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The Effect of Medicare's Prospective Payment System on Discharge Outcomes of Skilled Nursing Facility Residents

In July 1998, the Centers for Medicare and Medicaid Services (CMS) changed the payment method for Medicare (Part A) skilled nursing facility (SNF) care from a cost-based system to a prospective payment system (PPS). Unlike the previous cost-based payment system, PPS restricts skilled nursing facility payment to pre-determined levels. CMS also reduced the total payments to SNFs coincident with PPS implementation. These changes might reduce quality of care at skilled nursing facilities and could be reflected in resident discharge patterns. The present study examines the effect of the 1998 policy change on resident discharge outcomes. The results indicate that PPS reduced the relative risk of discharge to home and to death for Medicare residents (compared to non-Medicare residents) and had no significant effect on hospitalizations or transfers.

Between 1990 and 1998, Medicare expenditures for skilled nursing facility (SNF) services increased from \$1.7 billion to \$10.2 billion (Centers for Medicare and Medicaid Services 2004b), leading to concerns about the financial sustainability of the benefit. To restrain this growth, in July 1998 the Centers for Medicare and Medicaid Services (CMS) began a four-year phase-in process to introduce a prospective payment system (PPS) to pay for Medicare Part A SNF care¹⁻². Following the success of prospective payment in acute care settings, Congress mandated that CMS develop and implement a PPS to increase control over Medicare SNF expenditures. While PPS can be expected to con-

strain Medicare expenditures, it may also adversely affect patient care and outcomes. The PPS policy implemented by the Medicare program introduced three important policy changes: 1) prospective payment; 2) case-mix adjustment; and 3) a reduction in the average per-diem payment rates. Prior to 1998, the Medicare program reimbursed SNFs on the basis of their costs subject to per-diem limits on routine costs (room, board and routine nursing) but with no limits on ancillary services (drugs, rehabilitation therapy) (MedPAC 2002). In contrast to the cost-based payment approach, PPS provides more control over expenditures because the reimbursement for resident care is fixed before the

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care is actually delivered. This approach creates new incentives to providers to limit costs to the predetermined payment level or less. A second significant attribute of the policy change was the introduction of case-mix adjustment. While the pre-determination of payment rates transfers the risk for additional costs to the facility, case-mix adjustment allows higher reimbursement for more expensive residents. In addition, the 1998 rates, as implemented, reduced facility reimbursement from Medicare by an average of 17% (CMS 1999). The overall impact was substantial, especially in facilities with a significant proportion of Medicare revenue.

The present study examines the effect of the change in the Medicare payment system on SNF resident outcomes. Its purpose is to describe the incentives provided to SNF residents under PPS and to examine empirically the effect of PPS on one type of outcome: resident discharges from SNF care. As the payment change is applicable only to the Medicare resident population, the change in payment should be reflected only for Medicare residents and not for other residents in SNFs, namely Medicaid and private-pay residents. Nearly all facilities provide care for both Medicare (SNF) residents and non-Medicare (non-SNF) residents (in our presentation we focus on the Medicare population and refer to all facilities as SNFs). Non-Medicare residents in SNFs are a useful comparison group in the empirical analyses because they should be unaffected by the payment change but affected by any common unobserved factors changing over time in the facility and the industry (e.g., changes in facility staffing, growth in community-based care alternatives).

The Medicare SNF benefit provides short-term, post-acute-care support and functional rehabilitation to help residents regain functional independence. Discharge to the community is an important outcome for rehabilitative care that is provided under the Medicare SNF benefit. Therefore, in this study, effectiveness of the Medicare program is measured by the likelihood of discharge to home. Faster discharge to home is also a component of efficiency for the Medicare SNF benefit; however, full assessment of Medicare program efficiency would require data on acute hospital stays and home health benefits as well as SNF care. If PPS improved the effectiveness of SNF care, the change to PPS should

be associated with earlier community discharges and deferred hospitalization and death for Medicare residents.

Discharge outcomes are a crude measure of the impact of a payment system change on SNF residents. Nonetheless, discharges can be measured with certainty and provide a summary outcome measure that may be indicative of the overall quality of care provided to SNF residents. Discharges to hospital or death are used commonly to indicate poor SNF practices as are prolonged SNF stays (Arling, Williams, and Kopp 2000; Cohen and Spector 1996; Cohen-Mansfield et al. 1999). In contrast, discharges to home are generally seen as a positive outcome, so long as the resident is functionally ready for the transition (Arling, Williams, and Kopp 2000; Engle and Graney 1993; Hutt et al. 2001). Earlier discharge to the community can represent negative outcomes if residents are discharged "quicker but sicker." We note the difference between hospital PPS (fixed rate per stay) and SNF PPS (fixed rate per day): "quicker but sicker" is a bigger concern in the former, supporting the view that community discharge is a good outcome in the SNF context. This study examines whether PPS reduced the relative risk of discharges to home from SNFs for Medicare residents compared to non-Medicare residents.

Provider Responses to PPS

PPS does not necessarily reduce facility revenues. Under PPS, the payment to a facility depends on both the composition of residents in the SNF as measured by the resource utilization groups (RUG-III) case-mix system (Fries et al. 1994), and the payment rate for each type of resident (MedPAC 2002). While the attribution of revenue to residents within facilities is directly influenced by case-mix payment, the overall effect on facility revenues is dependent on the total revenue stream from the Medicare program. Payment rates under PPS can be set to provide the same overall budget for Medicare SNF care. However, because CMS believed that SNF costs were too high before the implementation of PPS, the payment rates were designed to provide real savings for the Medicare program. Only 53 of the total 9,037 SNFs in the United States were expected to receive higher payments immediately following the PPS implementation (CMS 1999). With a re-

duction in revenues imposed by PPS, there is an incentive for facilities to reduce costs and potentially provide lower quality of care. Because the high level of payment from Medicare is thought to subsidize other SNF residents, Medicare reductions also could result in subsidy reductions and a decline in the quality of care for non-Medicare residents.

Under PPS, facilities still may benefit if their facility costs are less than the predetermined PPS rates, even if these payments are low. At the same time, inefficient or high-cost facilities may face operating deficits. In this context, efficiency refers to lower-cost care that achieves the same resident outcome. Unlike acute settings where payment is provided for an episode of care, SNFs are reimbursed on a per-diem basis. Because the SNF PPS is a per-diem payment rather than an episode-based prospective payment, an incentive for earlier discharge only occurs if the per-diem payment level is insufficient to meet facility costs. To reduce costs, facilities may require staff to spend less time caring for residents, or facilities may use less expensive, lower-skilled staffing inputs. Facilities also may reduce activities that are not directly reimbursed under the PPS, such as social and recreational programming for residents. The latter changes may have deleterious effects on resident outcomes: functional improvement may be impeded and discharge to the community may be delayed. In addition, lower quality may increase the risk of hospitalization and death. For most Medicare residents, discharges to the community indicate an efficacious treatment outcome and we presume such outcomes to be preferable in most, if not all, cases. If resident discharges to the community are negatively affected, and discharges to hospital or death increase, the effectiveness of the Medicare SNF benefit will be compromised.

Each facility could be expected to respond differently to PPS. Facilities with a higher prevalence of Medicare residents would be the most responsive to the change in payment. Furthermore, to the extent that facilities provide differential care to residents based on payment source, changes in resident outcomes would affect Medicare residents more than private pay or Medicaid residents within the same facilities.

The Office of Inspector General has produced a number of reports examining the effect of PPS on Medicare resident access to SNF care. All

conclude that Medicare residents continue to have access to SNF care following the implementation of PPS (Office of Inspector General 1999, 2001). Angelelli and colleagues (2002) similarly found minimal changes in SNF admissions, even among residents considered to be at high risk. This corroborates earlier Medicaid evidence provided by Cohen and Dubay (1990), who found no difference in admission patterns for Medicaid residents in states with cost-based payment compared to states with prospective case-mix payment. However, an equally important evaluation criteria is the effect of PPS on resident outcomes.

There is very little empirical information regarding the effect of payment on resident discharge outcomes. Hutt and colleagues (2001) analyzed data from the PPS demonstration project and found no effect of PPS on resident discharges to the community. However, the latter results were based on an experimental sample. Following the full implementation of PPS, it is not known whether potential cost-saving measures undertaken by facilities, such as lowering staffing skill mix or reducing resident activity programming, had a negative effect on Medicare SNF residents. The present study provides more robust results with less opportunity for selection bias, by using data from all residents in all SNFs in two states.

Hypothesis

With three simultaneous changes in the payment policy (prospective payment, case-mix adjustment, reduced overall program spending), there are different possible provider behavioral responses to PPS. We state our hypotheses in two frameworks: first holding quality of care constant; and then relaxing this assumption to allow quality to vary in response to the changes in payment policy. If quality is held constant, facilities will have a relatively lower per-diem profit from Medicare resident care. Whether there are any incentives to select residents for admission with particular care requirements depends on the extent to which the RUG-III case-mix system accurately reflects resident care costs. Nonetheless, on average, there is no explicit change in the incentive to retain or discharge Medicare residents who are admitted to the facility. Facilities may be able to maintain profit margins by improving efficiency and delivering the same quality of care at a lower cost. Here again there would be no change in

resident discharges. However, if quality is reduced in response to a lower and fixed payment, we expect that resident recovery will be impeded and residents will take longer to improve to a point where discharge to the community is possible. Thus reduced quality will delay resident discharges. If resident care is compromised, community discharges may be delayed while deaths and hospital discharges may be more prevalent and occur sooner.

Thus, we hypothesize that the introduction of PPS will reduce the level of care provided by SNFs and resident outcomes will decline as a result. If resident care is compromised, community discharges will be delayed while deaths and hospital discharges will occur sooner.

For the present study, discharges to the community are considered positive outcomes; discharges to death and hospital are considered negative outcomes. We explore the changes in the rates of transfers between SNFs, without positing whether or not these transfers are beneficial. This particular interpretation of the appropriateness of discharges to each destination does have limitations. For example, it is possible that if care practices were to deteriorate substantially following the implementation of PPS, the community could be perceived as a relatively more attractive treatment location for Medicare residents than a SNF. Even if this were the case, however, discharges to the community would be a positive outcome relative to remaining in the poor quality facility.

Methods

Overview

The outcome of interest for our analysis was time to discharge to home, to hospital, and to death. We used an observational study design, based on a natural experiment that occurred when the Medicare program changed payment methods while other payers for SNF care maintained their respective payment methods. We first examined a simple pre- and post-PPS comparison within the Medicare population. However, the effect of PPS in the latter analysis could have been confounded by other trends in the SNF market that affected all residents, such as changes in the overall utilization and treatment patterns in SNFs. For example, the electronic submission of Minimum Data Set (MDS) assessments for all nursing home residents began in July 1998, which coincided

with or was contemporary to the implementation of PPS for Medicare residents. Hence, the effect of PPS on Medicare resident discharge outcomes was identified using a difference-in-differences (D2) strategy and a competing-risks hazard regression. The D2 strategy used an indicator variable to identify the discharge risk for Medicare residents compared to non-Medicare residents, and a second indicator variable to identify the discharge risk in the post-PPS period compared to the pre-PPS period for all residents. The interaction between these two variables identified the change in the difference between Medicare and non-Medicare residents that coincided with the change to PPS payment. Changes in the relative risk of discharge between Medicare and non-Medicare residents before and after the change in payment were used to identify the effect of PPS on discharge outcomes and thus to test our hypothesis. The D2 strategy provides a means to avoid selection bias and collinearity of the treatment effect with contemporaneous changes that affected all residents. Fixed resident, facility, market, and state attributes, and a continuous time trend were used as risk-adjustment controls. In addition, we estimated several specification tests, including a market fixed-effects model that used a single indicator variable for each market, rather than market-level characteristics (the number of facilities made it impossible to similarly identify facility fixed effects).

Data

This study used resident-, facility- and market-level data for all elderly SNF residents in Michigan and Ohio in 1998 and 1999. These two states were selected because resident-level admission and discharge data were available electronically for the periods both before and after the change in the Medicare payment system. Information detailing resident characteristics was obtained from the Resident Assessment Instrument/Minimum Data Set. The MDS is a comprehensive assessment that includes information on resident demographic, functional, and diagnostic conditions as well as nursing and medical treatments. By congressional mandate, the MDS is performed for every SNF resident on admission, annually, and upon significant change in health status, with a reduced assessment performed quarterly (that permits the RUG-III classifications to be

determined). MDS assessments are collected and used to determine case mix for payment purposes using resident-specific RUG-III scores. MDS data also now are used for the public Nursing Home Compare website (CMS 2004a).

A longitudinal database of all resident assessments was used for the present study. The MDS has been shown to be reliable and valid for clinical and health services research purposes in several studies (Arling, Williams, and Kopp 2000; Fredriksen, Tariot, and De Jonghe 1996; Hawes et al. 1995; Hutt et al. 2001; Morris, Fries, and Morris 1999; Morris et al. 1997; Sgadari et al. 1997). Facility characteristics were obtained from the On-line Survey Certification and Reporting System (OSCAR) files, collected by state licensure agencies through the SNF certification process. The OSCAR database includes all Medicare- and/or Medicaid-certified SNFs in the United States and is commonly used in studies to measure provider characteristics (Harrington et al. 2000a, 2000b; Harrington et al. 1998). In addition, the CMS medical wage index is used to account for differential Medicare reimbursements provided to facilities in different markets.

Outcome Variables

The outcome of interest in the regressions is time to discharge to each possible destination as recorded on the MDS discharge tracking form. The Medicare SNF benefit provides up to 100 days of SNF care (with an additional copayment of \$101.50, or about 30% to 50% of the total cost, required from residents after 20 days). The period of observation for the present study was limited to the first 120 days of SNF care. Longer-stay residents were considered here as "not discharged" during the period under study. Past studies of nursing home discharges have used a variety of periods from 30 through 180 days (Engle and Graney 1993; Hutt et al. 2001). Little information was lost by limiting the period of observation because most Medicare beneficiaries are discharged by day 120 (Garber and MaCurdy 1993); data for the present study indicate that 70% of Medicare residents were discharged before 120 days. The defined observation period also limits bias caused by interactions between discharge outcomes and time. We chose a period slightly longer than the 100-day Medicare benefit limit in an effort to identify as many discharges as possible and not to exclude discharges slightly outside the benefit pe-

riod. Any number of circumstances including transportation requirements, home accessibility issues, and the availability of adequate support systems could slightly delay a discharge, while censoring these observations would add measurement error in determining resident discharge patterns. Sensitivity analyses examined the impact of using a 100-day rather than a 120-day exposure period.

Four dependent variables were constructed to represent the time of discharge to the community, to an acute care facility, to death, or to transfer to another nursing care facility within the first 120 days of a SNF stay. Residents still remaining in the SNF beyond 120 days were coded as "not discharged" (censored).

Independent Variables

We follow an "intention to treat" paradigm by presuming that outcomes achieved by the 120th day are attributable to the care provided under the initial payer for the SNF stay. Moreover, changes in payer are relatively uncommon during the first 100 days of a Medicare SNF stay. The payment source for resident care was identified from resident MDS admission assessments.

Reimbursement under PPS began for each facility with the first cost-reporting period after July 1, 1998. The exception was for facilities that changed ownership or began operation after 1994. In the latter facilities, PPS was uniformly effective as of Jan 1, 1999. The fact that PPS was effective for facilities at irregular periods provides additional protection against bias from temporal changes in the SNF market. To identify the effective date of PPS, the cost-reporting date for each facility was obtained from OSCAR data. The PPS payment period indicator variable was coded as "1" for all residents in the facility after the first cost-reporting period following July 1, 1998, and "0" for assessment data before the effective date. The interaction of Medicare payment and the PPS period indicator identified the treatment group (i.e., Medicare residents after the change to PPS payment).

Several resident characteristics were included in multivariate analyses to avoid the possibility of omitted variable bias or confounding that would occur if any resident characteristics or treatments on admission were systematically related to both Medicare payment on admission and resident discharge. Resident demographic characteristics included in all analyses were admission age,

gender, admission from hospital, and admission from SNF. Early models developed for this study included an extensive array of resident diagnoses and conditions. However, because most conditions had a trivial effect on discharges (relative risk within range of .98 to 1.02) and were not correlated with payment variables (coefficients were monitored), the list of conditions was reduced to simplify the analysis. Resident diagnoses and conditions included in the final model are: Alzheimer's disease; the presence of pressure sores; whether the resident had a recent fall; whether the resident was bedfast; physical and cognitive functioning; and the RUG-III case-mix index. Physical functioning was measured with the Activities of Daily Living (ADL) Hierarchical Scale. This scale, ranging from 0 (fully independent) to 6 (fully dependent) is based on resident capacity in personal hygiene, locomotion, toileting, and eating, and has been validated against the functional independence measure (Morris, Fries, and Morris 1999; Williams et al. 1994; Williams et al. 1997). Cognitive function was assessed using the Cognitive Performance Scale (CPS). This scale measured cognition ranging from 0 (fully intact) to 6 (totally dependent) and has been validated against the Folstein Mini Mental State Exam (Hartmaier et al. 1995; Morris et al. 1994). ADL and CPS scores were each collapsed into three categories of impairment representing broad levels of functional capacity: scores of 0 and 1 are associated with independence; scores of 2, 3, or 4, are associated with moderate levels of impairment; and scores of 5 or 6 are associated with severe impairment or total dependence. Three treatments also were included as control variables in the final model because they could affect discharge and might be correlated with payment source on admission: indwelling catheter; tube feeding; and oxygen therapy. Finally, the RUG-III case-mix index was used to account for additional resident heterogeneity. This index ranged from .39 to 3.68 and provides a cardinal measure of the overall resource intensity required to care for the resident. The index was the weighting factor used to determine Medicare reimbursement for resident care. Here it provided a control for differences in care resources associated with a given resident on admission to the facility. To the extent that the case-mix index reflects resident severity, the index captured additional resident heterogeneity on admission to the facility.

Facility characteristics may also play an important role in the care and discharge patterns of residents (Braun 1991; Cohen and Spector 1996; Porell et al. 1998). The most proximal OSCAR facility survey information was linked to MDS. Facility-level variables from OSCAR included in the model were: the occupancy rate; the percentage of facility residents who were Medicare; the percentage who were Medicaid; whether the facility was a for-profit organization; and whether the facility was hospital-based. Staffing ratios per 100 residents were calculated separately for nurses, health aides, and the combination of licensed practical nurses (LPN) and licensed vocational nurses (LVN). Market-level competition was addressed by calculating a transformed Hertfindahl Index of Competition. The formula for the calculation used is one minus the sum of the market shares squared. The most competitive markets have index values near one, while the least competitive markets have index values near zero. Consistent with prior research, we used number of beds to calculate the market share of facilities and chose the county as the SNF market area (Banaszak-Holl, Zinn, and Mor 1996; Cohen and Spector 1996; Grabowski 2001a, 2001b). The market-level wage index was obtained from the CMS PPS rule to control for area wage costs. Weights were associated with individual metropolitan statistical areas (MSAs) and state-level weights were applied to SNFs in non-MSA areas. These weights were used to adjust the Medicare payment rates for SNFs under PPS.

Finally, a continuous time variable was included to capture the temporal trend in discharge patterns for all SNF residents. The time variable was calculated as time since January 1998, the start of the study period.

Study Population

The total number of Medicare, Medicaid, and private-pay SNF admissions in Michigan and Ohio in 1998 or 1999 was 221,660. Less than 1% of these admissions ($n = 1,039$) were deleted because of missing data. To ensure a common exposure period for residents, we excluded a further 39,415 residents who were admitted in the final 120 days before the study end date. Facilities not certified as SNFs also were excluded from the analyses (24,318 residents). Some residents,

particularly those discharged to a hospital, had more than one SNF stay. In these cases, a single random SNF stay was selected; including multiple SNF discharges would introduce correlated errors between observations from the same resident. We examined the sensitivity of results to selecting a random versus the first observed resident stay. Selecting the first resident stay introduces a bias toward SNF stays occurring early in the study period prior to the implementation of PPS (we discuss these results as sensitivity analyses). The final study population is 106,126 resident admissions.

Analyses

The primary objective of the analyses was to assess the effect of PPS on SNF discharge outcomes. The analyses used a competing-risks hazard model to estimate the relative risk of discharge based on resident admission information. The risk period for residents in this study began with entry to the facility and continued for 120 days. The risk of discharge in the first 120 days was assumed to be dependent on admission characteristics, including the source and method of payment. Four models were used to examine the effect of PPS on resident discharge to the community, to hospital, to death, or to transfer, respectively. In each model, residents who were not discharged to the destination of interest were treated as censored either because they were discharged to another destination or were not discharged before 120 days. This form of hazard model is referred to as a "competing-risks" hazard model because it estimates the likelihood of an event occurring before another, competing event occurs. The primary advantage of this model was that it provided a standardized means to account for different potential discharge destinations and for observations where discharge was not observed by censoring these observations. The hazard model estimated the following equation:

$$h_i(t) = h_0(t) \exp\{\beta_1 * \text{Medicare}_i + \beta_2 * \text{PPS}_i + \beta_3 * (\text{Medicare}_i * \text{PPS}_i) + \underline{\mathbf{Z}}\gamma\}$$

where $h_0(t)$ represented the baseline hazard for all residents; i indexed each resident observation; β_1 captured the effect attributable to Medicare; β_2 captured the change in discharge coincident with the PPS period; and β_3 captured the effect of PPS on the existing difference between Medicare and non-Medicare residents. $\mathbf{Z}\gamma$ was an array of ex-

ogenous risk-adjustment factors, including fixed resident facility market and state variables and a continuous time trend. In the Medicare-only analysis, β_1 and β_3 were constrained to be zero and β_2 identified the change in discharge outcomes coincident with the post-PPS period.

An important advantage of the hazard model was that it estimated the likelihood of discharge to each destination, conditional on continuous residence in the SNF from admission until the observed assessment. Thus, when point estimates were created, the model controlled for the effect of a given length of stay and the underlying propensity for discharge. Furthermore, the proportional-hazard model did not assume a constant underlying risk of discharge. The hazard model thus estimated the effect of PPS on ending SNF stays with a discharge to each destination; relative-risk estimates measure the effect of PPS on the exit rate from a SNF stay for residents discharged to each destination.

Results

The discharge destinations and length of stay on discharge are depicted in Table 1 for all residents discharged from SNFs within the first 120 days. Results are shown for Medicare residents and for non-Medicare residents for admissions before and after the implementation of PPS. Sixty-one percent of all residents were discharged during the first 120 days of their SNF stay. Nearly half the discharged residents went home; about one-sixth were hospitalized. Thirteen percent of all admissions died within 120 days in the facility and 9% were transferred to another non-acute institutional facility (nearly all transfers were to other nursing facilities). More residents were discharged in the post-PPS period and discharges occurred earlier in the post-PPS period for both patient groups. Most residents were admitted with Medicare as their payment source. Medicare residents had a higher prevalence of discharge to home and to hospital than non-Medicare residents, while deaths and transfers in the first 120 days were similar for the two groups. Pre- and post-PPS changes in discharge prevalence and length of stay were in the same direction for both Medicare and non-Medicare residents. The univariate results cannot identify whether changes in resident discharges following the implementation of PPS payment were experienced equally by all residents, were

Table 1. Summary discharge characteristics: prevalence of discharge destination in first 120 days and mean length of stay (LOS) in days at discharge

Discharge destination	Medicare stays		Non-Medicare stays		Overall
	Pre-PPS	Post-PPS	Pre-PPS	Post-PPS	
<i>N</i>	37,015	39,140	16,469	13,502	106,126
Home (%)	32	37	10	17	29
Mean LOS (days)	30.7 (22.5)	27.3 (20.9)	29.3 (21.8)	27.3 (20.8)	28.7 (21.6)
Hospital (%)	10	12	4	6	10
Mean LOS (days)	36.0 (25.5)	30.8 (24.2)	41.3 (28.6)	38.6 (27.9)	34.1 (25.6)
Death (%)	13	15	10	13	13
Mean LOS (days)	38.6 (28.3)	32.8 (27.6)	47.2 (30.4)	44.9 (30.7)	38.0 (29.0)
Transfer (%)	9	9	8	10	9
Mean LOS (days)	41.2 (28.7)	33.6 (27.4)	44.9 (29.5)	43.4 (30.4)	39.1 (28.9)
Not discharged (%) (censored)	36	26	68	54	39

Note: Standard deviations are in parentheses.

due to changes in the resident populations, or resulted from the change in the payment system. Multivariate analyses were required to control for resident, facility, and market characteristics not identified in the summary results.

Summary resident, facility, and market characteristics are presented in Table 2. About two-thirds of all residents were admitted from the hospital and the most prevalent age cohort was 75 to 84 years old. Over half of all residents were totally dependent in ADL function. Just over 40% of residents were independent in cognitive performance, and about the same proportion were moderately impaired.

The most common conditions on admission were a recent fall (45%) and pressure ulcers (43%), and the most common diagnosis was stroke (21%). Sixty-four percent of facilities were for-profit and the average occupancy rate was 83%. Medicare residents constituted one-fifth of the SNF population at any given point in time, while the longer-stay Medicaid residents dominated facilities with 56% of residents. In Michigan and Ohio facilities, there were about 14 full-time-equivalent (FTE) registered nurses, 17 FTE licensed practical or vocational nurses, and 45 FTE health aides per 100 residents. The transformed Herfindahl index average of .86 suggests that SNF markets in these two states were quite competitive.

Figures 1 and 2 display the unadjusted Kaplan-Meier survival and hazard curves depicting the duration of SNF stays before a discharge home. Curves are shown before and after PPS for the Medicare and non-Medicare populations. The figures show that non-Medicare residents have

longer SNF stays (also note the spike in the hazard rate only for Medicare beneficiaries at about the 100-day benefit limit). The figures also show that both Medicare and non-Medicare populations were more likely to be discharged home in the post-PPS period and thus survival in the SNF was lower. The survival curves are thus lower and the hazard curves higher for both populations in the post-PPS period. Multivariate analysis was used to examine whether this change was larger for the Medicare population.

All the variables shown in Table 2 as well as a continuous linear time trend were included as covariates in the multivariate hazard regressions to control for resident, facility, and market factors that might be correlated with discharge outcomes and payment. Relative-risk estimates and significance levels from the hazard estimation are presented in Table 3. To simplify the exposition of the effect of PPS, only payment characteristics are presented in Table 3 (full model results are provided as appendices). Hazard relative-risk (RR) estimates indicate the relative risk (relative to absence of the indicator) of discharge to each destination at a point in time, given that the resident has resided in the SNF until that point in time.

The first row of Table 3 presents the RR between the post-PPS period and discharges for Medicare residents only. The results indicate a RR of 1.05 for discharge to home within 120 days compared to the pre-PPS period. Deaths were less likely for Medicare residents in the post-PPS period with a RR of only .92.

Comparing the differential change in the discharge duration for Medicare residents compared to non-Medicare residents tests the hypothesis

Table 2. Summary of independent variables

Variable	Percent or mean
<i>N</i>	106,126
Payment characteristics on admission	
Payment	
Private pay	15%
Medicare	72%
Medicaid	13%
Post-PPS period	50%
Medicare * Post-PPS (D2 estimator)	37%
Resident-level variables on admission	
Male	32%
Admitted from hospital	68%
Admitted from nursing facility	5%
Age	
65–74	24%
75–84	45%
85+	32%
ADL	
Independent (ADL = 0,1)	10%
Impaired (ADL = 2,3,4)	37%
Totally dependent (ADL = 5,6)	53%
Cognition	
Independent (CPS = 0,1)	42%
Impaired (CPS = 2,3,4)	40%
Totally dependent (CPS = 5,6)	18%
Recent fall (<180 days)	45%
Cerebrovascular accident (stroke)	21%
Alzheimer's disease	9%
Bedfast	9%
Pressure ulcer	43%
Indwelling catheter	17%
Feeding tube	9%
Oxygen therapy	23%
RUG-III case-mix index	1.99 (.96)
Facility-level characteristics (<i>N</i> = 1,450)	
Total beds	152 (101)
Occupancy rate	83%
Facility is hospital-based	12%
For-profit ownership	64%
Chain membership	55%
Percent Medicare residents	20%
Percent Medicaid residents	56%
Registered nurses / 100 residents	13.9 (18.1)
LPN & LVN / 100 residents	16.8 (12.6)
Health aides / 100 residents	44.7 (22.3)
Market-level and state characteristics (<i>N</i> = 160)	
Market competition	.86 (.18)
Market wage index	.94 (.09)
Ohio	59%

Note: Standard deviations are in parentheses.

for this study. Discharges for Medicare and non-Medicare residents were subject to changes in the availability of community supports and alternative care settings throughout the study period. Quality improvement activities within SNFs were also expected to affect all residents in the facility. However, only Medicare residents were directly affected by the introduction of PPS. Thus it is the differential change in discharges that measures the effect of PPS on Medicare resident outcomes and provides a test for our hypothesis. This effect is measured by the interaction between the Medicare payment source variable and the post-PPS period.

The full sample results shown in Table 3 indicate that the post-PPS relative risk for discharge to home for all residents was 1.16 times that of the pre-PPS period risk. Thus, while the Medicare population alone experienced an increased RR of discharge to home post-PPS (compared to pre-PPS) of 1.05, the population of (both Medicare and non-Medicare) residents in certified SNFs had an even higher (1.16) RR for discharge to home following the implementation of PPS.

Residents with a Medicare payment source had a RR of discharge to home of 1.84 relative to non-Medicare residents. The RR of .86 on the Medicare-PPS interaction term (D2 estimator) indicates that the difference between Medicare and non-Medicare residents shrank to 1.58 ($1.84 \times .86$) in the post-PPS period. Thus the gap between Medicare and non-Medicare resident discharges was reduced following the implementation of PPS.

In the full population, the risk of discharge to other destinations did not change significantly from the pre-PPS to the post-PPS period. The Medicare payment source RR estimates indicate that for residents admitted with Medicare as their payment source, the relative risk of discharge within 120 days to all destinations was 1.45 to 1.91 times higher than that of non-Medicare residents. The Medicare PPS difference-in-differences (D2) estimator shows that the PPS program reduced the RR of discharge to death for Medicare residents relative to other residents. The relative risk of hospitalization and transfer for Medicare residents in the post-PPS period was also less than 1.0, but not significant.

Sensitivity Analyses

Several sensitivity analyses were conducted. These results are too numerous to display, but are available from the first author on request.

Figure 1. Survival before discharge home

The first analysis identified fixed-market effects for all counties in the two states. In the Medicare-only population, these results indicated an RR of 1.13 (compared to 1.05). Similarly the RR for discharge to home in the overall sample in-

creased from 1.16 to 1.22. The D2 (Medicare post-PPS) estimate was .88, thus providing analogous overall results to those presented in Table 3. The largest difference in a RR point estimate was a reduction in the RR for transfer of residents with

Figure 2. Hazard for discharge home

Table 3. Medicare and full population: relative risk for each discharge destination

	Discharge destination relative risk			
	Home	Hospital	Death	Transfer
Medicare sample only				
Post-PPS period	1.05**	.99	.92**	1.07*
Full sample results				
Post-PPS period	1.16***	.97	1.05	1.10
Medicare payment source	1.84***	1.45***	1.45***	1.91***
Medicare × Post-PPS (D2)	.86***	.96	.81***	.93

Note: Model adjusts for continuous time and all resident, facility, and market indicators from Table 2.

*** $p < .001$.

** $p < .01$.

* $p < .05$.

“Medicare payment source” where the estimated risk decreased from 1.91 to 1.82. The relative risk estimates for the test of our hypothesis, namely the “Medicare × post-PPS (D2)” increased for each destination by .01 or .02. The latter results indicate that the effect of PPS on Medicare resident discharges was only slightly affected by market-level factors not identified in the base model.

The D2 result is the parameter that tests our hypothesis. Thus, for brevity, hereafter we discuss only changes in the Medicare post-PPS (D2) estimates. Only magnitude changes are described because there were no changes to the reported significance levels. The second sensitivity analysis compared the use of a 100-day observation period. These results again provided analogous results with the D2 RR estimate increasing by between .02 and .03. The third analysis compared the use of the first (instead of a random) resident stay for residents with multiple SNF admissions. The study start date was deferred for 120 days in this analysis to allow for a “look-back” period to ensure our first admission sample did not include residents who had had recent nursing home stays. These results provided lower RRs for discharge to home (.84 instead of .86), and for discharge to death (.77 instead of .81). These values suggest that Table 3 results provide a lower bound on the effect of PPS for Medicare resident outcomes.

The proportion of a facility’s revenues from Medicare could increase facility sensitivity to the change in payment system for Medicare residents. Because specialization in Medicare residents is collinear with payment source, sensitivity analyses were conducted to assess the importance of the proportion of Medicare payment to the facil-

ity. This analysis was based on facilities with less than 2.5% Medicare residents (lowest quartile), between 2.5% and 12.5% Medicare residents (inter-quartile range), and more than 12.5% Medicare residents. The full analyses were run on each of these subpopulations of residents. The effect of PPS on discharge home within each subsample increased with increasing prevalence of Medicare residents (not significant for residents in the lowest quartile, $RR = .85$ in “mixed” inter-quartile range, and $RR = .80$ in the “Medicare specializing” facilities with more than 12.5%). Thus, as expected, facilities that depended more heavily on Medicare revenues were more sensitive to the changes associated with PPS.

Results also were examined based only on residents admitted directly from the hospital to the SNF (reducing the Medicare sample by 19% and the non-Medicare sample by 66%). The changes in the RR for Medicare PPS (D2 estimator) were .87 for discharge to home, or just .01 higher than the full sample result, and .03 lower for discharge to death. Selecting a post-acute sample had a more substantial effect on the RR associated with Medicare payment source on discharge to home. This RR was reduced to 1.61 (.23 lower than full sample results in Table 3), while the association between Medicare payment and the RR for discharge to hospital, death, and transfers were reduced to 1.35, 1.41, and 1.89, respectively .10, .04, and .02 lower than Table 3 results. Finally, we examined the potential for bias in Table 3 results due to potential endogeneity of occupancy rate and payer mix by excluding these characteristics, and we found that all relative risk point estimates for the D2 estimator were within .02.

Sensitivity analyses also examined the importance of the payment source reference category (non-Medicare) by identifying Medicaid payment source in the regression model. Although the additional payment indicator variable was significant in the final model (with Medicaid residents having a lower relative risk of discharge than private-pay residents), all estimates of the relative risk for the Medicare PPS difference-in-differences estimator were within the 95% confidence interval of the base results when the additional payment source indicator variable was included in the regression model.

Discussion

This study provides the most detailed information to date on resident discharge outcomes following the implementation of PPS for Medicare Part A SNF stays. The results should be of particular interest to policymakers monitoring the effect of PPS on resident outcomes. We find that PPS reduced the relative risk for discharge to home and for discharge to death among Medicare residents compared to non-Medicare residents. Thus PPS is associated with neither uniformly declining standards of care nor a large improvement in effectiveness.

We hypothesized that the Medicare PPS program would reduce the care provided in the SNF and that Medicare resident outcomes would deteriorate as a result. This would lead to delayed discharges to home for Medicare residents, while deaths and discharges to hospitals could be more prevalent and occur sooner. The D2 estimator provides the direct evidence for this change. We found that while all residents experienced an increased relative risk for discharge to the community during the time period studied, Medicare residents had a reduced relative risk of discharge to home and death compared to non-Medicare residents in the post-PPS period. PPS payment can be seen to have had a negative effect, holding back Medicare residents from experiencing the same level of increase in the RR of discharge to home as non-Medicare residents. Similarly PPS payment has reduced the gap in the relative risk of discharge that exists between the shorter-stay Medicare and longer-stay non-Medicare populations. Under an alternative interpretation, if the increased relative risk for discharges among all residents indicates that residents are being dis-

charged "quicker and sicker," then PPS has helped to protect Medicare residents from the deterioration in standards of care.

The reduced relative risk for discharge to death suggests quality of care for Medicare residents may have improved for residents most at risk for death. Hospitalizations, another indicator of negative outcomes, was unaffected by the change to PPS. Thus, using discharges as an outcome measure of the Medicare SNF benefit, PPS appears not to have unambiguously and seriously harmed Medicare residents.

The restriction on Medicare payment rates may have decreased unobserved subsidies to other payer groups, and while Medicare resident care was protected, the quality of care provided to non-Medicare residents diminished. If unobserved subsidies have changed under PPS, we identify a lower bound on the effect of PPS on Medicare SNF care. The role of cross-subsidization in this marketplace is an open empirical issue. The present study examined only outcomes depending on the payer responsible for care on admission. Changes in payers throughout the period of exposure (first 120 days of SNF care) are not addressed by this study. However, given average length of stay of 30 to 50 days, we expect little impact on the results shown here. Without any reliable source of information on payment changes during the first three months of a resident's stay, we used sensitivity analyses to indicate any potential impacts: first ensuring the full 100 days of Medicare benefits were available by selecting only first SNF admissions; and second, by limiting the follow-up period to the first 100 days post-admission.

The pattern of SNF admissions and discharges varies for different population groups. For example, it is a common pattern for nursing-home residents who are Medicare beneficiaries and hospitalized for an illness or injury to have a post-hospital SNF stay covered by Medicare, often (though not always) in the same SNF. At the end of Medicare utilization (which may be affected by payment factors, like the copay amount, as well as by coverage criteria), they return to their previous living situation—a non-Medicare bed in a SNF-certified facility. The dynamics of SNF episodes is not addressed by our research. We found interim hospitalizations were not uncommon in our data and intend to pursue the definition of SNF "episodes of care" in future research.

Our evidence reflects the experience of Medicare SNF residents amid concerns raised by others that reimbursement for complex medical care was insufficient under PPS to ensure adequate quality of care (Angelelli et al. 2002; Office of Inspector General 1999, 2001). While the latter studies were unable to demonstrate changes in admission patterns, ongoing research suggests that PPS had a negative impact on other quality of care outcomes for Medicare residents (Hodlewsky 2002). Others have found that SNFs responded to PPS by optimizing treatment levels (Wodchis 2004; Wodchis, Fries, and Pollack 2004) and improving revenues (White 2003).

The results presented in this research are based on only the first year of PPS payment. The CMS implementation of PPS was staged so that facility reimbursement would be phased in over four years (described in endnote 2). In the first year, only one-quarter of most facilities' revenues was based on the PPS rates, while three-quarters was based on retrospective costs. Monitoring facility response to the payment change over the four-year implementation of PPS will provide increased understanding of changes in resident treatment and outcomes. As is often the case, several studies are required to appreciate the impact of PPS on resident quality of care and outcomes.

In the present study, the effect of the change to PPS for Medicare residents is measured with a difference-in-differences estimator. This estimator captures all changes that were associated with Medicare residents (only) and occurred after the change to PPS payment. This includes the use of the RUG-III case-mix classification system, the prospectively determined payment rates, and a reduction in total program payments. Our model posits that SNF providers were directly affected by the change to PPS payment and that the resident outcomes observed here were secondary outcomes (i.e., changes in resident outcomes resulted from changes in provider behavior). Any changes in facility behavior to restrict treatment costs, such as reducing medication use, resident rehabilitation treatments, or activity programming, were captured in the D2 estimator. Thus, the present study does not provide empirical evidence for which provider behavior changes are most sensitive to the change in payment and which are most responsible for the change in Medicare resident outcomes. Moreover, our re-

sults do not specifically identify within-facility effects. Even in sensitivity analyses, our results only identify the effect of PPS on resident care within markets, controlling for fixed facility characteristics. Further investigation of facility-level changes is an important extension to the results presented here.

Delays in discharges to home for Medicare residents following PPS also may be related to changes outside the nursing-home market. Between 1997 and 1999, Medicare home health benefits declined by more than 50% (McCall et al. 2001). The observed delay in discharges to home in this study may be due in part to reductions in home-based support.

The data for this research were extracted from a large administrative database. Electronic databases are generally subject to source data problems, errors in initial coding, and electronic submission errors, among other things. However, such data also tends to be of higher quality when used for payment purposes, as is the case for the MDS database. This research does not assess facility-specific costs, reimbursement, or efficiency. A full accounting for Medicare SNF, hospital, physician, and home health care costs, as well as long-term resident outcomes, would be required to assess any change in overall efficiency of the Medicare program. Because the present study does not include facility-specific changes in total Medicare reimbursement, the effect of PPS captures both changes in allocation of payment among residents in the facility and a reduction in total Medicare expenditures for SNF care. CMS continued to update and increase reimbursement rates under PPS following the period studied here. These changes provide additional sources of identification to isolate the effects of the case-mix payment method from the effect of changes in reimbursement rates (prices).

Evaluating the implementation of PPS and refinements to the RUG-III payment system is an ongoing concern. The present research identified changes in resident discharge outcomes as a result of PPS. Other clinical quality of care and resident outcomes, such as the incidence of pressure sores, resident functional status and resident quality of life, should be examined to ensure that resident care is not compromised as a result of increased federal control over expenditures.

Notes

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- 1 Medicare Part A benefits are referred to simply as Medicare benefits throughout this text. Medicare expenditures for SNF care are provided through Part A benefits for up to 100 days of SNF care for residents who are admitted to a SNF within 30 days of a discharge following at least three days of hospital care. For residents who are not eligible for Part A benefits and pay for supplementary medical insurance, Medicare Part B benefits cover physician visits and ancillary treatments (e.g., physical therapy or oxygen therapy) that are also available to elderly beneficiaries who live in the community.
- 2 The full implementation of Medicare PPS provides a four-year transitional period with a blended funding formula. In the first year of PPS, 25% of facility reimbursement was based on case mix and 75% based on the old reasonable cost method; in subsequent years the case-mix proportion rose to 50%, 75% and finally 100% in the fourth year.

Appendix Table 1. Medicare sample only results: competing-risks hazard regression

	Discharge destination relative risk			
	Home	Hospital	Death	Transfer
Post-PPS period	1.05**	.99	.92**	1.07*
Admitted from hospital	2.74***	1.22***	1.14***	2.52***
Admitted from SNF	.82**	1.04	1.03	1.18
Male	1.05***	1.31***	1.54***	.94*
75–84	.85***	.87***	1.29***	1.32***
85+	.59***	.75***	1.66***	1.53***
Impaired (CPS = 2,3,4)	.46***	.91***	1.37***	1.01
Totally dependent (CPS = 5,6)	.27***	.89***	2.22***	.84***
Impaired (ADL = 2,3,4)	.69***	1.30***	1.94***	.79***
Totally dependent (ADL = 5,6)	.48***	1.59***	3.87***	.66***
RUG-III case-mix index	1.18***	.96***	.81***	1.06***
Recent fall (<180 days)	.88***	.87***	.84***	1.14***
Bedfast	.64***	1.12***	2.17***	1.03
Pressure ulcer	.88***	1.11***	1.09***	.92***
Cerebrovascular accident (stroke)	.84***	.90***	.88***	1.00
Alzheimer's disease	.62***	.78***	.75***	1.03
Oxygen therapy	.98	1.40***	2.23***	1.04
Indwelling catheter	.86***	1.09***	1.25***	1.10**
Feeding tube	.68***	1.17***	.67***	.71***
Total beds	1.03***	1.01	1.00	1.04***
Occupancy rate	.75***	.77***	1.42***	.60***
For-profit ownership	.98	1.08**	.98	.95
Chain membership	.92***	1.01	1.00	1.00
Facility is hospital-based	1.55***	1.01	.98	2.09***
>7% Medicare	.94**	1.02	.93*	.91**
>12% Medicare	1.16***	1.13***	.91**	1.35***
>65% Medicaid	.86***	1.02	.97	.79***
>77% Medicaid	1.06**	1.09**	.83***	1.08
RN > 6/100 residents	1.15***	1.02	.99	1.09*
RN > 8/100 residents	.93***	1.02	.96	.96
RN > 12/100 residents	1.39***	.97	.99	1.36***
LPN & LVN > (10/100) residents	.97	1.00	.99	1.16***
LPN & LVN > (14/100) residents	1.09***	1.00	.95	.92*
LPN & LVN > (18/100) residents	1.04	1.05	1.07	1.05
Health aides > 35/100 residents	.98	1.09**	.99	1.02
Health aides > 41/100 residents	.99	.96	1.06	1.01
Health aides > 49/100 residents	.96*	.95	.95	.98

Appendix Table 1. (continued)

	Discharge destination relative risk			
	Home	Hospital	Death	Transfer
Ohio	1.71***	1.34***	1.10**	1.59***
Market competition	.85***	2.23***	.87	1.92***
Market wage index	.68***	1.24	.62**	.42***
Time trend	1.01***	1.01***	1.01***	1.01***

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Appendix Table 2. Full results: competing-risks hazard regression

	Discharge destination relative risk			
	Home	Hospital	Death	Transfer
Medicare	1.84***	1.45***	1.45***	1.91***
Post-PPS period	1.16***	.97	1.05	1.10
Medicare* Post-PPS (D2)	.86***	.96	.81***	.93
Admitted from hospital	3.34***	1.37***	1.21***	2.58***
Admitted from SNF	.71***	1.11*	1.00	1.18**
Male	1.06***	1.31***	1.52***	.98
75-84	.83***	.88***	1.24***	1.28***
85+	.58***	.78***	1.62***	1.45***
Impaired (CPS = 2,3,4)	.45***	.89***	1.31***	.98
Totally dependent (CPS = 5,6)	.26***	.87***	2.09***	.80***
Impaired (ADL = 2,3,4)	.69***	1.27***	1.91***	.78***
Totally dependent (ADL = 5,6)	.48***	1.54***	4.14***	.65***
RUG-III case-mix index	1.29***	1.00	.83***	1.11***
Recent fall (<180 days)	.89***	.89***	.89***	1.14***
Bedfast	.65***	1.09**	2.25***	1.06
Pressure ulcer	.89***	1.13***	1.11***	.92***
Cerebrovascular accident (stroke)	.84***	.97	.91***	1.02
Alzheimer's disease	.64***	.87***	.79***	1.03
Oxygen therapy	1.00	1.49***	2.38***	1.03
Indwelling catheter	.86***	1.13***	1.26***	1.10***
Feeding tube	.68***	1.14***	.64***	.72***
Total beds	1.03***	1.01	.98	1.04***
Occupancy rate	.74***	.80***	1.39***	.60***
For-profit ownership	.98	1.11***	.99	.97
Chain membership	.94***	1.00	.98	1.00
Facility is hospital-based	1.54***	1.00	1.00	2.11***
>7% Medicare	.96**	1.02	.94*	.95
>12% Medicare	1.15***	1.11***	.91***	1.29***
>65% Medicaid	.86***	1.03	.97	.78***
>77% Medicaid	1.04	1.10***	.83***	1.06
RN > 6/100 residents	1.15***	1.01	1.03	1.07*
RN > 8/100 residents	.92***	1.02	.98	.98
RN > 12/100 residents	1.38***	.99	.98	1.30***
LPN & LVN > (10/100) residents	.97	.96	.98	1.14***
LPN & LVN > (14/100) residents	1.10***	1.04	.96	.94*
LPN & LVN > (18/100) residents	1.00	1.04	1.03	1.01
Health aides > 35/100 residents	.98	1.08**	.99	1.01
Health aides > 41/100 residents	.99	.97	1.04	1.03
Health aides > 49/100 residents	.98	.96	.97	1.00
Ohio	1.83***	1.37***	1.10**	1.63***
Market competition	.83***	2.26***	.98	1.93***

Appendix Table 2. (continued)

	Discharge destination relative risk			
	Home	Hospital	Death	Transfer
Market wage index	.77**	1.20	.58***	.43***
Time trend	1.01***	1.01***	1.01***	1.01***

* $p < .05$.** $p < .01$.*** $p < .001$.

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