Original Investigation

Association Between the Medicare Hospice Benefit and Health Care Utilization and Costs for Patients With Poor-Prognosis Cancer

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IMPORTANCE More patients with cancer use hospice currently than ever before, but there are indications that care intensity outside of hospice is increasing, and length of hospice stay decreasing. Uncertainties regarding how hospice affects health care utilization and costs have hampered efforts to promote it.

OBJECTIVE To compare utilization and costs of health care for patients with poor-prognosis cancers enrolled in hospice vs similar patients without hospice care.

DESIGN, SETTING, AND PARTICIPANTS Matched cohort study of patients in hospice and nonhospice care using a nationally representative 20% sample of Medicare fee-for-service beneficiaries who died in 2011. Patients with poor-prognosis cancers (eg, brain, pancreatic, metastatic malignancies) enrolled in hospice before death were matched to similar patients who died without hospice care.

EXPOSURES Period between hospice enrollment and death for hospice beneficiaries, and the equivalent period of nonhospice care before death for matched nonhospice patients.

MAIN OUTCOMES AND MEASURES Health care utilization including hospitalizations and procedures, place of death, cost trajectories before and after hospice start, and cumulative costs, all during the last year of life.

RESULTS Among 86 851 patients with poor-prognosis cancers, median time from first poor-prognosis diagnosis to death was 13 months (interquartile range [IQR], 3-34), and 51 924 (60%) entered hospice before death. Matching yielded a cohort balanced on age, sex, region, time from poor-prognosis diagnosis to death, and baseline care utilization, with 18 165 patients in the hospice group and 18 165 in the nonhospice group.

	Nonhospice Group (n = 18 165)	Hospice Group (n = 18 165)	Risk Ratio (95% CI)
Hospitalizations, % (95% CI)	65.1 (64.4-65.8)	42.3 (41.5-43.0)	1.5 (1.5-1.6)
Intensive care unit admission, % (95% CI)	35.8 (35.1-36.5)	14.8 (14.3-15.3)	2.4 (2.3-2.5)
Invasive procedures, % (95% CI)	51.0 (50.3-51.7)	26.7 (26.1-27.4)	1.9 (1.9-2.0)
Death in hospital or nursing facility	74.1 (73.5-74.8)	14 (13.5-14.5)	5.3 (5.1-5.5)
Costs in last year of life, $ (95% CI)	71 517 (70 543-72 490)	62 819 (62 082-63 557)	**Difference,** 8697 (7560-9835)

After matching, 11% of nonhospice and 1% of hospice beneficiaries who had cancer-directed therapy after exposure were excluded. Median hospice duration was 11 days. Nonhospice beneficiaries had significantly greater health care utilization, largely for acute conditions not directly related to cancer and higher overall costs.

CONCLUSIONS AND RELEVANCE In this sample of Medicare fee-for-service beneficiaries with poor-prognosis cancer, those receiving hospice care vs not (control), had significantly lower rates of hospitalization, intensive care unit admission, and invasive procedures at the end of life, along with significantly lower total costs during the last year of life.

JAMA. 2014;312(18):1888-1896. doi:10.1001/jama.2014.14950

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Multiple studies have documented the high intensity of medical care at the end of life,[1,2] and there is increasing consensus that such care can produce poor outcomes[2-4] and conflict with patient preferences.[4,5] The Institute of Medicine report *Dying in America* has drawn attention to the difficulties of promoting palliative care, including Medicare's hospice program,[6] the largest palliative care intervention in the United States, which covers all comfort-oriented care related to terminal illnesses from medications to home care to hospitalizations. Although the number of people receiving hospice care has increased since the program began in 1982, enrollment length decreased over the same period and end-of-life care intensity increased.[7] Patients with cancer, the single largest group of hospice users,[8] have both the highest rates of hospice enrollment and the highest rates of hospice stays less than 3 days.[7]

Several policy factors are cited to explain these trends. First, the Medicare administration monitors and prosecutes hospices with inappropriately long hospice stays, creating a perceived disincentive for physicians to make early hospice referrals that are more likely to produce long stays.[9,10] Second, Medicare does not reimburse physicians for discussions to elicit patients' preferences for end-of-life care.[11] Third, Medicare requires patients to formally renounce curative care before enrolling in hospice, which is thought to limit demand.[10,12] This last issue is particularly relevant to cancer care since patients often wish to continue active treatment irrespective of prognosis—an area of concern to payers as use of costly new targeted therapies, often oral and less toxic, becomes widespread at the end of life.[13]

Many of these policies are related to concerns that increasing hospice use could increase health care utilization and ultimately costs—while advocates of hospice argue that aggressive end-of-life care outside of hospice is the more pressing cost issue.[10,14] A key input to these debates is a better understanding of the relationship between hospice and health care utilization, and its implications for costs. To date, however, few studies have described the realities of how hospice affects medical care at the end of life, and attempts to estimate cost savings have produced mixed results with 2 recent studies finding only small differences in costs that were inconsistent across different lengths of hospice stays.[10,15] Using data from Medicare beneficiaries with poor-prognosis cancers, we matched those enrolled in hospice before death to those who died without hospice care and compared utilization and costs at the end of life. We excluded patients who received cancer-directed treatment during hospice or the equivalent period before death for nonhospice beneficiaries to compare beneficiaries who may have had similar preferences for no further cancer treatment.

Methods

Study Population

In a nationally representative 20% sample of fee-for-service Medicare beneficiaries (74% of the Medicare population, excluding those enrolled in managed care), we identified those with poor-prognosis malignancies who died in 2011 after a full year of Medicare coverage. Because they died after poor-prognosis diagnoses, these beneficiaries would have been eligible for hospice, available to those with terminal illness and expected survival of less than 6 months. We assumed beneficiaries had enough evidence of advanced disease to make hospice enrollment a reasonable consideration.The Institutional Review Board of the National Bureau of Economic Research approved this study.

Data

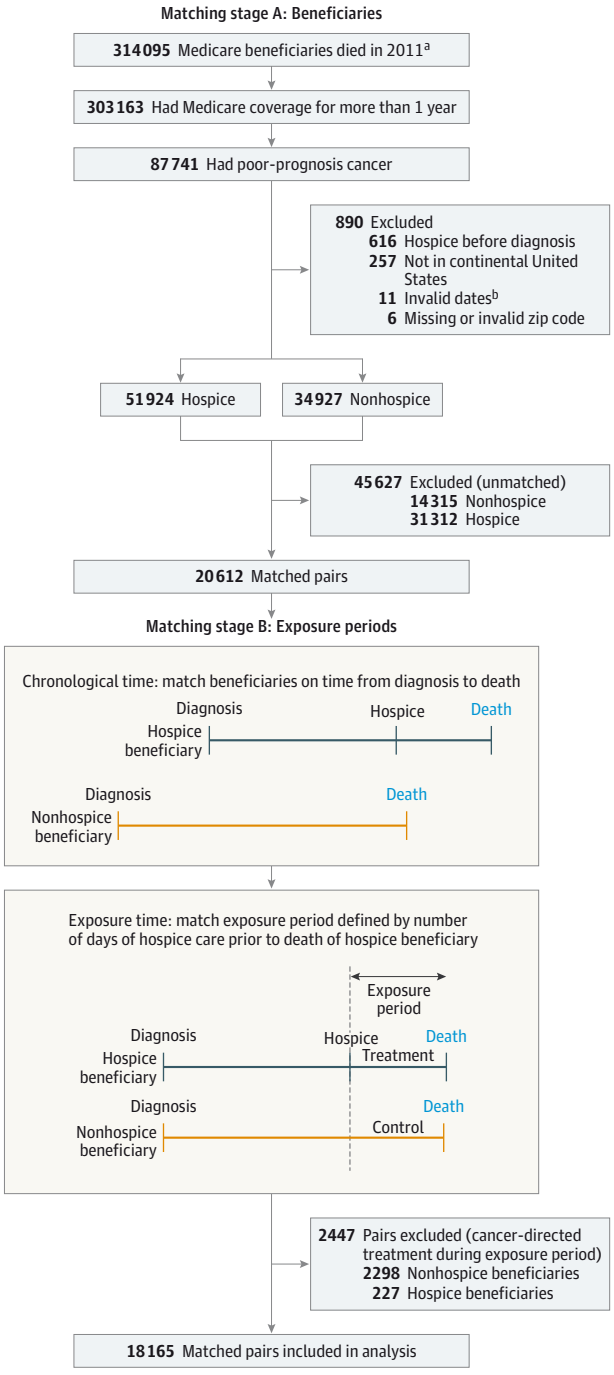
We created a list of *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes corresponding to poor-prognosis malignancies, derived from a palliative care screening instrument at a major US cancer center, including poor-prognosis primary diagnoses (eg, lung, pancreatic, brain), any metastatic or ill-defined malignancy, and hematologic malignancies designated as relapsed or not in remission (eTable 1 in the Supplement).[16] We retained beneficiaries with any of these codes present in claims between 2007-2011 in the inpatient, outpatient, and carrier hospice files, excluding potential outpatient rule-out codes.[17] We attributed to hospice all care received by the beneficiary from enrollment (ie, day of first hospice claim) until death, and assumed beneficiaries remained in hospice until death; 98.6% had a hospice claim within 30 days of death. We excluded those with hospice claims prior to poor-prognosis cancer diagnoses, indicating enrollment for another prior disease.

Matching

We used a 2-stage matching approach to create pairs of beneficiaries who were as similar as possible, but made different choices regarding hospice enrollment at the same point in time before death. First, we matched hospice beneficiaries to a control group of beneficiaries who did not choose hospice. Second, for each matched pair, we matched the hospice period to the equivalent exposure period of nonhospice care before death. By matching hospice beneficiaries with nonhospice beneficiaries, then comparing outcomes before and after hospice enrollment, we attempted to capture what might have happened if the nonhospice beneficiary had instead enrolled in hospice.

To match beneficiaries, we split the sample into those who enrolled in hospice at any time before death and those who did not. Our initial plan was to perform propensity score matching, but this resulted in multiple significant imbalances between groups that persisted despite attempts to rematch on different covariates. As a result, we used coarsened exact matching,[18] present the results here, and report detailed propensity score matching results in eMethods (in the Supplement). We matched using 4 variables: place of residence, age, sex, and time from first poor-prognosis cancer diagnosis to death. We assumed illness duration from diagnosis to death was inversely correlated with disease severity and thus a good proxy measure for it; we also assumed that hospice enrollment did not affect ill-

Figure 1. Matching of Hospice to Nonhospice Beneficiaries



[a] Nationally representative 20% sample (74% of the Medicare population, excluding those enrolled in managed care).

[b] Indicates that recorded date of death was before the poor-prognosis diagnosis date or the hospice start date. Matching stage B shows exposure periods for 2 hypothetical beneficiaries matched in the first stage. In chronological time, the 2 beneficiaries are represented as lines spanning from poor-prognosis diagnosis to death; in the exposure time frame used for analysis, dates of death are aligned to create a similar exposure period of hospice or nonhospice care prior to death. Because beneficiaries are matched on time from diagnosis to death, the lengths of the lines are approximately the same. After matching exposure periods, we dropped pairs in which one or both beneficiaries received chemotherapy or curative surgery during the periods.

ness duration. First, we matched on the finest strata of all variables (home zip code, year of birth, sex, illness duration in months), then iteratively coarsened variables and rematched beneficiaries unmatched in the first round to a maximum coarseness of 5-year age intervals, 4-month illness duration intervals, and home hospital referral region (see eTable 2 in the Supplement).

To match exposure periods, (ie, treatment period of hospice care to period of the same length before death for patients in the control group), we defined the hospice period as the number of days, d^h, of hospice care prior to death, and defined the corresponding exposure period for matched nonhospice beneficiaries as d^h days prior to death. Thus, a beneficiary who died d^h days after starting hospice was matched to a nonhospice beneficiary whose exposure period also began d^h days prior to death (**Figure 1**B).

We identified beneficiaries receiving chemotherapy or curative surgery before and after exposure using claims-based codes (eTable 3 in the Supplement).[19,20] We excluded pairs where one or both beneficiaries received cancer-directed treatment after exposure, creating a cohort matched on preference for no further treatment, to better identify differences in utilization and cost associated with hospice rather than simply with the decision to abandon cancer treatment.

Statistical Analysis

We verified balance between hospice and nonhospice beneficiaries by comparing means or medians for all variables used for matching. We also compared care utilization before hospice enrollment including clinic, emergency, inpatient, home health, and skilled nursing facility use; and comorbidity, measured on a scale synthesizing Elixhauser and Charlson indices.[21] We calculated comorbidity over 2 periods: from the earliest data available (2006) to first poor-prognosis cancer diagnosis (median, 4.4 years), and from diagnosis to exposure (median, 5.5 months). We could not match on preexposure utilization or comorbidity because nonhospice beneficiaries had no intrinsic exposure periods—these could only be defined after matching, with respect to hospice enrollment for matched hospice beneficiaries.

The primary outcome was health care utilization during exposure periods (ie, hospice care or the equivalent period for the matched controls) in the last year of life. We measured frequency of hospitalizations, intensive care, inpatient procedures, and death in hospitals or skilled nursing facilities, ascertained by the presence of a facility claim on the date of death. The secondary outcome was total costs, calculated at the beneficiary-week level, starting 1 year before death or 6 months before exposure (whichever was earlier). We added amount paid by beneficiaries, Medicare, and third-party payers[22] for all inpatient and outpatient care,[23] including hospice, physician, and other noninstitutional provider payments, but excluding outpatient medication claims, personal care, and other expenses not covered by Medicare. Statistical analyses were performed using Stata version 13 (StataCorp) and R version 3.0.2 (R Foundation).

Results

Study Population

In this nationally representative 20% sample of Medicare fee-for-service beneficiaries with poor-prognosis cancer, median time from first poor-prognosis diagnosis to death was 13 months (interquartile range [IQR], 3-34); 60% received hospice care. Figure 1A shows creation of the matched cohort from this population. Figure 1B shows creation of exposure periods, matching hospice periods to equivalent periods of nonhospice care for matched controls. Of 86 851 deaths in patients with poor-prognosis cancer, we matched 41 224 beneficiaries or 59% of the smaller nonhospice group. After hospice enrollment, 1% of hospice beneficiaries received cancer-directed therapy compared with 11% of nonhospice beneficiaries over similar exposure periods before death. Pairs in which one or both beneficiaries received such therapy were excluded. The final cohort of 36 330 beneficiaries was largely similar to the overall population of 86 851 patients with cancer death from which it was drawn (eTable 4 in the Supplement), but had shorter median time from diagnosis to death (reflecting fewer exact matches on illness duration among beneficiaries with longer survival times; eFigure 1 in the Supplement) and lived in zip code areas with mean incomes 1% to 3% higher than the overall cohort.

Table 1 shows baseline characteristics of the matched cohort. There were no statistically significant differences between patients in the hospice vs nonhospice groups for age, sex, region, time from poor-prognosis diagnosis to death, comorbidity before poor-prognosis diagnosis, or daily cost in the year before hospice enrollment. Solid tumors accounted for the majority of diagnoses in both groups (91% hospice, 88% nonhospice). More hospice beneficiaries were white and lived in higher-income zip codes. Median hospice duration was 11 days; less than 6% of stays exceeded 6 months. Hospice and nonhospice beneficiaries had similar comorbidity before poor-prognosis diagnosis but higher comorbidity between diagnosis and hospice enrollment; illness duration from diagnosis to death, however, was the same for both groups (7 months). Before exposure, hospice beneficiaries had similar prevalence of dementia, anemia, fluid/electrolyte disturbances, hemiplegia, and weight loss compared with nonhospice beneficiaries; hospice beneficiaries had more days of home health assistance (7 days vs 6; difference, 1 [95% CI, 0.4-1.6]), but used skilled nursing facilities less (46.5% vs 52.6%; difference, 6.2% [95% CI, 5.1%-7.2%]). Together, these results indicated similarity between hospice and nonhospice beneficiaries on important aspects of functional status. Hospice beneficiaries had more clinic visits (45 vs 42; difference, 3 [95% CI, 2-4]) and more claims for cancer-directed therapy (44.5% vs 35.5%; difference, 9% [95% CI, 8%-10%]) before hospice start.

Utilization and Costs

Table 2 compares health care utilization during hospice with the equivalent period before death for matched nonhospice beneficiaries in the last year of life. Nonhospice beneficiaries had more hospitalizations, largely for acute conditions (eg, infections, organ failure) and exacerbations of medical comorbidities. Only 1 of the 10 most frequent primary discharge diagnoses involved cancer. Rates of intensive care and invasive procedures were also higher for nonhospice beneficiaries. Seventy-four percent of nonhospice beneficiaries died in hospitals or skilled nursing facilities compared to 14% of those in hospice.

We compared total costs for hospice and nonhospice beneficiaries, before and after hospice start, to capture overall intensity of care utilization and yield insight into whether differences in utilization were associated with hospice or with preexisting patient characteristics or care preferences. **Figure 2** shows daily costs for representative groups of beneficiaries, separated by length of hospice enrollment. Over the year before hospice, average daily care costs for hospice beneficiaries were $145 (95% CI, $143-$147) compared to $148 (95% CI, $146-$150) for nonhospice beneficiaries (difference, $3; 95% CI, $0-$5). In the week before hospice, average daily costs for hospice beneficiaries were $802 , which exceeded daily costs for nonhospice beneficiaries by $146 (95% CI, $126-$166). Costs declined rapidly thereafter and by the last week of life, daily costs for hospice beneficiaries were $556 (95% CI, $542-$571) vs $1760 (95% CI, $1718-$1801) for nonhospice beneficiaries, a difference of $1203 (95% CI, $1161-$1245).

Table 3 shows cumulative total costs during the last year of life by length of hospice enrollment, calculated irrespective of exposure period start, for comparability to other studies. Overall, costs during the last year of life were $62 819 (95% CI, $62 082-$63 557) for hospice beneficiaries and $71 517 (95% CI, $70 543-$72 490) for nonhospice beneficiaries, a difference of $8697 (95% CI, $7560-$9835). Beneficiaries enrolled in hospice for 5 to 8 weeks had cumulative costs of $56 986 (95% CI, $55 098-$58 875) compared to $74 890 (95% CI, $71 910-$77 869) for nonhospice, a difference of $17 903 (95% CI, $14 543-$21 264). Differences in cost for short hospice stays (1-2 weeks) were smaller, but remained statistically significant. For the 2% of beneficiaries with hospice stays over 1 year, hospice beneficiaries had higher costs (difference, $7387; 95% CI, $1485-$13 289).

Propensity Score Analysis

Propensity scores allowed us to match 100% of the smaller nonhospice group (eFigure 2 in the Supplement), but produced imbalance on important covariates including baseline cost and geography, with median distance between pairs greater than 800 miles; only 0.8% of matched pairs lived in the same hospital referral region (eTable 5 in the Supplement). There was significant imbalance in time from poor-prognosis diagnosis to death, 436 days for nonhospice beneficiaries and 286 for hospice, which likely contributed to significant differences in costs during the year before exposure ($149 for nonhospice care vs $135 for hospice; eTable 6 in the Supplement): this year would have included a median of 79 days before hospice beneficiaries received their poor-prognosis diagnosis, spuriously lowering cost estimates. Despite this, cost trajectories (eFigure 3 in the Supplement) were grossly similar to the coarsened ex-

act matching cohort, and care utilization patterns were nearly identical (eTable 7 in the Supplement). Cumulative costs over the last year of life (eTable 8 in the Supplement) were $71 860 (95% CI, $71 094-$72 626) for nonhospice and $59 037 (95% CI, $58 353-$59 538) for hospice (difference, $12 823; 95% CI, $11 921-$13 726).

Table 1. Baseline Characteristics of the Matched Cohort[a]

	Nonhospice (n = 18 165)	Hospice (n = 18 165)	Difference	Standard Difference[b]
Variables used for matching				
Age, mean (95% CI), y[c]	80 (79.9 to 80.1)	80 (79.9 to 80.1)	0 (−0.2 to 0.2)	0
Men, % (95% CI)[d]	48 (47.3 to 48.8)	48 (47.3 to 48.8)	0 (−1.0 to 1.0)	0
Days from poor-prognosis cancer diagnosis to death, median (IQR)[e]	213 (43 to 818)	210 (48 to 822)	3 (−10 to 16)	0
Distance between pair home zip codes in miles, median (IQR)[e]	24.5 (10.2 to 51.8)			
Demographics				
White race, % (95% CI)[d]	84.7 (84.1 to 85.2)	87.8 (87.3 to 88.2)	−3.1 (−3.8 to −2.4)	−0.09
Income of beneficiary home zip code in thousands, median (IQR)[e]	62.9 (51.5 to 83.1)	64.9 (52.7 to 86.6)	−2.0 (−2.6 to −1.4)	−0.08
Region, % (95% CI)[d]				
Northeast	22.7 (22.1 to 23.4)	22.8 (22.2 to 23.4)	0 (−0.9 to 0.8)	0
Midwest	23.6 (23.0 to 24.3)	23.8 (23.2 to 24.4)	−0.1 (−1.0 to 0.7)	0
South	37.8 (37.1 to 38.5)	37.6 (36.9 to 38.3)	0.2 (−0.8 to 1.2)	0
West	15.9 (15.3 to 16.4)	15.9 (15.4 to 16.4)	0 (−0.8 to 0.7)	0
First poor-prognosis malignancy diagnosis, % (95% CI)[d]				
Solid tumor	88.2 (87.7 to 88.7)	91 (90.6 to 91.5)	−2.9 (−3.5 to −2.2)	−0.09
Hematological	12.2 (11.7 to 12.7)	9.4 (9.0 to 9.8)	2.8 (2.2 to 3.4)	0.09
Illness and hospice time course, median (IQR)[e]				
Poor-prognosis cancer diagnosis to exposure start, days	166 (24 to 757)	165 (25 to 758)	1.0 (−13.3 to 11.3)	0
Exposure start to death, days	11 (4 to 35)	11 (4 to 35)	0 (−0.4 to 0.4)	0
2006 to poor prognosis cancer diagnosis, days	1767 (1185 to 1942)	1770 (1181 to 1941)	−3.0 (−14.4 to 8.4)	0
Comorbidity index, median (IQR)[e,f]				
2006 to poor-prognosis cancer diagnosis	3 (1 to 6)	3 (1 to 6)	0 (−0.1 to 0.1)	[g]
Poor-prognosis diagnosis to exposure start	6 (2 to 9)	7 (4 to 9)	−1 (−1.1 to −0.9)	[g]
Presence of selected individual comorbidities related to functional status, 2006 to exposure start, % (95% CI)[d]				
Anemia	68.5 (67.8 to 69.2)	68.3 (67.6 to 69.0)	0.2 (−0.7 to 1.2)	0
Dementia	18.0 (17.5 to 18.6)	18.0 (17.5 to 18.6)	0 (−0.8 to 0.8)	0
Fluid and electrolyte disorders	71.7 (71.0 to 72.3)	71.2 (70.5 to 71.9)	0.5 (−0.5 to 1.4)	0.01
Hemiplegia	6.7 (6.4 to 7.1)	6.8 (6.4 to 7.1)	0 (−0.5 to 0.5)	0
Weight loss	26.2 (25.6 to 26.8)	25.8 (25.2 to 26.5)	0.4 (−0.5 to 1.3)	0.01
Healthcare utilization, 2006 to exposure start				
Inpatient admissions, median (IQR)[e]	3 (1 to 6)	3 (2 to 5)	0	[g]
Emergency visits, median (IQR)[e]	4 (2 to 7)	4 (2 to 7)	0	[g]
Clinic visits, median (IQR)[e]	42 (21 to 70)	45 (24 to 73)	−3 (−4 to −2)	[g]
Home health days, median (IQR)[e]	6 (0 to 31)	7 (0 to 30)	−1 (−1.6 to −0.4)	[g]
Use of skilled nursing facility, % (95% CI)[d]	52.6 (51.9 to 53.3)	46.5 (45.7 to 47.2)	6.2 (5.1 to 7.2)	0.12
Active cancer treatment, % (95% CI)[d,h]	35.5 (34.8 to 36.2)	44.5 (43.8 to 45.2)	−9 (−10 to −8)	−0.18
Daily expenses, year prior to exposure start, $ (95% CI)[c]	148 (146 to 150)	145 (143 to 147)	3 (0 to 5)	0.02

Abbreviation: IQR, interquartile range.

[a] Variables used for coarsened exact matching are shown first, followed by demographics, and measures of health and healthcare utilization in the baseline period before exposure start (ie, before the start of hospice or the equivalent period for nonhospice beneficiaries).

[b] Standardized difference is the difference in group means divided by the common standard deviation.

[c] For normally distributed variables, means (95% CIs) are reported with differences calculated by *t* test.

[d] For binary variables, proportions (95% CIs) are reported with differences calculated by proportion test.

[e] For non-normally distributed variables, medians (IQRs) are reported with differences calculated by quantile regression.

[f] Gagne comorbidity score was measured on a composite scale synthesizing Elixhauser and Charlson indices (range, −2 to 26).

[g] Standardized difference cannot be calculated for count variables.

[h] Active cancer treatment refers to chemotherapy or surgery.

Table 2. Care Utilization During Exposure Periods in the Last Year of Life

	Matched Cohort		
	Nonhospice, % (95% CI) (n = 18 165)	Hospice, % (95% CI) (n = 18 165)	Risk Ratio (95% CI)
Hospital admission	65.1 (64.4-65.8)	42.3 (41.5-43.0)	1.5 (1.5-1.6)
Primary *ICD* code, discharge			
Sepsis	10 (9.5-10.4)	3.4 (3.1-3.7)	2.9 (2.7-3.2)
Pneumonia	4.4 (4.1-4.7)	2.1 (1.9-2.3)	2.1 (1.8-2.3)
Acute/chronic respiratory failure[a]	3.9 (3.6-4.2)	1.1 (1.0-1.3)	3.5 (3-4.1)
Pneumonitis, aspiration	2.3 (2.1-2.5)	1.0 (0.8-1.1)	2.3 (1.9-2.7)
Acute kidney failure	2.2 (2.0-2.5)	1.6 (1.4-1.8)	1.4 (1.2-1.6)
Neoplasm of bronchus and lung	2.1 (1.9-2.3)	1.5 (1.4-1.7)	1.3 (1.1-1.6)
COPD exacerbation	1.4 (1.2-1.6)	0.6 (0.5-0.7)	2.5 (2.0-3.1)
Subendocardial infarction	1.3 (1.2-1.5)	0.4 (0.3-0.5)	3.6 (2.8-4.7)
Urinary tract infection	1.2 (1.1-1.4)	0.6 (0.5-0.8)	1.9 (1.5-2.3)
Cerebral artery occlusion, stroke	1.0 (0.9-1.2)	0.8 (0.6-0.9)	1.4 (1.2-1.8)
ICU admission	35.8 (35.1-36.5)	14.8 (14.3-15.3)	2.4 (2.3-2.5)
ICU	27 (26.4-27.7)	8.4 (8.0-8.8)	3.2 (3.0-3.4)
Step-down or intermediate	10.1 (9.6-10.5)	6.5 (6.1-6.8)	1.6 (1.5-1.7)
Invasive procedures	51.0 (50.3-51.7)	26.7 (26.1-27.4)	1.9 (1.9-2.0)
Insertion of venous catheter	21.4 (20.8-22.0)	7 (6.6-7.4)	3.1 (2.9-3.3)
Endotracheal intubation	19.3 (18.8-19.9)	2.7 (2.4-2.9)	7.3 (6.6-8.0)
Packed cell transfusion	15.6 (15.1-16.2)	8.7 (8.3-9.1)	1.8 (1.7-1.9)
Platelet or plasma transfusion	6.3 (5.9-6.6)	2.9 (2.6-3.1)	2.2 (2.0-2.4)
Noninvasive ventilation	5.9 (5.6-6.3)	1.7 (1.5-1.9)	3.4 (3.0-3.9)
Thoracentesis	4.3 (4.0-4.6)	2.5 (2.3-2.8)	1.7 (1.5-1.9)
Hemodialysis	4.1 (3.8-4.4)	1.2 (1.0-1.3)	3.6 (3.1-4.2)
Cardiopulmonary resuscitation	4.0 (3.7-4.2)	0.2 (0.1-0.2)	21.8 (15.4-30.8)
Closed bronchial biopsy	3.8 (3.5-4.1)	1.2 (1.0-1.3)	3.3 (2.8-3.9)
Arterial catheterization	3.5 (3.2-3.8)	0.4 (0.3-0.5)	8.8 (6.9-11.1)
Death in hospital or SNF	74.1 (73.5-74.8)	14.0 (13.5-14.5)	5.3 (5.1-5.5)
Acute care hospital[b]	50.2 (49.5-51.0)	3.4 (3.2-3.7)	14.6 (13.5-15.8)
Long-term hospital or SNF[c]	23.9 (23.3-24.5)	10.5 (10.1-11.0)	2.3 (2.2-2.4)

Abbreviations: COPD, chronic obstructive pulmonary disease; *ICD*, *International Classification of Diseases*; ICU, intensive care unit; SNF, skilled nursing facility.

[a] Combines *ICD* codes 518.81 and 518.84.

[b] Percent of beneficiaries with an inpatient facility claim on day of death.

[c] Percent of beneficiaries with a claim from a long-term care hospital or SNF on day of death. Data on SNFs are incomplete because of Medicare restrictions on the number of SNF days reimbursed per year, so these should be seen as minimum estimates for both groups.

Discussion

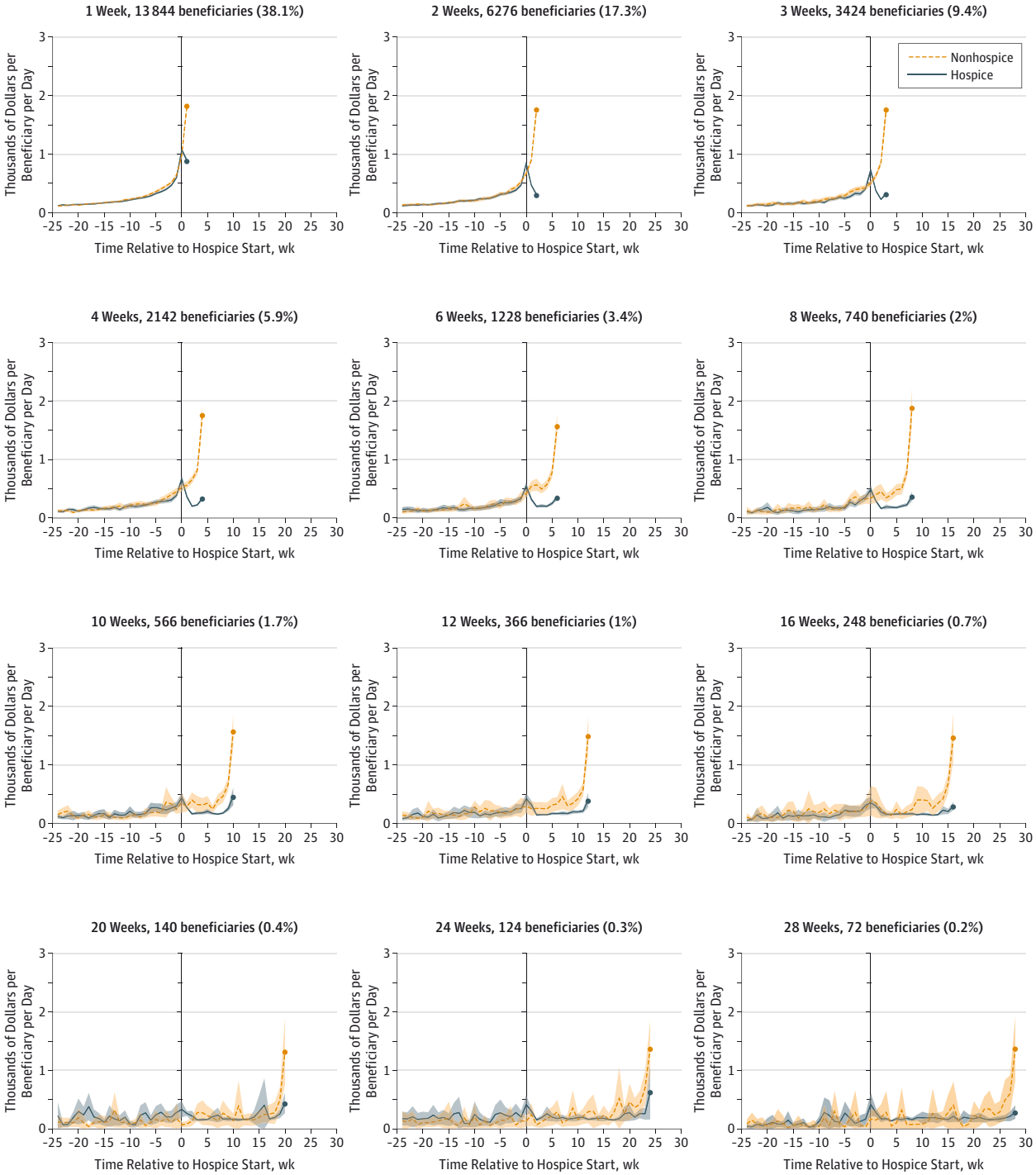
In a matched cohort of Medicare beneficiaries with poor-prognosis cancers, we found large, statistically-significant differences in care utilization between hospice and nonhospice beneficiaries at the end of life. While enrolled in hospice, beneficiaries were hospitalized less, received less intensive care, underwent fewer procedures, and were less likely to die in hospitals and skilled nursing facilities. Over similar periods before death, most nonhospice beneficiaries were admitted to hospitals and ICUs for acute conditions not directly related to their poor-prognosis cancer. Such care is unlikely to fit with the preferences of most patients. Our findings highlight the potential importance of frank discussions between physicians and patients about the realities of care at the end of life, an issue of particular importance as the Medicare administration weighs decisions around reimbursing physicians for advance care planning.

Differences in care utilization between hospice and nonhospice beneficiaries translated into statistically significant lower total medical care costs for hospice beneficiaries in the last year of life. Cost trajectories began to diverge in the week after hospice enrollment, implying that baseline differences between hospice and nonhospice beneficiaries were not responsible for cost differences. Hospice enrollment of 5 to 8 weeks produced the greatest savings; shorter stays produced fewer savings, likely because of both hospice initiation costs, and need for intensive symptom palliation in the days before death.[24] Overall, these results may indicate that efforts to promote broader and earlier hospice uptake are unlikely to produce increases in total costs.

Our study does not replicate a randomized trial of a hospice intervention, and results depend on the validity of the matching strategy, making it important to highlight key choices involved in the creation of the study cohort. First, coarsened exact matching achieved excellent balance for matched beneficiaries but failed to match a substantial number of beneficiaries (41% of the smaller nonhospice group, 53% of the overall cohort). Propensity score matching matched 100% of the nonhospice group and 80% of the overall cohort, but at the expense of inferior balance on important covariates. Each method had trade offs in terms of internal

and external validity, but both ultimately produced very similar results. Second, we matched on illness duration as a proxy for disease severity. This required us to select only beneficiaries who died, which could introduce bias if illness duration was affected by hospice enrollment.[25] Matching on duration would bias results if hospice prolonged life: hospice

Figure 2. Cost Trajectories Before and After Hospice Start



Graphs show mean total daily costs relative to hospice start, with beneficiaries separated into groups based on the length of the exposure period (ie, the length of hospice or nonhospice care before death). Because showing all 109 groups was not possible and aggregation would obscure time trends, we show representative groups with exposure periods of 1, 2, 3, and 4 weeks, which together make up 71% of the entire cohort; every 2 weeks from 6 to 12 weeks (8% of the cohort); and every 4 weeks from 16 to 28 (2%). Circles mark week of death for each group of beneficiaries. The shaded area around the lines indicate the 95% CIs for the mean; lower CI bounds of less than zero were censored at zero. Week zero is defined as the week before the first day of hospice.

Table 3. Total Costs in the Last Year of Life

Exposure Period Length, wk	Weeks from Diagnosis to Death, No. (95% CI)	Matched Pairs, No.	Total Costs in the Last Year of Life, Mean (95% CI), $		
			Nonhospice	Hospice	Difference
1	58 (57-60)	6922	71 582 (70 027-73 137)	66 779 (65 470-68 087)	4803 (2933-6674)
2	57 (55-58)	3138	70 987 (68 680-73 294)	63 13 (61 322-64 955)	7848 (5141-10 555)
3-4	62 (60-64)	2783	72 660 (70 177 to 75 144)	59 595 (57 719-61 471)	13 065 (10 201-15 930)
5-8	67 (65-69)	2231	74 890 (71 910-77 869)	56 986 (55 098-58 875)	17 903 (14 543-21 264)
9-26	91 (88-93)	2161	72 432 (69 504-75 360)	60 326 (58 518-62 134)	12 106 (8821-15 392)
27-52	118 (114-122)	556	66 035 (60 718-71 352)	65 300 (62 687-67 913)	735 (−5131 to 6601)
>52	152 (148-157)	374	48 981 (44 206-53 755)	56 368 (52 931-59 805)	−7387 (−13 289 to 1485)
Total	67 (67-68)	18 165	71 517 (70 543-72 490)	62 819 (62 082-63 557)	8697 (7560-9835)

patients with more severe disease at baseline, who improved after hospice treatment, would be matched with controls who had less severe baseline disease. Since utilization and severity are usually correlated, our estimates of differences would be biased downward. If hospice beneficiaries had shorter survival, eg, because of discontinuation of effective anticancer treatment, the opposite would be true; but since cancer-directed therapy was more common for hospice beneficiaries before enrollment, insufficiently aggressive treatment seems unlikely. Third, hospice beneficiaries had higher comorbidity scores after poor-prognosis diagnoses, which could reflect higher overall utilization or higher true comorbidity. The latter would have biased downward our estimates of savings athough matching on illness duration should have controlled for overall disease severity in this period. Fourth, our results are unlikely to generalize to this subgroup of 1% of hospice beneficiaries who received cancer-directed treatment after exposure start. Further, we could not determine if other hospice beneficiaries left hospice. If this were widespread, contamination would lead to downward bias in estimates of differences in outcomes. Finally, hospice beneficiaries lived in wealthier areas, potentially giving them increased access to hospice. However, since pairs were matched by hospital referral region, geographic access to hospice should have been similar, except possibly in large-area rural hospital referral regions.

There are other limitations to note. We restricted our analysis to beneficiaries with poor-prognosis cancer, but noncancer diagnoses are an increasing part of the hospice population and our results may not generalize. We excluded beneficiaries with managed care, for whom claims data were not available, and the entire non-Medicare population. We relied on *ICD* codes to identify poor-prognosis diagnoses, but claims-based diagnoses can be inaccurate. We determined place of death via same-day facility claims, which did not include inpatient hospice facilities or assisted living; we had incomplete data on skilled nursing facilities, and no data on personal care utilization. We did not include outpatient medication expenses; these were likely lower in the hospice group because hospice covers medications related to patients' terminal condition.

Conclusions

In this sample of Medicare fee-for-service beneficiaries with poor-prognosis cancer, those receiving hospice care, compared with matched control patients not receiving hospice care, had significantly lower rates of hospitalization, intensive care unit admission, and invasive procedures at the end of life, along with significantly lower health care expenditures during the last year of life.

ARTICLE INFORMATION

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Obtained funding: Obermeyer.
Administrative, technical, or material support: Obermeyer, Cutler.
Study supervision: Obermeyer, Cutler.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Funding/Support: This work was supported by National Institutes of Health grant DP5 OD012161 (Dr Obermeyer), National Cancer Institute grant P01 CA134294 (Dr Dominici), and Agency for Healthcare Research and Quality grant K18 HS021991 (Dr Dominici).

Role of the Funders/Sponsors: The funders had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; in the preparation, review, or approval of the manuscript; or in the decision to submit the manuscript for publication.

Additional Contributions: We acknowledge the help of Jean Roth, MS, and Mohan Ramanujan, MS, at the National Bureau of Economic Research; comments from Karen E. Joynt, MD, MPH, and Anupam B. Jena, MD, PhD, and the editors and peer reviewers; and support from the Research Data Assistance Center Help Desk at the University of Minnesota, particularly Benjamin Sunderlin, MPH. None of the aforementioned individuals received compensation in association with their contributions to this article.

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