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RESEARCH ARTICLE

Organizational Factors

Hospice Effect on Government Expenditures among Nursing Home Residents

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Objective. To examine the effect of the Medicare hospice benefit on Medicare and Medicaid expenditures by dual-eligible Medicare–Medicaid nursing home (NH) residents.
Data Sources/Study Setting. Secondary data for NH residents for 1998–1999.
Study Design. Retrospective cohort study of NH residents in the state of Florida who died between July and December 1999 ($N = 5{,}774$). Medicare claims identified hospice enrollment, and Medicare and Medicaid claims identified expenditures by categories of care. Nursing home resident assessments were used to control for case-mix differences. Geocoding of nursing homes, hospice providers and hospitals was used to identify and characterize local health care markets.
Data Collection/Extraction Methods. A file was constructed linking Medicare and Medicaid claims to Minimum Data Set assessments of NH residents, and NH provider (Online Survey and Certification Automated Record) and hospice provider files.
Principal Findings. Hospice enrollment results in substantial savings in government expenditures (22 percent) among all short-stay ($\leq$ 90 days) dying NH residents. For long-stay ($>$90 days) dying NH residents, hospice provides some savings (8 percent) among cancer residents while it is cost-neutral among dementia residents and adds some cost (10 percent) for residents with a diagnosis other than cancer or dementia. There is evidence of selection bias, particularly among residents with cancer (19 percent savings unadjusted versus 8 percent adjusted). Among short-stay NH residents, hospice greatly reduces Medicare expenditures but increases Medicaid expenditures.
Conclusions. Hospice enrollment results in lower combined Medicare/Medicaid expenditures in the last month of life, particularly among short-stay NH residents. This effect, however, varies by diagnosis and NH length of stay. In addition, for short-stay NH residents, current payment policy creates a Medicare incentive and Medicaid disincentive for promoting residents' referral to hospice.

Key Words. Hospice, nursing home, medicare, medicaid, end-of-life, causal effect

Over the last decades, improvements in health care and socioeconomic conditions have resulted in an increase in longevity and a rising share of deaths occurring from chronic and long-term illnesses. These demographic and case-mix changes, coupled with changes in Medicare reimbursement policies for hospitals and postacute facilities during the 1980s and 1990s, have greatly increased the importance of nursing homes (NHs) as a site where terminal health care decisions take place. The number of people, aged 65 years and older dying in NHs in the United States has steadily increased from 16 percent in 1990 to 28.4 percent in 2003 (Flory et al. 2004; NCHS 2006), and it reaches a much larger 67 percent among dementia-related deaths (Mitchell et al. 2005).

An end-of-life health care option that has gained increased acceptance is Medicare's hospice benefit, introduced as an alternative to traditional aggressive curative medical care for dying Medicare beneficiaries. Between 1992 and 2002 the proportion of Medicare beneficiaries using hospice in the last year of life tripled, from 8 to 26 percent (General Accounting Office 2000; Medicare Payment Advisory Commission 2005). Indeed, one of the largest increases in hospice utilization has occurred among institutionalized individuals (primarily in nursing homes), where a nine-fold increase in enrollment occurred between 1991–1992 and 1999–2000 (Han et al. 2006).

Most prior studies have found that hospice use is associated with significant cost savings and with improved quality of care (Mor and Kidder 1985; National Hospice Organization 1995; Miller et al. 2002, 2004; Wu et al. 2003). However, results from existing cost studies show wide variation, from savings of 68 percent for cancer patients in their last month of life (National Hospice Organization 1995) to 34 percent additional cost for dementia patients in their last year of life (Campbell et al. 2004). The main limitations of these studies can be classified in three categories. First, some have focused on just one class of beneficiaries, typically non-NH cancer patients. While cancer patients constituted the vast majority hospice patients in the early years of the benefit, the

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proportion of noncancer Medicare hospice beneficiaries has steadily increased, reaching 58 percent in 2002/03 (Medicare Payment Advisory Commission 2006). Second, the scope of government costs studied has been Medicare expenditures exclusively. The fact that Medicaid pays for nursing home care for the majority of elderly NH residents (65 percent in 2006) (American Health Care Association 2006) makes joint consideration of both Medicare and Medicaid expenses more relevant to this population. Finally, prior studies have not addressed, or only inadequately, the issue of controlling for selection bias.

The primary objective of this research was to estimate the treatment effect of the Medicare hospice benefit on end-of-life government expenditures among NH residents, addressing several important limitations of previous research. First, this research focuses on NH residents with cancer AND noncancer diagnoses, and second, it estimates the effect of hospice on both Medicare and Medicaid government expenditures, rather than on Medicare expenditures alone. Additionally, it uses advanced statistical causal inference methods to control for treatment heterogeneity and selection bias between hospice and nonhospice groups, allowing us to give a causal interpretation to our hospice effect estimates, unlike previous studies (Mor and Kidder 1985; National Hospice Organization 1995; Campbell et al. 2004; Miller et al. 2004). Finally, this research takes advantage of the detailed health status information available in our dataset (not possible using Medicare claims data alone as in most other studies), allowing for better control of confounders such as the physical and mental disability common among elderly beneficiaries.

METHODS

Design

This study used a retrospective cohort design to estimate the causal effect of hospice on both Medicare and Medicaid expenditures of NH residents in their last month of life. We used regression models and propensity score weights to correct for confounding and sample selection bias. Based on observed differences in case mix and in expenditures by NH length-of-stay (LOS) and by diagnostic group we carried out the analysis separately within six strata, with strata formed by NH LOS (short of ≤ 90 days or long of > 90 days) and three diagnosis groups (cancer, dementia/Alzheimer's, and other). The regression models controlled for NH resident characteristics, NH facility characteristics, and environmental characteristics.

Cohort Development and Data Sources

The study cohort consisted of all NH residents in the state of Florida who died in the second half of 1999, in an NH or an acute care or hospice inpatient setting after transfer from the NH. These NH residents were Medicare eligible and age 65 or older for the entire last year of life, Medicaid eligible for at least their entire last month of life, and did not participate in a Medicare Managed Care program. Medicare data for 1998–1999 included NH resident assessment data (i.e., the Minimum Data Set [MDS]) (MDS 2003) as well as Medicare denominator and claims data approved for use by the Centers for Medicare and Medicaid Services (CMS). Medicaid claims and eligibility data for 1998–1999 were approved for use by the Florida Agency for Health Care Administration (AHCA) and the Florida Department of Public Health approved use of vital statistics data for 1999 decedents.

Resident assessments (MDS) were used to help determine whether a beneficiary was residing in an NH and to obtain information on the health status of the resident. In our cohort, short-stay residents had their last MDS assessment a mean $\pm$ SD of 20.2 $\pm$ 19.4 days before death; for long-stay residents the last MDS assessment was on average 47 $\pm$ 35.3 days before death.

Dates of death were determined using the Florida vital statistics data and the Medicare denominator file. In case of conflict the vital statistics date was chosen given its higher accuracy when reconciled with claims utilization dates. Medicare and Medicaid claims plus MDS data were used to determine place of death.

Hospice status and LOS (days receiving the benefit) were established using Medicare claims data. In cases of more than one hospice episode, days across episodes were aggregated except in the rare instance when more than 6 months elapsed between a non-NH and an NH hospice episode, in which case only the NH episode was used.

Our final sample ($N=$ 5,774) was identified after excluding residents whose NH residence at time of death was questionable ($N=$ 410) (their last MDS was dated more than 120 days before death) and residents who were transferred to a hospital and from the hospital to inpatient hospice, where they died ($N=$ 217), as their hospice enrollment occurred outside of the NH. Of our final 5,774 sample, 23 percent ($N=$ 1,308) received some hospice in the NH before death.

Outcome Measures

The primary outcome measure was total Medicare and Medicaid expenditures in the last month of life. Medicare and Medicaid expenditures were categorized into four expenditure groups: acute inpatient, hospice, NH (skilled nursing facilities [SNF] in the case of Medicare), and other. The latter category included home health, outpatient, medications, and other services. Medicaid appropriation and eligibility codes were used to determine NH-days under Medicaid, and co-pays in each category.

Covariate Measures

Hospice NH residents consisted of those with at least 1 day of hospice enrollment while residing in an NH, whether hospice election occurred in the NH ($N=1{,}185$) or before admission ($N=123$, 9.4 percent). Medicare denominator file and Medicaid eligibility records were used to obtain age at death (categorized as 65–74, 75–84, and 85 or older), gender, and race (categorized as white, black, and other; other being mostly of Hispanic origin).

Residents were classified into disease groups by using the diagnoses in claims data as well as diagnoses from MDS assessments. Following past studies (Mor and Kidder 1985; Kidder 1992; Campbell et al. 2004; Miller et al. 2004) we assigned cancer to individuals who had any cancer diagnosis in the claims or had a diagnosis of cancer in either of the last two MDS assessments. The overall small number of cancer patients among long and short-stay NH residents prevented us from analyzing specific types of cancer. A dementia/Alzheimer's diagnosis was obtained in a similar fashion using diagnoses in the claims or from either of the last two MDS assessments. The few individuals ($N=355$) who had both cancer and dementia diagnoses were classified as dementia patients based on analyses showing their expenditure patterns to be almost identical to those for individuals with dementia (and no cancer). The remaining NH residents were classified as having a diagnosis other than cancer or dementia.

Additional health status information was derived from the last MDS before death and included limitations in Activities of Daily Living (ADL) (six-point scale, with 0 representing no limitations and 5 representing total dependence), categorized as a binomial indicator variable representing an ADL score of 4 or more. From these data, an indicator variable representing the presence of severe cognitive impairment was also created (defined as a value of 4 or higher in the Cognitive Performance Scale where 0 represents intact cognition and 6 very severe cognitive impairment). We also included indicator variables to represent the presence of congestive heart failure, peripheral vascular disease, septicemia, emphysema/chronic obstructive pulmonary disease (COPD), pneumonia, hip fracture, significant change in self-sufficiency, bowel incontinence, hypertension, and the presence of pressure ulcers. In addition, MDS data were used to create variables indicating the presence of do-not-resuscitate (DNR) and do-not-hospitalize (DNH) orders. A variable identifying high use of health care (i.e., in top quartile of total expenditures during months 7 through 12 before death in each stratum) was used to help control for selection bias, as high utilization in the half-year before hospice eligibility may be related to underlying individual, facility, or regional preferences for more aggressive care. Given that the majority of NH hospice enrollees elected hospice during their last month of life (53 percent among NH long-stayers and 74 percent among NH short-stayers), not adjusting for high historical expenditures may result in an underestimation of the potential hospice savings if hospice (versus nonhospice) NH residents already have a history of higher expenditures (or vice versa). Our expenditure models allowed for heterogeneity of the hospice effect by including interactions of hospice with indicators of older age (85 years and older), male gender, and severe cognitive impairment.

Based on prior studies of hospice among NH residents, we also included as covariates NH facility organizational characteristics that may influence utilization patterns (Gozalo and Miller 2006). These data were derived from the Online Survey and Certification Automated Record (OSCAR) each NH facility submits to the Center for Medicare and Medicaid Services. Variables included were whether the NH is hospital-based, has for-profit proprietorship, the occupancy rate, an indicator of size ($\geq$ 120 beds), and the number of full-time-equivalent nurses per 100 residents. From a listing provided to us by Florida's Agency for Health Care Administration, we also created a variable to indicate whether a nursing home participated in EverCare, a special NH-based Medicare managed care program relatively prevalent in Florida (Kane et al. 2002). As a measure of access to hospice for residents in a given NH, we used latitude and longitude coordinates based on the addresses of NH and hospice providers to calculate the distance from each NH to its nearest hospice provider (categorized as <6, 6–12, and >12 miles). Finally, we included variables to indicate the major Florida geographic regions (North, Central, and South) to account for utilization differences between regional health care markets.

Analytic Approach

Given that hospice is an elective benefit program, we would expect individuals choosing hospice to have different characteristics than those not choosing hospice. Ignoring these differences can lead to regression estimates suffering from selection bias, a problem criticized in prior hospice cost studies (Emanuel and Emanuel 1994; Scitovsky 1994). Our approach to account for the nonrandom assignment of the treatment effect was based on the Inverse Probability of Treatment Weighting (IPTW) method proposed by Robins and colleagues (Robins and Rotnitzky 1995; Robins, Hernan, and Brumback 2000). The IPTW technique combines two commonly used methods, regression and propensity score weighting, to take advantage of the best features of each individual method. Regression corrects for confounding while the inverse propensity score weighting corrects for imbalances in the distribution of the covariates between the treatment and control groups producing an unbiased treatment effect estimate (Hirano and Imbens 2001; Hogan and Lancaster 2004; Imbens 2004). The IPTW method has been recently applied to study the effect of hospice on end-of-life hospitalizations (Gozalo and Miller 2006), and it has better properties than methods based on using the propensity score for stratification matching (Lunceford and Davidian 2004) or as an additional covariate (Campbell et al. 2004; Newgard et al. 2004; Austin and Mamdani 2006).

The probability of hospice enrollment was estimated using a logistic regression model allowing for clustering within NH (Diggle et al. 2002). Expenditures were modeled using two alternative methods (see Appendix A), but results from the Box–Cox modeling approach are presented here. The predictive model of expenditures was used to estimate for each NH resident their expected government expenditures were they to choose hospice, $\hat{Y}(1)$, and were they not to choose hospice, $\hat{Y}(0)$. To better inform policy, we present the hospice effect for those that actually enrolled in hospice, which provides an estimate of the current impact of hospice on government expenditures (Lunceford and Davidian 2004). In addition, we provide estimates of the hospice effect in the limiting hypothetical "universal enrollment" scenario where every NH resident enrolls in hospice, calculated as the average of the individual-level differences $\hat{Y}(1) - \hat{Y}(0)$ over all hospice and nonhospice NH residents. Confidence intervals for the average treatment effect estimates were obtained using bootstrap methods (Efron and Tibshirani 1993).

RESULTS

Our overall sample was 71 percent female, 21 percent nonwhite, and had an average age of 84.9 years. Short- and long-stay residents differed, with higher proportions of short-stay residents being male, nonwhite, younger, and more often having cancer and other diagnoses such as congestive heart failure and COPD than dementia (Table 1). Short-stay residents also had lower rates of severe cognitive and physical (ADL) impairment than did long-stay NH residents, and they had lower rates of hospice enrollment. Residents also differed by hospice enrollment status, with higher proportions of hospice patients being white, having cancer, having DNR orders in place, and residing in NHs in the more urban South and Central Florida regions (Table 1).

Unadjusted government total expenditures and their breakdown into Medicare and Medicaid expenditures showed strong differences among long-stay and short-stay NH residents, and by hospice status (Table 2). Expenditures were considerably higher (70 percent) among short-stay NH residents, in part due to the case-mix differences observed in Table 1 and to the higher use of hospital care before entering the NH. However, among short-stay residents the dementia cohort had the lowest total expenditures. Among long-stay residents, those with cancer had almost 25 percent higher expenditures than the other two diagnosis cohorts. As can be observed under "Unadjusted Differences" in Table 2, hospice was associated with lower costs among all short-stay cohorts (26 percent difference overall) and, to a lesser degree, among the cancer long-stay cohort (19 percent difference); however, expenditures were higher for hospice residents (by 7 percent) among the two noncancer long-stay cohorts. The unadjusted differences in Table 2 also reveal that most of the hospice effect results from changes in Medicare expenditures. Hospice had little effect on Medicaid expenditures among long-stay NH cohorts but it increased Medicaid expenditures among short-stay NH cohorts.

Table 3 shows that after applying IPTWs to the cohorts, the case-mix differences by hospice status observed in the raw data (see Table 1) greatly diminished, confirming the validity of using the IPTW sample.

The adjusted hospice effect estimates derived from the IPTW regression analyses had the same direction as in the unadjusted estimates but quantitatively the effects were more modest, particularly for the long- and short-stay cancer cohorts (Table 4). These differences present clear evidence of selection bias in the unadjusted estimates. Adjusted hospice estimates averaged a total savings of $1,453 or of 13 percent for short-stay cancer residents, and of $663 or 9 percent for long-stay cancer residents (Table 4). In the two noncancer long-stay cohorts, the adjusted estimates showed no hospice effect among the long-stay dementia cohort. However, for the "other" long-stay cohort our model estimated a large (14 percent) increase in expenditures associated with hospice (Table 4). The largest savings occurred in the dementia (18 percent)

Table 1: Selected Characteristics of Hospice and Nonhospice for Long-Stay (> 90 Days) and Short-Stay (≤ 90 Days) Decedent Nursing Home (NH) Residents (% or Mean ± SD)§

	Long-Stay NH Residents		*Short-Stay NH Residents*	
Variable	*Hospice (N = 958, 24%)*	*Nonhospice (N = 3,077)*	*Hospice (N = 350, 20%)*	*Nonhospice (N = 1,389)*
Sociodemographic				
Male	25	27	35	36
Black	8	11	11	16
Other race	6	7	10	15
Age				
65–74 years	8	9	15	16
75–84 years	33	30	37	38
85 years or older	59	60	48	46
Diagnosis group				
Cancer	10	4	22	12
Dementia/Alzheimer's	44	43	45	47
Other	46	53	33	41
Additional diagnoses				
Congestive heart failure	15	15	33	36
Chronic obstructive pulmonary disease	12	11	26	32
Severe cognitive impairment*	80	78	68	71
≥ 4 limitations in ADL†	74	65	67	68
Do-not-resuscitate advanced directive	37	26	57	39
Do-not-hospitalize advanced directive	1	1	‡	‡
Environmental				
Distance from NH to nearest hospice (miles)	9.2 ± 9	10.4 ± 11	8.5 ± 8	9.6 ± 10
North FL region	26	41	32	40
Central FL region	37	31	35	30
South FL region	37	28	32	30

*Cognitive Performance Scale value > 3 (0–6 scale, 0 = no cognitive impairment, 6 = very severe impairment).

†Activities of daily living (ADL) 6-point scale, with 0 = no limitations and 5 = total dependence.

‡The percent of do-not-hospitalize among short-stay NH residents was identical for hospice and nonhospice. The actual % value not reported due to small sample size that may potentially result in the identification of individuals.

§p-values of Hotelling's T^2 test of equality of means of all covariates by cohort: long-stay NH residents = .403 (cancer), 0 (dementia), 0 (other); short-stay NH residents = 0.055 (cancer), 0 (dementia), 0 (other).

and "other" (30 percent) short-stay cohorts (Table 4). The estimated effects in the hypothetical case that all residents in a cohort enrolled in hospice showed slightly larger savings than the effects observed for those who actually enrolled

Table 2: Average Unadjusted Total Expenditures (in $US) in the Last Month of Life and Their Breakdown into Medicare and Medicaid Expenditures for Nonhospice and Hospice Nursing Home Residents by Nursing Home Length-of-Stay and Diagnostic Category

	Expenditure Group	*Hospice*	*Nonhospice*	*Unadjusted Difference*	*Unadjusted Difference Relative to Nonhospice (%)*
Long-stay NH residents					
Cancer (N= 223)	Total	7,090	8,747	– 1,657#	– 19
	Medicare	4,355	5,990	– 1,635	
	Medicaid	2,735	2,757	– 22	
Dementia (N= 1,678)	Total	6,768	6,328	440	7
	Medicare	4,096	3,659	437	
	Medicaid	2,672	2,669	3	
Other (N= 1,971)	Total	6,917	6,447	470#	7
	Medicare	4,106	3,655	451	
	Medicaid	2,811	2,792	19	
All diagnoses (N= 3,872)	Total	6,869	6,495	374#	6
	Medicare	4,127	3,758	369	
	Medicaid	2,742	2,737	5	
Short-stay NH residents					
Cancer (N= 233)	Total	9,743	12,466	– 2,723#	– 22
	Medicare	7,843	10,936	– 3,093#	
	Medicaid	1,900	1,530	370#	
Dementia (N= 791)	Total	8,489	11,025	– 2,536*	– 23
	Medicare	6,088	9,071	– 2,983*	
	Medicaid	2,401	1,954	447*	
Other (N= 659)	Total	8,370	12,416	– 4,046*	– 33
	Medicare	6,311	10,689	– 4,378*	
	Medicaid	2,059	1,727	332#	
All diagnoses (N= 1,683)	Total	8,722	11,764	– 3,042*	– 26
	Medicare	6,543	9,953	– 3,410*	
	Medicaid	2,179	1,811	368*	
All NH residents	Total	7,364	8,134	– 770*	– 9
	Medicare	4,774	5,685	– 911*	
	Medicaid	2,591	2,449	142*	

*p-value < .001.
#p-value < .05 (two-tail test of equality of means assuming unequal variance).

in hospice, indicating that the unenrolled have higher potential for savings than those who actually enrolled.

Two more results are noteworthy. First, there was enough hospice treatment effect heterogeneity that not all subgroups within a given cohort were equally affected. Considering the long-stay "other" cohort in which hospice

Table 3: Selected Characteristics Adjusted by IPTWs of Hospice and Nonhospice for Long-Stay (> 90 Days) and Short-Stay (≤ 90 Days) Nursing Home (NH) Residents (% or Mean ± SD)[§]

	Long-Stay NH Residents		*Short-Stay NH Residents*	
Variable	*Hospice (N= 958, 24%)*	*Nonhospice (N= 3,077)*	*Hospice (N= 350, 20%)*	*Nonhospice (N= 1,389)*
Sociodemographic				
Male	27	26	36	36
Black	11	10	16	15
Other race	7	7	13	14
Age group				
65–74 years	9	9	16	16
75–84 years	32	31	39	38
85 years or older	59	60	45	46
Additional diagnoses				
Congestive heart failure	15	15	33	35
Chronic obstructive pulmonary disease	12	12	32	31
Severe cognitive impairment*	77	78	73	71
≥4 limitations in ADL[†]	65	66	70	68
Do-not-resuscitate advanced directive	29	28	40	42
Do-not-hospitalize advanced directive	1	1	‡	‡
Environmental				
Distance from NH to nearest hospice (miles)	10.1 ± 9	10.2 ± 11	9.7 ± 8	9.5 ± 10
North FL region	36	37	37	38
Central FL region	33	33	33	31
South FL region	31	30	30	31

*Cognitive Performance Scale value > 3 (0–6 scale, 0 = no cognitive impairment, 6 = very severe impairment).

[†]Activities of daily living (ADL) 6-point scale, with 0 = no limitations and 5 = total dependence.

[‡]The percent of do-not-hospitalize among short-stay NH residents was identical for hospice and nonhospice. The actual % value not reported due to small sample size that may potentially result in the identification of individuals.

[§]p-values of Hotelling's T^2 test of equality of means of all covariates by cohort: long-stay NH residents = 0.998 (cancer), 0.999 (dementia), 0.676 (other); short-stay NH residents = 0.990 (cancer), 0.998 (dementia), 0.991 (other).

increased expenditures most, and using this cohort's expenditure estimates to calculate the hospice effect for the eight cohort subgroups formed by age (85 years and older versus < 85), gender (male versus female), and cognitive status (severe impairment versus not severe) we show differences by subgroups (Table 5). As shown, while hospice adds cost in this cohort, the hospice effect varies among subgroups from large savings for younger males without severe

Table 4: Adjusted Average Hospice Treatment Effect (in $US) on Total Government Expenditures in the Last Month of Life within Nursing Home Length-of-Stay and Diagnostic Stratum for Those Treated (Those That Enrolled in Hospice) and if (Hypothetically) All NH Residents Had Enrolled in Hospice

	Unadjusted Treatment Effect	*Adjusted Treatment Effect (among Enrolled)*		*Adjusted Hypothetical Treatment Effect (if All Enrolled)*	
		($)(95% CI)	*Percent Attributable Effect (%) (95% CI)*	*($)(95% CI)*	*Percent Attributable Effect (%) (95% CI)*
Long-stay NH residents					
Cancer	− 1,657#	− 663 (− 3,417; 493)	− 9 (− 33; 7)	− 740 (− 3,408; 463)	− 9 (− 32; 7)
Dementia	440	28 (− 701; 557)	0.4 (− 9; 9)	− 3 (− 673; 503)	− 0.0 (− 9; 8)
Other	470#	833# (220; 1,335)	14 (3; 24)	611# (19; 1,101)	10 (0.3; 19)
All diagnoses	374#	400 (− 7; 807)	6 (− 0.1; 13)	267 (− 127; 661)	4 (− 2; 11)
Short-stay NH residents					
Cancer	− 2,723#	− 1,453 (− 3,726; 750)	− 13 (− 28; 8)	− 1,493 (− 3,661; 653)	− 13 (− 27; 7)
Dementia	− 2,536*	− 1,804* (− 2,988; − 722)	− 18 (− 26; − 8)	− 1,993* (− 3,162; − 893)	− 19 (− 27; − 10)
Other	− 4,046*	− 3,584* (− 5,125; − 2,380)	− 30 (− 38; − 22)	− 3,742* (− 5,106; − 2,655)	− 31 (− 38; − 24)
All diagnoses	− 3,042*	− 2,452* (− 3,273; − 1,631)	− 22 (− 27; − 16)	− 2,609* (− 3,388; − 1,830)	− 23 (− 28; − 17)
All NH residents	− 770*	− 464# (− 841; − 87)	− 6 (− 10; − 1)	− 604# (− 966; − 242)	− 8 (− 12; − 3)

*p-value < .001.

#p-value < .05 (two-tail test of equality of means assuming unequal variance).

Confidence intervals obtained from 1,000 bootstrap replications.

Table 5: Long-Stay Nursing Home Residents with Diagnosis "Other": Adjusted Average Hospice Treatment Effect on Total Government Expenditures in the Last Month of Life for Those Enrolled in Hospice and if (Hypothetically) All Had Enrolled in Hospice

Subgroup (0 = No, 1 = Yes)						
Age 85+	*Male*	*Severe Cognitive Impairment*	*Sample Size*	*Unadjusted Treatment Effect ($)*	*Adjusted Treatment Effect (among Enrolled) ($) (95% CI)*	*Adjusted Hypothetical Treatment Effect (if All Enrolled) ($) (95% CI)*
0	0	0	195	− 2,234#	− 1,336# (− 2,674; − 79)	− 1,433# (− 2,795; − 114)
0	0	1	341	1,108#	1,661* (646; 2,981)	1,623* (650; 2,719)
0	1	0	111	− 1,827	− 3,464* (− 6,271; − 1,963)	− 3,629* (− 5,462; − 1,977)
0	1	1	168	− 424	484 (− 1,205; 1,963)	447 (− 1,284; 1,960)
1	0	0	233	− 311	− 680 (− 1,925; 480)	− 668 (− 1,886; 507)
1	0	1	735	1,998*	1,977* (1,342; 2,618)	1,884* (1,200; 2,471)
1	1	0	49	− 24	− 2,268* (− 4,081; − 702)	− 2,344* (− 3,939; − 801)
1	1	1	139	− 574	835 (− 338; 2,299)	754 (− 435; 2,077)
Total			1,971	470#	833# (220; 1,335)	611# (19; 1,101)

*p-value $<.001$.

#p-value $<.05$ (two-tail test of equality of means assuming unequal variance).

Confidence intervals obtained from 1,000 bootstrap replications.

cognitive impairment who enroll in hospice to large additional costs for older females with cognitive impairment (Table 5). Relative to younger males without severe cognitive impairment, severe cognitive impairment added approximately $3,000 in estimated expenditures, being female an additional $1,400 and being 85+ another $500 (Table 5).

Second, because of the opposite Medicare/Medicaid hospice effect observed in the raw data among short-stay NH residents (Table 2), we estimated the hospice effect on Medicaid expenditures (not shown). Our results confirmed a substitution effect between Medicare and Medicaid expenditures among short-stay NH residents occurs. Using the short-stay "other" diagnosis cohort as an illustration, the estimated adjusted hospice treatment effect on Medicaid expenditures represented $567 in additional expenditures on average, doubling (from 12.5 percent to 25 percent) Medicaid's share of total expenditures.

Discussion

Overall, we estimate NH hospice enrollment reduces the last month of total government expenditures by 6 percent. This effect, however, is not uniform across NH residents. Short-stay NH hospice enrollment results in uniformly large savings (22 percent overall), but for long-stay NH residents, the hospice effect is mixed. We observe a hospice cost saving effect among cancer long-stay NH residents (of 9 percent), cost neutrality among dementia long-stay NH residents, and additional expenditures (of almost 14 percent) for long-stay NH residents with diagnoses other than cancer or dementia. However, even among this last group of NH residents, factors such as cognitive impairment, gender and/or age have a strong influence on whether hospice has a positive or negative effect on end-of-life expenditures. Another important study finding is the modest but statistically significant increases in Medicaid expenditures among short-stay NH cohorts, resulting in a financial disincentive for state Medicaid programs to promote hospice enrollment (at least for short-stay dual-eligible residents). Finally, the sometimes large differences between the unadjusted and adjusted results makes evident the importance in hospice cost studies of using methodologies that correct for selection bias.

The heterogeneity in our hospice effect estimates can be partly understood as a reflection of the difference in utilization patterns, particularly of Medicare benefits, among different cohorts and their subgroups. Long-stay NH residents have a greater need for long term care supportive services and a lower use of Medicare inpatient and SNF care. In addition, the longer observation of their trajectory to death by the NH staff may help explain their longer hospice LOS (27 days median hospice LOS versus 13 days median hospice LOS for short-stay NH residents). As a result, Medicare savings for inpatient and SNF care may not be large enough to offset the added cost of the hospice benefit. Short-stay NH residents, on the other hand, tend to be admitted to the NH to receive skilled care following an inpatient episode, and while for many their prognosis is uncertain, others are transferred to NHs within days or weeks before death (Miller, Teno, and Mor 2004). Due to the high acuity of these short-stay residents, their use of Medicare inpatient and SNF care is greater than among long-stay residents (see Table A in electronic Appendix A), resulting in a greater opportunity for cost savings upon hospice enrollment, despite their shorter hospice LOS.

Unlike another study that included NH residents as part of their study (Campbell et al. 2004), we did not observe a large (30 percent) increase in expenditures for hospice residents having a diagnosis of dementia, and we also did not observe large increases in expenditures for those 85 years of age or older. Instead, our findings show severe cognitive impairment and gender have much larger effects on expenditures than does age or a documented diagnosis of dementia. This difference in results could be due to our study population (NH residents), our greater ability to control for case mix, the sophistication of the statistical techniques used to adjust for selection bias, and/or to the difference in the time period studied (last year of life versus last month of life).

The partial substitution of Medicaid for Medicare expenditures associated with hospice enrollment among short-stay NH residents results in part from Medicare's payment policies. In particular, Medicare SNF residents cannot simultaneously access Medicare hospice (unless SNF care is unrelated to the terminal condition). Thus, when SNF dual-eligible residents elect hospice, NH payment becomes the responsibility of Medicaid, rather than Medicare. (Of note, similarly, when private-pay Medicare SNF residents elect hospice, NH payment becomes the responsibility of the patient/family, rather than of Medicare [Miller, Teno, and Mor 2004].) This shift in payment source also affects NH facilities as Medicaid per diem payment rates are typically substantially lower than the SNF per diem rates, creating a financial disincentive for both NHs and Medicaid programs to promote hospice enrollment among short-stay NH residents. However, given the overall large savings resulting from hospice enrollment among short-stay NH residents (Table A in electronic Appendix A), it may be of interest to all parties involved (Medicare, Medicaid, NHs, and Medicare beneficiaries) to relax or modify the hospice/SNF exclusion policy barrier so to increase hospice enrollment. For example, implementation of some type of additional time-limited Medicare payment to state Medicaid programs (with some portion going to NHs) to supplement the Medicaid NH per diem rate when dual-eligible SNF residents elect hospice could serve to subsidize the additional Medicaid NH expenses incurred when caring for these high acuity residents as well as result in increased hospice access for SNF residents. While study results show such a subsidy program to be viable and desirable for beneficiaries, nursing homes, and the government, further study across more states is needed to validate whether these findings can be generalized, and thus to determine whether a subsidy program would in fact be feasible nationally.

The observed results for the cancer cohorts confirm the cost saving effect of hospice for cancer found in several studies (Mor and Kidder 1985; Kidder 1992; Campbell et al. 2004), but the results also show cancer cohorts to have the largest evidence of selection bias. This evidence of selection bias, emphasizes the importance for hospice cost studies to use both data sources that allow for comprehensive adjustment for confounding and more sophisticated statistical techniques to help control for selection.

Our study has certain limitations. Despite the use of good statistical methods and comprehensive patient assessment data to control for case mix and selection bias, there is always a possibility that some important factor remains unobserved. Additional studies that allow for better control of unobserved factors such as the use of a natural experiment, instrumental variables or clinical trial would be helpful to validate our findings. Also, while our data covers all Florida NH dying residents during our observation period, the results may not generalize to other states. Additionally, this study focused on expenditures in the last month of life as 53 percent of long-stay and 74 percent of short-stay NH residents enrolled in hospice in the last 30 days of life, and as expenditures by both hospice and nonhospice enrollees are largest in the last month of life (Yang, Norton, and Stearns 2003; Miller et al. 2004). However, given our study's focus, the financial effects of hospice for months beyond the last month of life cannot be determined from the results presented here.

This study extends the findings of other hospice cost studies and emphasizes the importance of conducting separate analyses for subpopulations that are known to differ substantially in their expenditure patterns. Still, hospice costs studies, while important, cover only one aspect of the potential benefits associated with hospice. A complete cost-effectiveness evaluation of the hospice benefit needs to include the potential patient/family benefits associated with hospice care such as higher-quality symptom management, continuity and comprehensiveness of care, and bereavement and spiritual comfort provided to the patient and family. These benefits may well justify the observed added monetary costs associated with hospice care for some beneficiaries.

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METHODOLOGICAL APPENDIX

The implementation of the IPTW method involves two steps, initial estimation of the probability of hospice enrollment, followed by estimation of the outcome model with a weighted regression where the weights are created using the propensity scores estimated in the first step. Both steps were performed for each of the six study groups (i.e., the three diagnosis groups by short versus longer NH stay).

The logistic propensity score estimates for each NH LOS/diagnosis stratum showed good overlap and good separation of their central values (mean, median) between the hospice and nonhospice groups (the mean probabilities for residents who had enrolled in hospice were on average .13 higher among long-stay cohorts and .18 higher among short-stay cohorts).

Expenditures were modeled using two alternative methods, the Box–Cox transformation family (of which the commonly used log-transformation is one member) and the newly proposed Generalized Gamma (GG) models (Greene 2003; Buntin and Zaslavsky 2004; Manning, Basu, and Mullahy 2005). In the transformation model we used Duan's smearing estimate when re-transforming our predictions to the original scale (Duan 1983; Duan et al. 1983). In both models, the Box–Cox and the GG models, it was important to allow for heteroskedasticity in the error term to obtain a good prediction model. In the Box–Cox approach we created separate smearing factors for hospice and nonhospice groups, as hospice has a strong variance-reduction effect, while in the nonhospice group expenditures vary substantially more depending primarily on whether the NH residents are hospitalized or not. Other variables used to model heteroskedasticity were male gender (in long-stay dementia and long-stay other stratums), an age of 85 or older (in long-stay dementia), and a diagnosis of COPD and the presence of a DNR order (in short-stay other). Because the GG estimation produced almost identical results, we just report the estimates of the Box–Cox model.

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Supplementary Material

The following supplementary material for this article is available:

Appendix A. Unadjusted Average Medicare and Medicaid Last-Month Expenditures ($US) by Major Expense Categories for Hospice and Nonhospice Long-Stay (>90 Days) and Short-Stay (≤ 90 Days) Nursing Home Residents.

This material is available as part of the online article from: http://www.blackwell-synergy.com/doi/abs/10.1111/j.1475-6773.2007.00746.x (this link will take you to the article abstract).

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