNF and physician services. Considerably weaker effects were observed for home health services and DME. Results for rehospitalizations showed very little influence of PPS. The effects of PPS also varied depending on diagnosis. For example, significant effects of PPS on post-hospital use of DME were observed for pneumonia only, and these appear to have been fairly strong (as gauged by consistency with the conceptual framework). More importantly, the effects of PPS on overall post-hospital use, as measured by post-hospital Medicare payments, also varied with diagnosis. The strongest overall effects were observed for stroke, whereas no effects were observed for pneumonia.

Table 7

Individual use of post-hospital Medicare payments: Tobit regression results, 1981-86

Variable	Pneumonia MEDPAY	Stroke MEDPAY	Hip replacement, arthritis MEDPAY	Hip replacement, fracture MEDPAY
Prospective payment system				
Financial impact	—	**–1,582.960	**–932.686	**–838.192
	—	(4.337)	(4.962)	(5.538)
Risk	—	**693.479	—	—
	—	(5.415)	—	
Case severity				
Pre-adm Hosp days	***60.033	—	—	—
	(10.511)	—	—	—
Pre-adm SNF days	—	—	—	—
	—	—	—	—
Pre-adm HH visits	***31.149	—	*6.710	***17.4965
	(37.835)	—	(3.344)	(20.468)
Pre-adm PHYS charges	***73.447	***57.362	***30.391	***33.139
	(58.520)	(9.663)	(14.311)	(18.785)
Preadm DME charges	***58.966	*15.665	***16.376	**11.208
	(123.655)	(3.642)	(10.937)	(5.978)
Demand				
Age	**4.185	***–11.473	***22.588	***15.218
	(5.339)	(6.982)	(59.861)	(46.470)
Sex (1 = male)	***117.208	—	—	**109.934
	(9.418)	—	—	(5.469)
RaceA	*–176.972	—	—	—
	(2.776)	—	—	—
RaceB	*–246.136	—	—	***386.195
	(3.695)	—	—	(7.551)
Income	—	—	—	—
	—	—	—	—
Geographic				
Isolation	—	—	—	—
	—	—	—	—
Rural-Urban Migr	—	—	***148.653	**92.915
	—	—	(9.185)	(4.322)

See footnotes at end of table.

As predicted by the conceptual framework, the use of post-hospital care was almost always negatively related to the financial impact of PPS on the discharging hospital and positively related to PPS risk faced by that hospital (gauged by its Medicare dependence). These effects were observed for both the level and the timing of post-hospital services. The fact that PPS did not have a significant effect on some diagnoses and types of post-hospital care is quite reasonable and does not undermine the validity of the findings. Post-hospital care is unlikely to be equally substitutable for hospital inpatient care in all instances.

Because of its potentially conflicting influences on the discharging hospital, the direction of the overall impact of PPS on the use of post-hospital care is difficult to predict. During the initial years of PPS, most hospitals experienced Medicare gains, increasing their overall operating ratio. For this reason, the financial impact of PPS may have been, on balance, to dampen the substitution of post-hospital services for hospital inpatient care. To some extent, these effects were countered by the positive influence of PPS risk. Medicare margins, however, have been steadily falling under PPS from their initial high levels. As more hospitals experience smaller Medicare gains or experience losses, the financial impact of PPS will tend to work more in the same direction as its risk effect. Consequently, the overall impact of PPS would likely be to increase the use of post-hospital services.

Other influences on the use of post-hospital care have been revealed in this study. Some of these, such as the usually positive effects of age and case severity (gauged by pre-admission service use) are obvious. Among the more noteworthy findings is the tendency of beneficiaries who migrate to more urban locations for their hospital care to have greater access to post-hospital services. Also of significance are the positive effects of a discharging hospital's occupancy rate and for-profit status and the substitutability and complementarity observed among specific types of post-hospital care.

Table 7—Continued

Individual use of post-hospital Medicare payments: Tobit regression results, 1981-86

Variable	Pneumonia MEDPAY	Stroke MEDPAY	Hip replacement, arthritis MEDPAY	Hip replacement, fracture MEDPAY
Supply				
HOSP stays per bene	—	—	—	—
	—	—	—	—
SNF admissions per bene	**–33,202.600	***94,281.800	—	**33,807.700
	(4.480)	(9.281)	—	(5.191)
HH visits per bene	—	—	***588.882	***1,265.240
	—	—	(8.263)	(47.941)
PHYS charges per bene	***2.263	**3.454	***3.020	***2.747
	(9.228)	(6.365)	(17.010)	(17.022)
DME charges per bene	—	—	*1.616	***3.321
	—	—	(3.052)	(15.782)
Hospital				
Beds	—	—	**.254	**.216
	—	—	(6.324)	(4.213)
Teaching	***138.642	—	—	—
	(12.294)	—	—	—
Number of services	—	—	***–37.075	—
	—	—	(12.323)	—
Occupancy	*207.867	—	***393.367	—
	(3.335)	—	(10.864)	—
Profit	—	**329.327	—	***255.398
	—	(5.344)	—	(12.977)
Nonprofit	—	—	—	—
	—	—	—	—
Trend	increasing	increasing	increasing	increasing

*Significant at 0.10 level.
**Significant at 0.05 level.
***Significant at 0.01 level.

NOTES: Chi square is in parentheses. For complete definitions of terms used in this table, see section entitled "Definition of terms."

SOURCE: Tracer Discharge Episode Files (1981-86), Medicare Cost Reports, American Hospital Association surveys, the Area Resource File, the Prospective Payment System Impact File, the (1981-86) Basic Economic Activity Area Quarter Per Capita File, and other data sources available at Abt Associates, Inc., Cambridge, Massachusetts.

Finally, it is cautioned that the four diagnostic groups studied may not be representative of the entire population of Medicare hospital discharges. This limits the generalizability of the findings. However, it is doubtful that an analysis based on other diagnostic groups would yield radically different results, particularly with respect to the nature of the influence of PPS on the post-hospital care.

Definition of terms

SNF days—Post-hospital skilled nursing facility days (as defined in text).

SNF timing—Post-hospital skilled nursing facility timing (as defined in text.).

HH visits—Post-hospital home health visits.

HH timing—Post-hospital home health timing.

PHYS chrgs—Post-hospital physician charges.

PHYS timing—Post-hospital physical timing.

DME chrgs—Post-hospital durable medical equipment charges.

DME timing—Post-hospital durable medical equipment timing.

RHSP days—Post-hospital rehospitalization days.

RHSP timing—Post-hospital rehospitalization timing.

MEDPAY—Post-hospital Medicare payments.

Financial impact—The financial impact imposed by PPS on the discharging hospital.

Risk—The risk imposed by PPS on the discharging hospital.

Pre-adm HOSP days—Number of hospital days used by each beneficiary during the 30-day period preceding the focal hospital stay (adjusted for differences in supply).

Pre-adm SNF days—Number of skilled nursing facility days used by each beneficiary during the 30-day period preceding the focal hospital stay (adjusted for differences in supply).

Pre-adm HH visits—Number of home health visits used by each beneficiary during the 30-day period preceding the focal hospital stay (adjusted for differences in supply).

Pre-adm PHYS charges—Physician charges incurred by each beneficiary during the 30-day period preceding the focal hospital stay (adjusted for differences in supply and cross-sectional and temporal price differences).

Pre-adm DME charges—Durable medical equipment charges incurred by each beneficiary during the 30-day period preceding the focal hospital stay (adjusted for differences in supply and temporal differences in prices).

Age—Beneficiary age at time of focal hospital stay.

Sex—Beneficiary sex.

RaceA—A binary variable taking a value of 1 if beneficiary is white, and 0 if beneficiary is black or of other race.

RaceB—A binary variable taking a value of 1 if beneficiary is black, and 0 if beneficiary is white or of other race.

Income—Per capita income of county in which beneficiary resides.

Isolation—Appalachian Regional Commission code for beneficiary's county of residence.

Rural-Urban Migr—Ratio of Appalachian Regional Commission codes for beneficiary's county and discharging hospital's county.

HOSP stays per bene—Annual number of hospital stays per Medicare beneficiary for the BEAA in which each beneficiary resides.

SNF admissions per bene—Annual number of skilled nursing facility admissions per Medicare beneficiary for the State in which each beneficiary resides.

HH visits per bene—Annual number of home health visits per Medicare beneficiary for the BEAA in which each beneficiary resides.

PHYS charges per bene—Annual physician charges per Medicare beneficiary for the State in which each beneficiary resides.

DME charges per bene—Annual durable medical equipment charges per Medicare beneficiary for the State in which each beneficiary resides.

Beds—The bed complement of the discharging hospital.

Teaching—A binary variable taking a value of 1 if the discharging hospital is a teaching institution and 0 otherwise.

Number of services—Number of medical services offered by the discharging hospital.

Occupancy—The occupancy rate of the discharging hospital.

Profit—A binary variable taking a value of 1 if the discharging hospital is for profit and 0 if nonprofit or government.

Nonprofit—A binary variable taking a value of 1 if the discharging hospital is nonprofit and 0 if for profit or government.

Trend—A set of five binary variables to reflect the years 1981-86.

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