

What length of hospice use maximizes reduction in medical expenditures near death in the US Medicare program?

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Abstract

Hospices have been expected to reduce health expenditures since their addition to the US Medicare benefit package in the early-1980s, but the literature on their ability to do so is mixed. The contradictory findings noted in previous studies may be due to selection bias and the period of cost comparison used. Accounting for these, this study focuses on the length of hospice use that maximizes reductions in medical expenditures near death. We used a retrospective, case/control study of Medicare decedents (1993–2003, National Long Term Care Survey screening sample) to compare 1819 hospice decedents, with 3638 controls matched via their predicted likelihood of dying while using a hospice. Variables used to create matches were demographic, primary medical condition, cost of Medicare financed care prior to the last year of life, nursing home residence and Medicaid eligibility.

Hospice use reduced Medicare program expenditures during the last year of life by an average of \$2309 per hospice user; expenditures after initiation of hospice were \$7318 for hospice users compared to \$9627 for controls ($P < 0.001$). On average, hospice use reduced Medicare expenditures during all but 2 of hospice users' last 72 days of life; about \$10 on the 72nd day prior to death, with savings increasing to more than \$750 on the day of death. Maximum cumulative expenditure reductions differed by primary condition. The maximum reduction in Medicare expenditures per user was about \$7000, which occurred when a decedent had a primary condition of cancer and used a hospice for their last 58–103 days of life. For other primary conditions, the maximum savings of around \$3500 occurred when a hospice was used for the last 50–108 days of life. Given the length of hospice use observed in the Medicare program, increasing the length of hospice use for 7 in 10 Medicare hospice users would increase savings.

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Introduction

When hospice was imported to the United States from the United Kingdom in the mid 1970s it took root first in the private sector, outside the purview of public financing. However, in 1983, hospice

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gained public reimbursement via Part A of the US Medicare program (NHPCO, n.d.), and proponents argued hospice would provide high quality physical, emotional and spiritual care to terminally ill persons at a cost lower than conventional care for dying patients (Corr & Corr, 1983; Miller, Williams, English, et al., 2002). The Medicare hospice benefit covers care provided by a team of providers (visiting nurse, physician, social worker, chaplain, home health aide, community volunteer) as well as other supplies and pharmaceuticals not otherwise covered by the Medicare program (NHPCO Medicare benefit fact sheet (2005); Casarett, 2007). The US Medicare program is a social-insurance system that covers virtually all US citizens age 65 and over, and is a larger single payer health system than the entire Canadian health system. However, Medicare only covers around half of the total health care expenditures of elderly beneficiaries, with the balance being covered by supplementary insurance or out-of-pocket payments (Goldman & Zissimopoulos, 2003).

Coverage of hospice by Medicare hastened diffusion of hospice into the US health care system because it covered the service for the elderly population which is the most likely to die. In the twenty-four years that hospice has been covered by Medicare, it has been a major innovator in the provision of palliative care at the end-of-life, and a growing body of research suggests that hospice provides high quality care when assessed from both the patient and family perspectives (Greer & Mor, 1986; Greer, Mor, et al., 1986; Lorenz, Lynn, Morton, et al., 2004; Miller et al., 2002; Morrison & Meier, 2004). Hospice is available to Medicare beneficiaries who decide to forego curative care, and is financed by per-diem payments. The presumptive period of eligibility is 180 days, though beneficiaries can receive hospice for longer periods when death does not occur within the expected time period. Most hospice care is received in beneficiaries' homes, but can also be received in inpatient hospices or nursing homes. The use of hospice by Medicare beneficiaries has risen dramatically, from seven percent of Medicare decedents in 1990 to approximately one-quarter by 2002 (National Hospice and Palliative Care Organization, 2003; United States General Accounting Office, 2000). In spite of the steady growth of hospice in the Medicare program, the broader US health care system generally, and the long interest in the impact of hospice on costs (Kane, Bernstein, Wales, et al.,

1984; Mor & Kidder, 1985), the issue of whether hospice significantly reduces expenditures near death remains unresolved.

Many studies assessing the effect of hospice on medical expenditures have identified savings (Hughes, Cummings, Weaver, et al., 1992; Kidder, 1992; Mor & Kidder, 1985; Pyenson, Connor, Fitch, & Kinzbrunner, 2004), yet others have found no cost differences (Kane et al., 1984). A US health care literature review found that third-party payer cost savings attributable to hospice was 25–40% during the last month of life, 10–17% for the last six months, and 0–10% during the entire last year, but noted methodological problems in design of most studies addressing the effect of hospice on expenditures (Emanuel, 1996). A recent study found *higher* costs among hospice users (Campbell, Lynn, Louis, et al., 2004), particularly among Medicare beneficiaries aged 85 and higher, a group with lower Medicare expenditures in the last year of life as compared with younger Medicare decedents, and hence a less expensive comparison group (Levinsky, Yu, Ash, et al., 2001). These investigators (Campbell et al., 2004) used a propensity score matching approach to control for selection bias. Yet another recent paper controlled for selection bias by carefully identifying cases of incident terminal illness that would constitute the most plausible candidates for hospice and compared this subset of hospice users to non-users. These investigators identified cost savings due to hospice use (Pyenson et al., 2004). Thus, uncertainty remains about the ability of hospice to reduce medical expenditures near death, even among recent methodologically sophisticated papers that have attempted to account for selection bias.

The biggest obstacle to precisely evaluating whether hospice reduces expenditures near death is identifying the period of time over which costs of hospice users and controls are compared. The last year of life is a common focal point for such comparisons given the well-known fact that one-fourth of the total US Medicare budget is spent on patients during the last year of their lives (Hogan, Lunney, Gabel, & Lynn, 2001). And the absolute magnitude of expenditures during the last year of life is striking, with a recent study finding mean expenditures by the US Medicare program during the last year of life to be \$24,600, as compared to \$9400 (1999 dollars) for the same beneficiaries during the year prior to the last year of life (Shugarman et al., 2004). For these reasons, and

related concerns about quality of life, there is a strong interest in reducing the high health care expenditures of decedents incurred in the last year of life. However, the last year of life is not a realistic period over which to find hospice cost savings given the median length of hospice use was 36 days in the early-1990s (Christakis & Escarce, 1996), and declined over the ensuing decade (United States General Accounting Office, 2000). Further, there is extreme variation in length of hospice use; one-fourth of persons use hospice for one week or less, while up to 12% do so for more than 180 days (Christakis & Escarce, 1996; United States General Accounting Office, 2000). Realistic cost assessments must account for a patients' actual length of benefit use; it is impossible for hospice to reduce third party expenditures prior to hospice use.

The purpose of this paper is to build on the strengths and improve upon the limitations of previous studies of hospice cost. As will be detailed below, we offer a strategy that precisely accounts for the length of actual hospice use in determining whether hospice reduces Medicare expenditures. We do this while also reducing selection bias by matching hospice users to decedents who did not use hospice but who were otherwise similar. Our approach allows us to identify the length of hospice use that is associated with the maximum expenditure reductions possible for the Medicare program, which is important for informing future hospice policy. Though this study relies upon a US sample of Medicare beneficiaries, its strategies for addressing selection bias and time frame comparison are applicable to evaluating the effect of hospice on costs near the end of life in other countries.

Methods

Study design

Our study employed a case match comparison strategy in which we identified hospice users and then created a control group of persons who did not use hospice, but who were otherwise similar. Hospice users were matched (1:2) to non-hospice user decedents using a propensity score approach. That score, the predicted probability of dying while using hospice, was estimated using logistic regression as detailed below. The key outcome measure was total Medicare program expenditures for cases and controls on each day during their last year of life. To test the null hypothesis that program

expenditures will be the same for hospice users and non-hospice users, we compared Medicare expenditures for cases and controls from the point of hospice entry for cases, until their death. Thus, a case who used hospice for ten days prior to death would have their costs during their last ten days of life compared to the mean costs of their two matches during their last ten days of life. The difference in costs between cases and controls after initiation of hospice is the estimate of the effect of hospice on Medicare expenditures.

We used two matches per case for two reasons. First, relative to using only one match, using two reduces the effect of high-cost outliers on the cost curve of matches without having to adjust, transform, or truncate the cost data. If selection is random, the expectation would be the same mean but smaller variance would be produced by using two instead of one match per case. Second, using three or more matches per case would substantially increase the number of patients selected as matches for multiple hospice users, particularly among matches with a high-predicted probability of being a hospice user. Alternatively (if we only allowed non-duplicated matches) a selection of large numbers of sub-optimal matches would occur. Using two matches per case maximized these two competing interests of having the most efficient match possible, while acknowledging that we did not have an unlimited sample of potential matches.

Study sample

Study subjects came from a random sample of age-eligible Medicare beneficiaries ($N = 35,000$) drawn from national Medicare enrollment files in 1982, which was supplemented with approximately 5000 persons who turned age 65 in 1984, 1989, and 1994, to ensure that the sample was large and nationally representative of Medicare beneficiaries age 65 and older (Center for Demographic Studies (2005)). The sample provided a sampling frame for respondents to the National Long Term Care Survey (NLTC) in 1984, 1989, 1994 or 1999, but decedents used for this study were drawn from the entire sample of Medicare beneficiaries, and not the sub-sample who participated in the NLTC surveys. We first identified the 12,073 age-eligible Medicare beneficiaries age 67 and older who died between January 1, 1993 and December 31, 2003. From this group we selected those dying while using hospice and our matched controls, as detailed below.

Several types of patients were excluded from our final analysis sample. We needed data on costs for each day during the last year of life, and on health care use and comorbid conditions from the year prior to the last year of life, as outcomes and to implement our propensity score matching. Subjects had to have at least two years of Medicare claims records (730 days) prior to their date of death, and therefore, we excluded persons who died before age 67 as noted above. Because we wanted to measure total costs for each sample member, we excluded persons who were covered by an HMO at any time during the last year of their life ($N = 250$) since their claims records are not available for assessing costs. Eleven persons were excluded because of missing racial information. Furthermore, we excluded those who did not incur any cost during the last year of life ($N = 567$), since they would be unlikely to be potential hospice users. The 1819 of the 11,245 remaining decedents died while using hospice (hospice users). Our final analysis sample consisted of these 1819 hospice users and 3638 matched controls. In spite of our excluding decedents with zero costs in their last year of life, the study sample includes Medicare decedents with a wide variation in costs during the last year of life, and not only high-cost decedents. For example, the fifth and tenth percentile of costs were as follows for cases and controls: \$3586 and \$913, \$6316 and \$2192, while the median was \$23,364 and \$27,592 (2003\$), for hospice users and matched controls, respectively.

Process of matching

We estimated logistic regression models predicting death while using hospice, as a function of variables that, according to the literature, were believed to be related to death in hospice. The predicted probability of being a hospice user was used to match cases and controls, separately for males and females. To control for period effects, logistic regression models were estimated separately for persons dying in the periods 1993–1996, 1997–1999, and 2000–2003. For each period we estimated separate models for decedents with cancer as their primary condition versus other primary conditions. Cases were always matched to persons who died during the same period (1993–1996, 1997–1999, or 2000–2003), who were in the same primary condition strata (cancer vs. others), and of the same gender (male vs. female). Explanatory variables used in the matching models were demo-

graphic, Medicare expenditures from the year prior to the last year of life, primary health condition present during the last year of life, Medicaid and nursing home residence during the last year of life, and census region. Some of the measures used for matching were measured in claims records during the year prior to the last year of life (366–730 days prior to death), while others were measured during the last year of life (1–365 days prior to death) following past work (Campbell et al., 2004).

The demographic explanatory variables used in the logistic regression matching models were age at death, gender, ethnicity (Caucasian vs. non-Caucasian), and year of death. We controlled for prior health care expenditures (year prior to the last year of life) in three ways. First, we created a binary variable for those with no Medicare financed cost. Second, we used a series of three variables that represented the quartile of Medicare-financed expenditures during the year prior to the last year of life (the lowest quartile of those with some costs was the omitted variable). Finally, we included the natural log of an individual's prospective diagnostic cost group (DCG) severity score, a continuous variable that takes account of health care use and health conditions present in Medicare claims during the year prior to the last year of life, and is a predictor of expected health care expenditures during the following year, which in this case, was the last year of life (DxCg, Inc., 2001).

We identified the decedent's primary health condition during the last year of their life following the approach of Campbell et al. (2004). The potential health conditions represented the 10 leading causes of death for persons age 65 and older (heart disease, cancer, cerebrovascular disease, COPD, diabetes, Alzheimer's disease and dementia, pneumonia and influenza, septicemia and accidents). A decedent was assigned a primary health condition based on the plurality of Medicare-financed cost during their last year of life when an ICD-9-CM code corresponding to one of these conditions was the primary reason for a visit or service. Cancers were divided into lung and other types to control for aggressiveness of disease. If a decedent's primary condition based on plurality of expenditure was found to be pneumonia/influenza, septicemia or accident, then we assigned their primary condition based on plurality of other primary diagnosis codes found during the last year of life (excluding these three diagnoses). This was done because pneumonia/influenza and septicemia

are conditions that may onset near death and cause an expensive hospitalization, but which likely do not represent what a person suffered from for a period of time that would enable them to consider hospice. Likewise, accidents do not allow for consideration of hospice. The point was to assign decedents to health conditions that are common causes of death, each of which has a different likelihood of resulting in hospice care (though we do not know the cause of death). We also included a duration variable for the primary health condition that identified the number of days from first mention of the primary condition in Medicare claims to death during the last two years of life (days 1–730 prior to death). This was a further control for aggressiveness of illness as well as opportunity to decide to use hospice. Finally, we included binary variables to represent the 9 census regions in which a study subject lived during year of death to control for unmeasured variation in provision of hospice that may be correlated with geography.

Medicare program expenditures

Medicare expenditures were defined as the amount that Medicare actually paid for care as recorded in claims records; the terms cost and expenditure are used interchangeably. We included all types of Medicare-financed care in cost calculations for both hospice cases and matches: hospice, inpatient, outpatient, skilled nursing facility (SNF), home health, Part B physician payments, and durable medical equipment. Persons who choose hospice can and do have other types of Medicare-financed costs while they are enrolled in hospice. Medicare claims records allow for costs to be identified as incurred on a specific day. In the case of inpatient and SNF claims in which beneficiaries received care over a period of days, the total cost of the stay was pro-rated equally across each day during the time they received the care. Expenditures were expressed in constant 2003 dollars.

Comparing expenditures for cases and controls

We compared costs of hospice users and controls from the day of hospice initiation until death during the last year of life. A person who used hospice the last ten days of life would have their costs in this period compared to the last ten days of the life of their two matches. Any difference in costs approx-

imates the differential associated with hospice since matching reduced selection bias that exists because those who choose hospice differ from those who do not. This method allows for cost comparisons from the day of hospice initiation until death, whenever that initiation begins, which answers the question of whether hospice saves Medicare money in the manner that the benefit is actually used. *T*-tests of means were used to compare costs of cases and controls for three periods: before hospice initiation; after hospice initiation; and the entire last year of life. The days involved in calculating these periods differed across cases since hospice users started such care at different times. However, a particular case and their two controls always had the same period of days in each comparison period.

We graphed the daily costs of cases and controls for each day prior to death during the last year of life to illustrate cost differences of hospice users compared to non-users. We also graphed cumulative cost savings of hospice users (stratified by cancer and others) in order to identify the length of hospice use associated with maximum cost savings during the last year-of-life for the Medicare program. We fit a non-linear least-squares regression model with three linear segments (splines) to identify the point in days when cost savings stopped increasing significantly for each extra day of hospice use, as well as to identify the point at which savings began to decrease significantly for each extra day of use. To estimate this model, the slope of the middle spline was constrained to be zero since we were interested in identifying the point at which the downsloping nature of the curve, and the upsloping nature of the curve became significantly different from zero. This model was implemented using the non-linear (nl) statement in Stata version 9.2 (Danuso, 1991; Royston, 1992, 1993), which was used for all analyses (StataCorp, 2003) This study was approved by the Duke University Medical Center Institutional Review Board.

Results

Of the 11,245 full sample decedents, 1819 (16.1%) died while receiving Medicare-financed hospice care (hospice users). The likelihood of Medicare decedents being hospice users in our sample increased dramatically over the study period, with 10.2% ($N = 440$) doing so from 1993–1996, 14.9% ($N = 455$) from 1997–1999, and 23.8% ($N = 924$) from 2000–2003. The median length of hospice use

across the entire study period from initiation until death was 15 days (mean 50 days, S.D. 102 days). One fourth of hospice users used such care for five days or less prior to death, while less than 7% used hospice for more than 180 days prior to death. Length of hospice use rose and then fell over the study period, and the proportion of decedents without cancer as their primary medical condition increased steadily (not shown).

Considering the full sample of decedents ($N = 11,245$), hospice users were more likely to be white (92% vs. 89%, $P < 0.001$), but the likelihood of dying while using hospice did not differ significantly by gender (Table 1). Older persons were less likely to be hospice users (41% of hospice users were age 85+, compared 48% of non-users, $P < 0.001$), and the mean age at death for hospice users was over 1 year younger than for non-users (83.3 years vs. 84.6 years, $P < 0.001$, not shown). Persons who were eligible for Medicaid and those who lived in a nursing home at some point during their last year of life were less likely to die while using hospice. Census region was not significantly related to death in hospice overall (chi square 12.3, $P = 0.13$, not shown), and no individual regions differed significantly after matching.

The primary medical condition of decedents was strongly related to hospice use, as those with cancer were more likely to be hospice users. Approximately 10% of the hospice decedents had lung cancer as their primary condition compared to just 2% of non-hospice decedents; similarly, 30% of hospice users had another type of cancer as their primary condition compared to 8% of the non-hospice decedents ($P < 0.001$ for both comparisons, not shown in Table 1). Decedents in Table 1 are stratified by cancer versus non-cancer for their primary medical condition, and the proportion with given primary medical conditions are shown in Table 1. Among decedents with primary medical conditions other than cancer, those with COPD, nephritic conditions, and Alzheimer's disease and other dementias were more likely to die in hospice. Persons with primary conditions of sepsis, pneumonia/influenza, accidents and other conditions were less likely to be hospice users. Overall, the observed, non-random differences between hospice users and non-users confirm that simple comparisons of Medicare-financed costs among the two groups are confounded by selection bias.

We addressed selection bias by matching each hospice user ($N = 1819$) to two controls ($N = 3638$)

who were similar to hospice users, but did not die while using hospice (males were always matched to females, and vice versa). Matches were implemented by using logistic regression results estimating the probability of death in hospice (matching regressions not shown). We included in Table 1 the p value for a t -test comparing the variables used in matching for only the cases and controls; this demonstrates that matching reduced differences in observed variables between those dying while using hospice and those not doing so as would be expected, but some statistically significant differences remained after matching. When using a standardized difference of 10% as suggested in a recent paper comparing propensity score matching to other methods, the practical differences between cases and matched controls were significant for only 4 of the 6 variables that remain statistically significant after matching, with only one showing a difference higher than 15% (D'Agostino & D'Agostino, 2007; Stukel, Fisher, Wennberg, et al., 2007). Three of the 4 variables were associated with a lower likelihood of being a hospice user (residence in a nursing home at some point during the last year of life, having ones primary medical condition for less than 31 days prior to death, and having other primary medical condition in the non-cancer strata).

After accounting for selection bias and the period of time hospice was actually used prior to death, we found that hospice reduced Medicare program expenditures by an average of \$2309 per hospice user. The mean cost between initiation of hospice and death was \$7318 for hospice users vs. \$9627 for controls, $P < 0.001$ (Table 2). This means that Medicare expenditures were \$2309 less, on average, after the initiation of hospice than they would have been if hospice had not been used. The number of days included in cost comparisons was always the same for each case and their two controls, thereby precisely accounting for how long hospice was actually used in assessing the effect of hospice on Medicare expenditures. Total costs for the entire last year of life did not differ between hospice users (\$32,727) and controls (\$33,837), $P = 0.90$. However, total Medicare costs during the last year of life *prior* to hospice entry were higher for hospice users (\$25,409) compared to controls (\$23,210), $P = 0.005$. We further investigated this phenomenon and found that this cost differential occurred primarily in the *week prior* to initiation of hospice, when hospice users incurred Medicare-financed costs

Table 1
Comparing persons dying in hospice ($N = 1819$) to those not using hospice ($N = 9426$) across the study period, 1993–2003

	No hospice proportion or mean (s.d.)	Died in hospice proportion or mean (s.d.)	P value ^a	P value after matching ^b
<i>Demographic</i>				
Male	0.40	0.42	0.12	0.94
Age at death 75–84 ^c	0.23	0.25	0.02	0.53
Age at death 85+	0.48	0.41	<0.001	0.10
White	0.89	0.92	<0.001	0.18
Year of death (1993 = 1)	4.64 (3.1)	6.06 (3.0)	<0.001	0.11
Medicaid eligible at some point during last year of life	0.27	0.20	<0.001	0.02
Lived in nursing home at some point during last year of life	0.59	0.50	<0.001	<0.001
<i>Medicare expenditures in year prior to the last year of life</i>				
Log of prospective DxCG score	0.89 (0.42)	0.91 (0.42)	0.28	0.24
No expenditures	0.05	0.04	0.04	0.87
Second quartile	0.24	0.23	0.20	0.84
Third quartile	0.23	0.25	0.25	0.82
Fourth quartile	0.23	0.27	<0.001	0.97
<i>Primary condition</i>				
<i>Cancer strata (N = 961 non-hospice and N = 734 hospice deaths)</i>				
Lung cancer	0.20	0.25	0.008	0.03
Other cancer	0.80	0.75	0.008	0.03
<i>Non-cancer strata (N = 8465 non hospice and N = 1085 hospice deaths)</i>				
Heart disease	0.23	0.22	0.72	0.73
Cerebrovascular disease	0.088	0.095	0.46	0.74
COPD	0.046	0.065	0.005	0.79
Nephrotic conditions	0.027	0.039	0.03	0.82
Alzheimer's/dementia	0.029	0.076	<0.001	0.009
Diabetes	0.023	0.019	0.48	0.87
Other incl. septic conditions, pneumonia/influenza and accidents	0.56	0.48	<0.001	0.05
<i>Duration of primary condition</i>				
Less than 31 days	0.29	0.17	<0.001	0.003
31–61 days	0.096	0.12	0.004	0.45
62–183 days ^d	0.18	0.24	<0.001	0.83
<i>Census region</i>				
East North Central	0.18	0.20	0.02	0.73
East South Central	0.09	0.08	0.32	0.86
Middle Atlantic	0.15	0.14	0.36	0.72
Mountain	0.04	0.05	0.33	0.60
New England	0.07	0.05	0.03	0.74
Pacific	0.12	0.12	0.66	0.64
South Atlantic	0.17	0.17	0.99	0.77
West North Central	0.08	0.07	0.34	0.89
West South Central	0.11	0.12	0.57	0.27
<i>N</i>	1,819	9,426		

^a P value is for t -test of means, or proportion.

^b P value for t -test comparing 1819 persons who died using hospice to 3638 matched controls.

^cOmitted age category was age at death 67–74.

^dOmitted duration of primary condition was more than 183 days.

of \$2493, on average, compared to \$1629 for matches ($P < 0.001$). The costs of hospice users during the pre-hospice period excluding this week did not differ statistically (\$22,916 vs. \$21,580, $P = 0.08$).

Hospice use reduced Medicare program expenditures for most days in the last three months of life; daily cost savings averaged under \$10 on the 72nd day prior to death, and rose steadily to around \$500

Table 2
Cost to Medicare during the last 365 days of life, hospice users and matches

	Hospice users	Matches	Difference	<i>p</i> -value
Pre-Hospice cost ^a	25,409	23,210	2199	0.005
Excl. last 7 days prior to hospice	22,916	21,580	1336	0.08
Last 7 days prior to hospice	2493	1629	864	<0.0001
Post-hospice cost	7318	9627	−2309	<0.0001
Total cost	32,727	32,837	−110	0.90
<i>N</i>	1819	3638		

Note: *p*-values from paired *t*-tests of cost for hospice users and matched non-hospice users.

^aPre and post hospice cost periods differ by individual. If a hospice user used hospice for 10 days prior to death, that decedent's two matched controls post-hospice period is also the last 10 days of life.

4 days prior to death, peaking at \$750 on the day of death (Fig. 1). The area between the solid dark line (controls) and the dark dotted line (hospice users) in Fig. 1 represents the difference in mean Medicare expenditures for hospice users compared to controls for a given day prior to death—this difference is an estimate of the cost reduction that is attributable to hospice. Mean daily expenditures for hospice users are actually higher than those for controls more than 80 days prior to death. Our findings were fairly consistent when mean daily expenditures were stratified by disease (cancer vs. other disease as the primary medical condition—not shown) except that hospice saves more money, starting earlier for persons with a primary health condition of cancer compared to other conditions.

For decedents whose primary medical condition was cancer, cumulative Medicare savings attributable to hospice reached a maximum after about eight weeks of hospice use: nearly \$7000 less for cases compared to matches (Fig. 2a). For other primary medical conditions, maximum savings of around \$3500 were realized when decedents used hospice for the last seven weeks of their life.

We identified the length of hospice use at which savings began to decline by estimating two “breakpoints” for each of the curves in Fig. 2b, fitting a non-linear least-squares regression model with three linear segments (splines). The slope of the middle spline was constrained to zero, and the breakpoints are testing for the point at which the slope of the curve is no longer zero. The first breakpoint indicates the day after which further extensions in the length of hospice use no longer increased Medicare's cumulative savings (savings remained at or near the maximum); the second point indicates the day after which cumulative savings begin to decrease. For cancer decedents Medicare savings increased with each additional day of hospice use up

to 57 days (95% CI: 52–62 days), extensions did not affect overall savings between days 58 and 103, and cumulative savings started decreasing significantly after a stay of 104 days (95% CI: 94–114 days). The results are similar for decedents with a primary medical condition other than cancer: cumulative savings increased up to 49 days (95% CI: 41–57 days) and start decreasing with use longer than 109 days (95% CI: 99–119 days), and cumulative savings were not altered significantly between 50 and 108 days of use. Considering patients together regardless of primary medical condition, the period associated with maximum savings was 53–105 days (this curve not shown on Fig. 2a or 2b).

Another way to frame our results is to consider the length of hospice use that results in negative savings (increases total last year of life costs compared to not using hospice). The intercept between the curves in Figs. 2a and 2b (the curves in the figures are identical, Fig. 2b identifies the breakpoints in the slope of curve noted above) and the *X*-axis are the points at which cumulative costs of hospice users equal those of non-hospice users, i.e., the length of use beyond which savings are negative. The use of hospice increased overall Medicare expenditures compared to what they would have been without hospice at 233 days of hospice use for persons with a primary medical condition of cancer, and 154 days for decedents with other primary medical conditions.

We simulated the relative cost savings associated with reducing the number of Medicare beneficiaries using hospice for more than 180 days by 50% as compared to increasing the length of hospice use among those who used hospice for less than 180 days (Fig. 3). If stays of 180+ days were halved, savings that accrue to the Medicare program from hospice would increase by around 12.5%, or mean savings due to hospice would rise from around

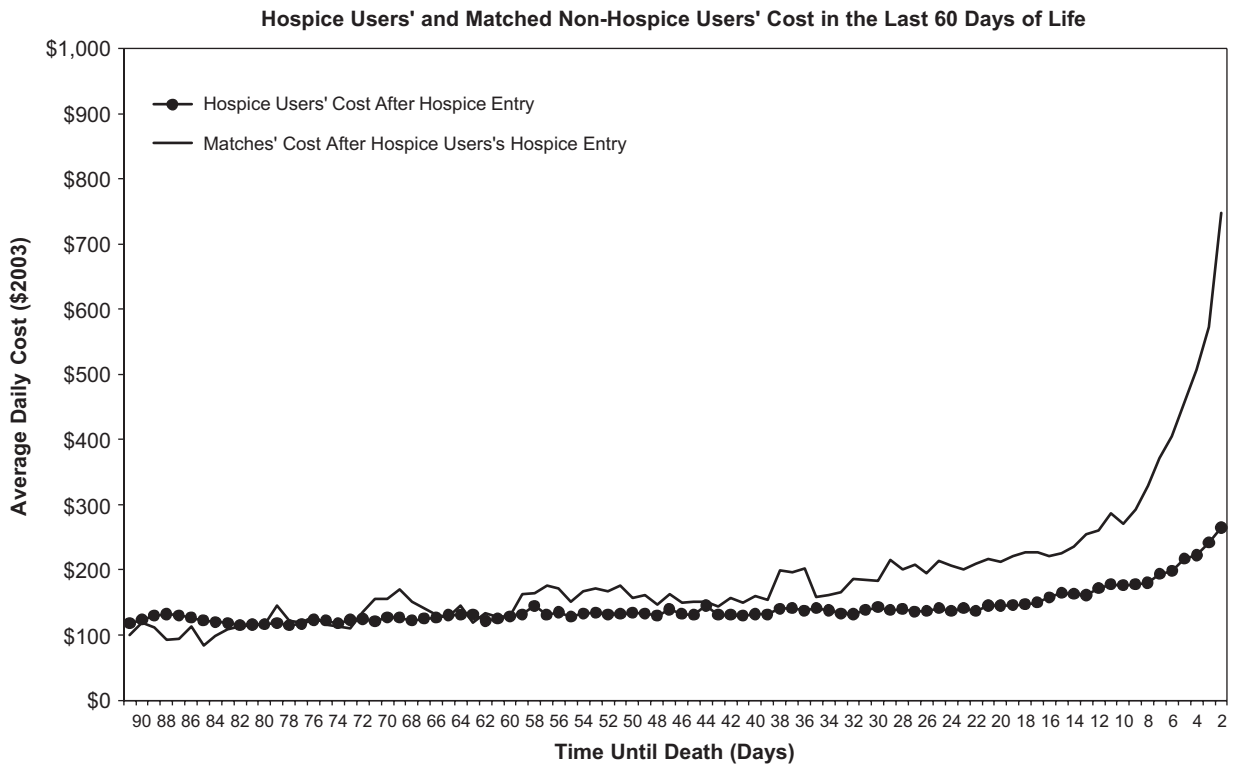


Fig. 1. Hospice users' and matched non = hospice users' cost in the last 90 days of life.

\$2300 to around \$2600 per hospice user. Alternatively, increasing the length of hospice use by four days for all hospice beneficiaries who used less than 180 days would result in an equivalent increase in cost savings to the Medicare program. Increasing length of hospice use by just three days would increase savings due to hospice by nearly 10%, from around \$2300 to \$2500 per hospice user.

Discussion

We found that hospice saves the Medicare program around \$2300 per beneficiary who died while using hospice. The maximum cumulative savings were \$7000 which occurred when those with cancer as their primary medical condition used hospice for 58–103 days prior to death, and around \$3500 when those with other primary conditions did so for 50–108 days. The major contribution of this paper is precisely accounting for the time hospice was actually used in determining the effect of hospice on Medicare program expenditures, while also accounting for selection bias. Conceptually, our paper identifies how much less-hospice users

cost the Medicare program compared to a decedent who was very similar to a hospice user except that they did not use hospice. We also clearly demonstrate the relationship between daily cost savings and cumulative savings over the last year of life.

Failing to account for length of hospice use masked cost differences that occur only near death in our study, and the lack of such an accounting could explain differences in conclusions and magnitudes of savings reported across studies (Campbell et al., 2004; Emanuel, 1996; Hughes et al., 1992; Kidder, 1992; Mor & Kidder, 1985; Pyenson et al., 2004). We found no cost differences between hospice users and controls when looking at the entire last year of life even controlling for selection (\$32,727 for users, vs. \$32,837 for controls, $P = 0.90$). This is the most common period of comparison in past work. However, we found clear evidence of savings for Medicare attributable to hospice use during the period of time in the last year of life that hospice is actually used in the Medicare program. Savings would have been masked if the only comparison made were for the entire last year of life. Given that hospice has been

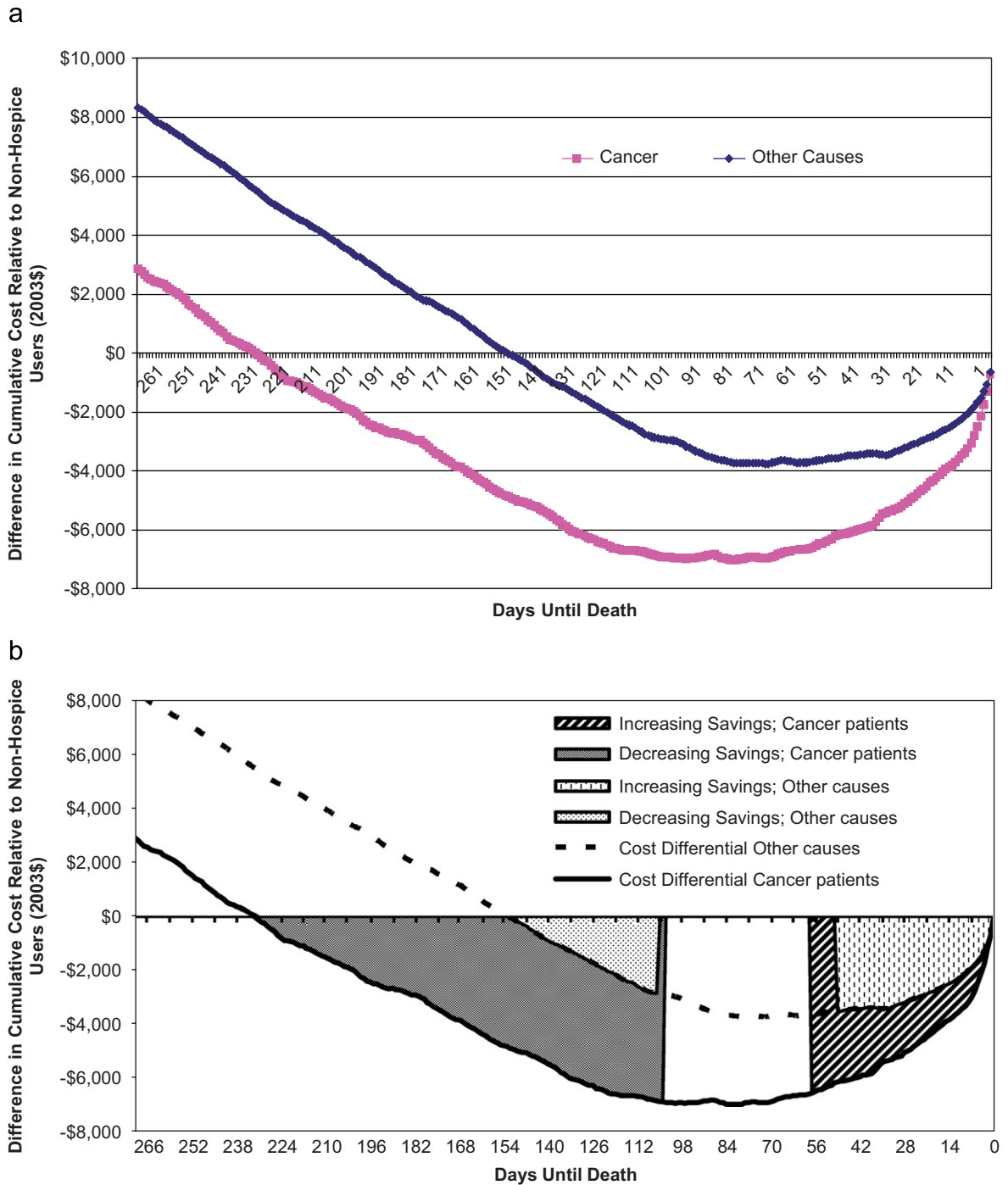


Fig. 2. (a, b) Difference in the cumulative cost of care for hospice users relative to matched non-hospice users.

widely demonstrated to improve quality of life of patients and family members (Christakis & Iwashyna, 2003; Higginson, Finlay, & Goodwin et al., 2003; Wallston, Burger, & Smith et al., 1988), the Medicare program appears to have a rare situation

whereby something that improves quality of life also appears to reduce costs.

Our finding that costs of hospice users are higher in the week before hospice initiation compared to controls helps illustrate that many persons likely

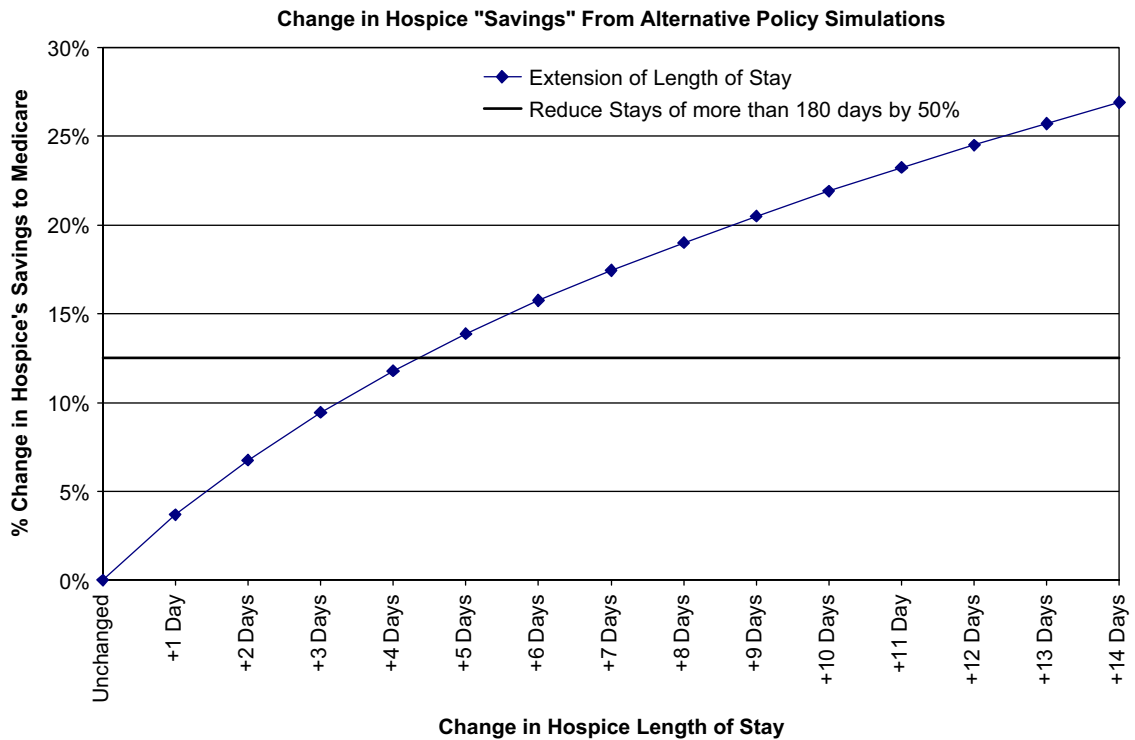


Fig. 3. Change in hospice "savings" from alternative policy simulations.

have an expensive hospitalization when curative treatment has not worked and patients begin to decline. It is during such a hospitalization that many persons decide to begin the use of hospice. The simulation we ran (Fig. 3) implies an approximately linear relationship whereby increasing hospice use by a day directly increases savings to Medicare. On average this relationship is correct, but reducing the length of a hospital stay once initiated will not effect costs since Medicare reimburses hospital stays using Prospective Payment which essentially pays an average amount based on diagnosis without respect to actual length of stay (except in the case of an extraordinarily long, unexpected length of stay). Completely avoiding hospitalizations just before hospice would clearly reduce costs, but reducing such admissions is extremely difficult. In spite of the common pattern of relatively high hospital costs in the week before hospice initiation, we still find that hospice reduces Medicare expenditures.

The Medicare hospice program has a presumptive eligibility period of the last 6 months of life. Though some beneficiaries use hospice for longer (7–8%), far more use hospice for less than one week (around one fourth). Even though very long periods of

hospice use actually cost the Medicare program more than normal care (233+ days for cancer, 154+ for other medical conditions), we feel that more effort should be put into increasing short stays as opposed to focusing on shortening long ones. First, it is hard to predict long stays, and they seem to most commonly occur when there is a change in the clinical condition of a hospice user. Second, even for persons who have been using hospice care for more than 180 days, our results suggest that hospice is still likely to reduce their cost to the Medicare program for future days if they continue using it until death given that previous hospice costs are sunk costs that cannot be recouped. Further, among persons with a primary medical condition of cancer, cumulative costs are lower among hospice users compared to controls for the last 233 days of life, nearly two months longer than the 6 month period of presumptive eligibility for hospice under the current Medicare benefit structure (154 days for other primary medical conditions). Third, efforts to curtail longer lengths of hospice use could have a chilling effect on hospice use in the Medicare program, further shortening length of use prior to death. It is possible that Operation Restore Trust,

a waste, fraud and abuse program enacted in the mid 1990s is responsible for declining lengths of use over the decade (Huskamp, Buntin, Wang, & Newhouse, 2001). Other explanations for the generally observed decline in length of use include increased use of hospice by persons with diagnoses other than cancer that have a less predictable course of illness, perhaps leading physicians to refer patients to hospice later in the disease course (Fox, Landrum-McNiff, Zhong, et al., 1999).

Increasing length of use for short hospice stays is obviously easier to say than to do, but there are possible strategies. One is to educate physicians about the tendency to over-estimate predicted life span among terminally ill cancer patients, which could lead to delayed referral to hospice (Hogan et al., 2001; Glare, Virik, & Jones et al., 2003). Another is to focus on improving communication skills that allow physicians to discuss hospice care earlier in the course of treatment. The introduction of an open access policy whereby one could elect hospice without foregoing curative treatments would almost certainly increase length of hospice use prior to death, but it would likely work against cost savings for the Medicare program, and is really a policy more suited to expanding access to hospice, generally. A recent essay calls for a redesign of hospice with the focus being on making the benefit more useable by patients as opposed to maximizing cost savings (Casarett, 2007).

Analyses such as ours are retrospective, while a preferred method would be a prospective matching approach that was able to account more fully for the choice process that is undertaken when a person decides to use hospice or not. This process includes input from patients, family members and medical providers; such variables are unmeasured and are likely to be confounders that are not likely to have been controlled for by our matching approach, but which are likely to be very important in determining who selects hospice. Other weaknesses of our study include not having clinical information or cause of death data, and having to exclude persons who were enrolled in Medicare HMOs during their last year of life. The plurality of diagnosis method we used to identify primary medical condition in the absence of cause of death has been criticized for overusing certain diagnoses such as congestive heart failure among elderly patients who were experiencing ill-defined dwindling (Barnato et al., 2005). In our study, this is likely to have limited effect since we specified relatively few clinical groups of primary

medical conditions. We included census region as a geographic variable, but this is a blunt approach. A smaller geographic area such as county or service area would be a conceptually better matching variable that would control for local market conditions, but measuring such a variable over the entire study period was not possible in our study due to data limitations. Further, while our matching process reduced sources of observed heterogeneity between cases and controls, a few variables remained significantly different for cases compared to controls (4 out of 32 when considering a standardized difference of 10%) (D'Agostino & D'Agostino, 2007). These variables reinforce some of what is well known about hospice, for example, that those with a primary medical condition of cancer are more likely to use hospice prior to death than others, and that those who die rapidly from the onset of illness are not likely to use hospice. We also found that persons who resided at some point in a nursing home during their last year of life (and who were eligible for Medicaid) remained less likely to use hospice, even after matching. This may point out access issues for low-income persons and those in nursing homes that warrant more attention in order to expand hospice into these populations.

Future investigations of the effect of hospice on cost should compare differences only after hospice has been initiated, when such a difference could plausibly be attributed to hospice. Our paper demonstrates the importance of making clear the relationship between daily and cumulative savings, and how such savings can be overshadowed by using the entire last year of life as ones period of comparison. Addressing selection bias in some manner is also necessary (Stukel et al., 2007). Finally, we have looked simply at the effect of hospice on Medicare program expenditures, and cannot evaluate the appropriateness of the care received by hospice users or matches, or the quality of life experienced by patients and families. In the future, being able to consider not only the costs, but also the benefits of hospice in the same study would be beneficial.

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