Comparing Outcomes of Care Before and After Implementation of the DRG-Based Prospective Payment System

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We compared patient outcomes before and after the introduction of the diagnosis related groups (DRG)-based prospective payment system (PPS) in a nationally representative sample of 14 012 Medicare patients hospitalized in 1981 through 1982 and 1985 through 1986 with one of five diseases. For the five diseases combined, length of stay dropped 24% and in-hospital mortality declined from 16.1% to 12.6% after the PPS was introduced ($P<.05$). Thirty-day mortality adjusted for sickness at admission was 1.1% lower than before (16.5% pre-PPS, 15.4% post-PPS; $P<.05$), and 180-day adjusted mortality was essentially unchanged at 29.6% pre- vs 29.0% post-PPS ($P<.05$). For patients admitted to the hospital from home, 4% more patients were not discharged home post-PPS than pre-PPS ($P<.05$), and an additional 1% of patients had prolonged nursing home stays ($P<.05$). The introduction of the PPS was not associated with a worsening of outcome for hospitalized Medicare patients. However, because our post-PPS data are from 1985 and 1986, we recommend that clinical monitoring be maintained to ensure that changes in prospective payment do not negatively affect patient outcome.

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TO EVALUATE whether patient outcomes have changed after the implementation of the diagnosis related groups (DRG)–based prospective payment system (PPS) and the professional review organization system, we conducted a study in which we compared outcomes before and after the PPS was introduced. In this article, we report on in-hospital mortality, mortality 30 and 180 days after admission, discharge to and prolonged stay in a nursing home, and readmission to hospitals.

METHODS

We present the study sample, design, and inclusion criteria elsewhere in this series.[1,2]

We used the medical record as our source of in-hospital mortality information and Health Care Financing Administration files to determine mortality status subsequent to the patient's discharge. By using the patient's last name, first name, date of birth, and health insurance claim number from the medical record, we were able to accurately match 92% of the patients in our sample to the Health Care Financing Administration health insurance master file.

We assessed short-term mortality by studying both in-hospital mortality and death within 30 days of the acute care admission. We chose death within 180 days postadmission as our indicator of medium-term mortality. We used the medical record as the source of both the patient's preadmission residence and discharge destination and Medicare's Part B files of physician bills to study duration of nursing home stay. When a physician bills a nursing home for a visit, either the place of service is designated as a nursing home or a special visit code is used. This information was available for patients in three of the five sampled states. In states A and B, we report the number of patients for whom a bill was submitted during months 5, 6, or 7 after hospital admission for a physician visit to a skilled nursing home or other (residential) nursing home. In

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state C, we report the number of patients for whom a bill was submitted for a visit to a skilled nursing facility.

To study hospital readmissions, we matched our patients to Health Care Financing Administration's bill retrieval file. Of the 92% of patients for whom we had accurate mortality data, we matched 96% for an overall success rate of 88%. We studied hospital readmission within 180 and 365 days postadmission and total days of acute care hospitalization. We included readmissions to all acute care hospitals regardless of the reason for readmission.

ADJUSTING OUTCOMES FOR SICKNESS AT ADMISSION

For length of stay and discharge destination (eg, home or nursing home), unadjusted and adjusted results are similar, and we present unadjusted data. For 30-day postadmission mortality, we adjusted pre- vs post-PPS differences using our 30-day disease-specific scale.[3-8] For 180-day postadmission mortality, prolonged nursing home stay, and hospital readmissions, we used the 30- and 180-day scales.[3-8] To compute, for example, pre- and post-PPS 30-day mortality adjusted for sickness at admission, we regressed 30-day mortality on a PPS indicator variable and the 30-day sickness scale and computed adjusted mortality rates pre- and post-PPS.

RESULTS

Length of Stay

For each of the diseases, length of stay fell: 21% for congestive heart failure, 18% for acute myocardial infarction, 14% for pneumonia, 32% for cerebrovascular accident, and 28% for hip fracture (Table 1). Overall, we found a 24% reduction in length of stay (from 14.4 to 11.0 days; 95% confidence interval, 3.1 to 3.8).

Mortality

The adjusted in-hospital mortality dropped from 16.1% to 12.8% (Table 2). Unweighted (for our sample design) adjusted mortality rates 30 days after admission for the five diseases combined were 16.7% pre- and 15.7% post-PPS, a difference of 1 percentage point (95% confidence interval, −0.1 to 2.1; $P=.07$). After reweighting our sample to represent the nation, values were 16.5% pre- vs 15.4% post-PPS, a difference of 1.1 percentage points ($P=.04$; Table 2).

As of 180 days posthospital admission, the adjusted mortality rates were 29.6% pre- and 29.0% post-PPS. Thus, almost one third of Medicare patients hospitalized with our five study diseases died within 6 months after admission. For congestive heart failure, cerebrovascular accident, and hip fracture, 180-day mortality dropped (significantly for hip fracture: 17.9% pre- and 14.8% post-PPS; $P<.05$), while for acute myocardial infarction and pneumonia, mortality rose post-PPS ($P>.05$). The pre- and post-PPS survival curves are similar for all conditions (Figure).

Discharge Destination

For the five diseases combined, the fraction of patients with a preadmission residence of home and a discharge destination of home was 77% pre- and 73% post-PPS ($P<.05$), with the most important difference being for hip fracture (56% pre- and 48% post-PPS, $P<.05$; Table 3). Overall, 95% of patients admitted from a nursing home returned to a nursing home, and this did not vary significantly by disease or time period.

Prolonged Nursing Home Stay

In studying prolonged nursing home stay, we focused on patients whose preadmission residence was home and who were still alive 7 months after the initial hospitalization. For the five study diseases combined, 8% of such patients in states A and B were in some type of nursing home approximately 6 months after the acute hospitalization, while 2% of such patients in state C were in a skilled nursing home (Table 4). In all three states, more, but not significantly more, patients had prolonged nursing home stays during the post-

Table 1.—Length of Stay, by Disease, Before and After Introduction of the Prospective Payment System (PPS)

Disease	n	Mean Length of Stay, d*† Pre-PPS (1981-1982)	Post-PPS (1985-1986)	Difference
Congestive heart failure	2824	11.1	8.8	−2.3‡
Acute myocardial infarction	2853	12.7	10.4	−2.3‡
Pneumonia	2749	12.1	10.4	−1.7‡
Cerebrovascular accident	2824	16.2	11.1	−5.1‡
Hip fracture	2762	20.1	14.5	−5.6‡
5 Diseases	14 012	14.4	11.0	−3.4‡

*Results were unadjusted for sickness at admission (unadjusted and adjusted results were similar).
†If the patient was discharged to a nonacute or "swing" hospital bed, the patient was considered discharged.
‡$P<.001$ for comparison of length of stay pre- vs post-PPS.

Table 2.—Adjusted Mortality Rates Before and After Prospective Payment System (PPS), by Disease and Type of Mortality Measure*

Mortality Adjusted for Sickness at Admission	Mortality Rates, % Dead† CHF Pre-PPS (n=1359)	CHF Post-PPS (n=1465)	AMI Pre-PPS (n=1416)	AMI Post-PPS (n=1437)	PNE Pre-PPS (n=1341)	PNE Post-PPS (n=1408)	CVA Pre-PPS (n=1382)	CVA Post-PPS (n=1442)	HIP Pre-PPS (n=1358)	HIP Post-PPS (n=1404)	5 Diseases Pre-PPS (n=6856)	5 Diseases Post-PPS (n=7156)
In-hospital mortality	12.3	8.9‡	24.0	21.8§	15.5	12.6‖	22.4	17.8‡	5.7	3.3‡	16.1	12.8‡
30-day postadmission mortality	14.7	13.0	24.2	24.2	15.9	15.7	21.3	19.9	5.3	4.6	16.7	15.7§¶
180-day postadmission mortality	33.5	31.7	33.6	34.8	27.8	29.2	35.3	34.3	17.9	14.8‖	29.6	29.0

*CHF indicates congestive heart failure; AMI, acute myocardial infarction; PNE, pneumonia; CVA, cerebrovascular accident; and HIP, hip fracture.
†In-hospital and 30-day postadmission mortality rates are adjusted for sickness at hospital admission using scales designed to predict death at 30 days postadmission; 180-day postadmission mortality rates are adjusted using scales designed to predict death at 180 days postadmission.
‡$P<.01$.
§$P=.05$ to .09.
‖$P<.05$.
¶As noted in the "Methods" section of the text, these data are unweighted. Reweighting for national representativeness changes the 30-day postadmission mortality rates for the five diseases combined as follows: 16.5% pre-PPS and 15.4% post-PPS ($P=.04$). This is the only outcome comparison whose significance is affected by the reweighting.

PPS period. The average increase across the three states was 1 percentage point ($P>.05$; 95% upper confidence bound, 2.2 percentage points).

Readmissions

As of 180 days after admission, the number of patients who died or who had at least one hospital readmission was unchanged: 57% pre- and 56% post-PPS ($P>.05$; Table 5). Results varied slightly by disease, with fewer patients with congestive heart failure, pneumonia, and hip fracture post-PPS having either a death or readmission ($P>.05$), but more patients with acute myocardial infarction suffering one of these two outcomes post-PPS ($P<.05$).

As of 365 days postadmission, the proportion of those patients discharged alive who had at least one hospital readmission was lower post-PPS for all diseases except acute myocardial infarction, and lower for the five diseases combined ($P<.05$ for congestive heart failure and hip fracture, and $P>.05$ for the other diseases individually and overall). Across all diseases except acute myocardial infarction, the total number of days spent in the hospital within 1 year of the study hospitalization was significantly lower post-PPS than pre-PPS ($P<.05$ for congestive heart failure, pneumonia, hip fracture, and the five diseases combined).

Summarizing Comparisons of Outcomes Pre- and Post-PPS

For the five diseases combined, in-hospital mortality was 3 percentage points lower post- vs pre-PPS ($P<.01$). However, this post-PPS improvement in mortality decreased to 1.1 percentage points by 30 days postadmission and to 0.6 percentage point by 180 days postadmission (Table 6).

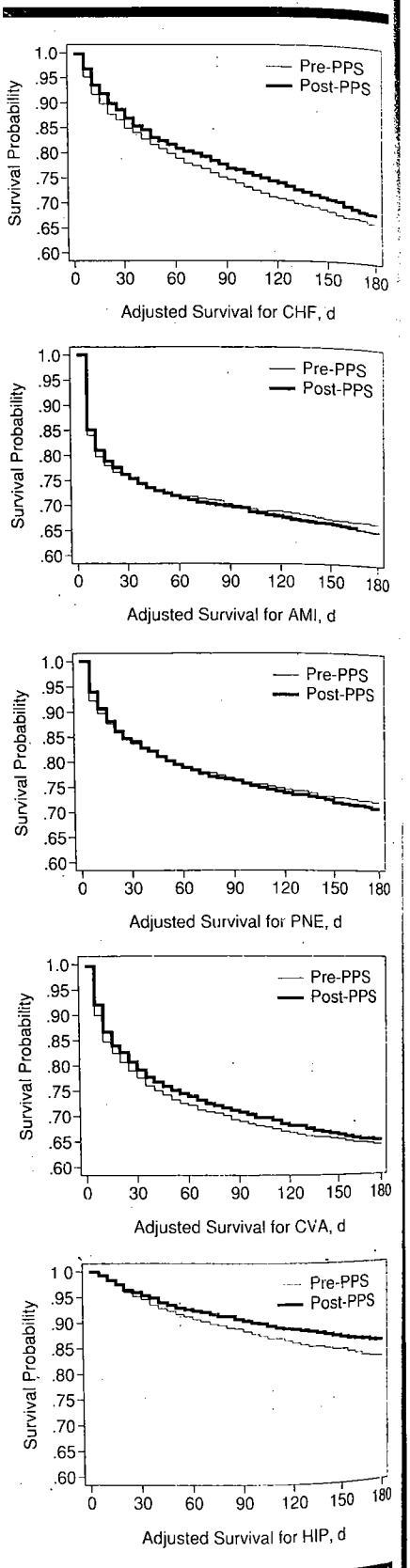
For patients admitted to the hospital from home, for the five diseases combined, we found that 4% more patients post-PPS were not discharged home ($P<.05$; 95% confidence interval for difference, 2.3 to 5.7 percentage points). We found that an additional 1% of patients (0% to 3% depending on the state) with a preadmission residence of home had evidence following hospitalization of a prolonged nursing home stay post-PPS ($P>.05$). For the five diseases combined, the proportion of patients with one or more hospital readmissions within 1 year of the initial hospitalization was 2 percentage points lower post-PPS than pre-PPS ($P>.05$).

COMMENT

Before discussing the relationship between the introduction of the PPS and changes in medical outcomes, it is important to note the severe burden of illness carried by elderly patients hospitalized with one of our five study conditions. By 1 month posthospital admission, 16% of these patients had died, with the death rate climbing to 29% within 6 months of admission. For hip fracture, the 6-month mortality rate is 16%, but for our other four medical conditions, it is over 33%. Of those patients who survived the initial hospitalization, more than half were readmitted in the next year. This fraction is highest for patients initially hospitalized with congestive heart failure (66%) and lowest for patients with hip fracture (44%). In addition, 25% of patients admitted from home and discharged alive are discharged to an institution. Forty-one percent of patients with cerebrovascular accident and 52% of patients with hip fracture previously living at home were discharged to an institution. However, most such institutional stays are short: of the patients still alive 7 months after hospital admission, 6% were in a nursing home.

Prior to and since the implementation of the PPS, clinicians, patients, and families have feared, and in some instances have reported, disasters in outcomes of care that were thought to be related to the new financial incentives. We have measured outcomes pre- and post-PPS on a nationally representative sample of more than 14 000 patients who were hospitalized with one of five diseases that make up 19% of Medicare admissions and 32% of deaths within 30 days. In contrast to these fears and anecdotal reports, we find no significant changes for the worse in either mortality at 30 and 180 days posthospital admission on the one hand or readmission and prolonged nursing home stay on the other.

We did find a significant increase in the fraction of patients discharged directly to an institution, but this does not appear to have resulted in a significant increase in prolonged nursing home stay. These last results, based on data from about 150 hospitals in three states, are not consistent with the findings of Fitzgerald et al[9,10] of increased prolonged nursing home stays post- vs pre-PPS for hip fracture patients (their findings were developed from two large hospitals). Our findings are consistent, however, with the clinical study of Mayer-Oakes et al[11] that examined outcomes of intensive care unit patients in three hospitals, the study of DesHarnais et al[12] that used secondary data sets to analyze inpatient mortality, and the studies of Palmer et al[13] and Gerety et al[14] that examined outcomes for hip fracture patients.



Survival curves comparing mortality following hospital admission through 180 days pre- and post-prospective payment system (PPS) for five diseases. CHF indicates congestive heart failure; AMI, acute myocardial infarction; PNE, pneumonia; CVA, cerebrovascular accident; and HIP, hip fracture.

Table 3.—Discharge Destination for Patients, by Disease* and Preadmission Residence

Admitted From and Discharged to	Patients Discharged to Each Destination†											
	CHF		AMI		PNE		CVA		HIP		5 Diseases	
	Pre-PPS	Post-PPS	Pre-PPS	Post-PPS	Pre-PPS	Post-PPS	Pre-PPS	Post-PPS	Pre-PPS	Post-PPS	Pre-PPS	Post-PPS
Home, % (n)	90 (1007)	88 (1133)	87 (960)	83‡(990)	92 (853)	88‡(875)	60 (922)	58 (1005)	56 (894)	48‡(987)	77 (4636)	73‡(4990)
Nursing home, % (n)	93 (82)	97 (99)	94 (32)	92 (39)	94 (204)	94 (268)	91 (90)	95 (114)	97 (301)	98 (263)	95 (709)	96 (783)

*CHF indicates congestive heart failure; AMI, acute myocardial infarction; PNE, pneumonia; CVA, cerebrovascular accident; and HIP, hip fracture.
†The entries in this table represent the number of patients discharged to each destination divided by the number of patients discharged alive, among those admitted from the indicated origin.
‡$P<.05$.

Table 4.—Residence in Nursing Home 6 Months Following Hospital Admission, by State and Disease, Pre– and Post–Prospective Payment System (PPS)

Disease‡	Patients Alive at 7 mo Posthospitalization Who Lived in Nursing Homes, %*								
	State A†			State B†			State C†		
	n§	Pre-PPS	Post-PPS	n§	Pre-PPS	Post-PPS	n§	Pre-PPS	Post-PPS
CHF	269	5.1	4.6	260	5.0	5.0	260	0.8	2.2
AMI	280	1.4	2.9	267	1.6	0.0	269	0.0	2.0
PNE	240	4.8	7.8	236	3.4	4.3	259	1.7	2.2
CVA	275	10.9	18.1	265	19.0	18.1	250	6.0	4.5
HIP	302	10.7	12.4	263	10.7	12.0	271	2.6	1.9
5 Diseases	1366	6.7	9.2	1291	7.9	8.1	1309	2.2	2.5

*The entries in this table represent the number of patients with evidence for physician nursing home bills submitted within months 5, 6, or 7 after admission divided by the number of patients alive 7 months after admission. This analysis only includes patients with a preadmission residence of home. None of the differences were significant at $P<.05$.
†Each fiscal carrier providing data for this analysis offered the data in a different format. For states A and B, the table compares the percentages of patients with evidence for prolonged nursing home stay indicated by a physician's bill to a skilled nursing or other (residential) nursing home. For state C, the table compares the percentages with evidence for prolonged nursing home stay as indicated by a physician's bill to a skilled nursing facility only.
‡CHF indicates congestive heart failure; AMI, acute myocardial infarction; PNE, pneumonia; CVA, cerebrovascular accident; and HIP, hip fracture.
§Pre- and post-PPS sample combined.

Table 5.—Hospital Readmissions Pre– and Post–Prospective Payment System (PPS) Adjusted for Sickness at Admission, by Disease*

Adjusted Outcome†	Outcome Within Time After Admission, No. of d	CHF		AMI		PNE		CVA		HIP		5 Diseases	
		Pre-PPS (n= 1078)	Post-PPS (n= 1247)	Pre-PPS (n= 1055)	Post-PPS (n= 1144)	Pre-PPS (n= 960)	Post-PPS (n= 1123)	Pre-PPS (n= 1164)	Post-PPS (n= 1273)	Pre-PPS (n= 985)	Post-PPS (n= 1045)	Pre-PPS (n= 5242)	Post-PPS (n= 5832)
Patients with death or readmission within 180 days, %‡	180	68	65	60	64¶	52	50	63	63	42	39	57	56
Patients with readmission within 1 year, %§	365	69	65¶	56	60	52	48	57	57	48	42¶	56	54
Mean No. of in-hospital days within 1 year‖	365	18	13¶	11	11	12	9¶	14	13	11	8¶	13	11¶

*CHF indicates congestive heart failure; AMI, acute myocardial infarction; PNE, pneumonia; CVA, cerebrovascular accident; and HIP, hip fracture.
†Outcomes are adjusted for sickness at admission using scales designed to predict death at 30 and 180 days postadmission.
‡Death (in-hospital or postdischarge) or any readmission within 180 days after admission.
§Any readmission within 1 year of admission among patients discharged alive from the initial hospitalization.
‖Mean number of in-hospital days within 365 days after the initial hospitalization for all sampled patients discharged alive regardless of readmission.
¶$P<.05$ for comparison of outcomes pre- and post-PPS.

Table 6.—Summary of Changes in Outcome Rates Post– vs Pre–Prospective Payment System (PPS)

Outcome Rates	Amount of Change (Post-PPS – Pre-PPS), %*					
	CHF	AMI	PNE	CVA	HIP	5 Diseases
In-hospital mortality†	−3#	−2#	−3#	−5#	−2#	−3#
30-day postadmission mortality†	−2	0	0	−1	−1	−1#
180-day postadmission mortality†	−2	+1	+1	−1	−3	−1
Patients admitted from home not discharged home‡	+2	+4#	+4#	+2	+8#	+4#
Prolonged nursing home stay§	0	+1	+2	+2	+1	+1
180-day postadmission mortality or readmission†‖	−3	+4#	−2	0	−3	−1
365-day postadmission readmission†¶	−4#	+4	−4	0	−6#	−2

*CHF indicates congestive heart failure; AMI, acute myocardial infarction; PNE, pneumonia; CVA, cerebrovascular accident; and HIP, hip fracture.
†Adjusted for sickness at admission.
‡Only includes patients admitted to hospital from home.
§Prolonged nursing home stay is measured by a physician's bill to a skilled nursing facility or other (residential) nursing home within months 5, 6, and 7 postadmission for three states combined, but only for patients admitted to hospital from home and alive as of 7 months postadmission.
‖Death or readmission within 180 days postadmission among all sampled patients.
¶Readmission within 1 year postadmission among all sampled patients.
#$P<.05$.

We were unable to prove that the PPS did not have a negative impact on outcome. Because of the manner in which the PPS was introduced, it was not possible to do a controlled trial of its effects, which would have permitted comparison of actual outcomes in the late 1980s under the PPS with outcomes during the same time period in the absence of the PPS. Valid causal conclusions from the only available data, which are observational in character, are difficult to achieve; we explore these issues in another article in this series.[15]

Moreover, our post-PPS data came from 1985 and 1986, a period in which the financial bases for prospective payment were still changing. The rates paid to hospitals at that time still included a component based on historical charges

during the cost-plus reimbursement era prior to the introduction of the PPS. In addition, the amount of reimbursement for a patient with a given diagnosis has been changing since 1986, and hospitals' financial margins have diminished. Evidence from another study, reported in this issue, indicates that clinical instability at discharge has increased post-PPS.[16] Last, although on average outcomes have not worsened, it is possible that some groups of patients may have suffered (eg, the old). Analyses addressing this last issue are ongoing.

In sum, the PPS was implemented in a manner that did not adversely affect overall outcomes for hospitalized Medicare patients. However, further clinical monitoring on a national level of the impact of the PPS is indicated to ensure that the continuing changes in the PPS do not negatively affect the outcomes of care.

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