Spending in the Last Year of Life and the Impact of Hospice on Medicare Outlays

(Updated August 2015)

A report by Direct Research, LLC, for the Medicare Payment Advisory Commission

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Analysis of a decade of Medicare data ending 2013, and assessment of the impact of hospice on Medicare costs.

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Executive Summary

Does the Medicare hospice benefit increase or reduce Medicare spending? In this report, we took three different approaches to answering this question:

- Tracking the past decade's trend in end-of-life spending and hospice enrollment.
- Replicating and reconciling conflicting findings in the literature regarding hospice cost or savings.
- Providing a market-level rather than person-level analysis of the impact of hospice on Medicare outlays.

While this report focuses on implications for Medicare costs, it is important to note that the main benefits of hospice are not financial. Hospice offers patients an option for holistic end-of-life care focused on symptom management and psychosocial supports consistent with an individual's preferences. The analysis in this report has no bearing on those benefits or on the value of those benefits relative to their costs.

1 Trends in spending in the last year of life and trends in hospice use.

This analysis (and prior work by CMS staff) shows that expansion of hospice from the mid-1990s to the present coincided with an increase in the fraction of Medicare spending for the last year of life.

Medicare hospice use nearly doubled over the last decade, with hospice use among elderly Medicare fee-for-service decedents rising from 26 percent in 2002 to 47 percent in 2012 (Figure 1-2). Hospice now serves the majority of elderly decedents with cancer and an increasing share of elderly non-cancer decedents.

One recent study estimated that hospice use saves thousands of dollars per decedent, even for very short hospice stays (Kelley et al., 2013). If true, rapid growth of hospice over the past decade should have reduced last-year-of-life spending as a fraction of the total, all other things equal. This first section asks whether or not national trends appear to reflect those estimated hospice cost savings.

We used the methodology developed by CMS (then HCFA) staff to track trends in end-of-life spending (Lubitz and Riley, 1993; Riley and Lubitz, 2010). We looked at fee-for-service enrollees age 65 and older, captured spending in the 12 months prior to death, and weighted the data to hold age-sex mix and mortality rate constant over the study period.

Last-year-of-life spending rose from 2002 to 2012 (Table 1-1, Figure 1-1). The share of Medicare spending for those in the last year of life increased at an average rate of 1.1 percentage points per decade ($p < 0.01$, versus a mean share of about 27 percent). Similarly, the ratio of decedents' to survivors' per capita cost rose 0.41 percentage points per decade ($p < 0.01$, versus a mean ratio of about 6 to 1). These continued an upward trend that began in the mid-1990s (Calfo, Smith, and Zezza undated).

Separately, we calculated hospice spending outside of the last year of life (Table 1-2). For the elderly, this rose from 25 percent of hospice spending in 2002 to 32 percent in 2012 (after peaking at 34 percent in 2008). Coupled with the overall increase in hospice use, this amounted to an increase from $0.9 billion to $3.4 billion over this period.[1]

Looking over a longer time period, adjusted for demographic changes, the published literature shows that by 2006, Medicare end-of-life spending had risen roughly to the level that existed in the pre-hospice era (Lubitz and Riley 2010). Our analysis in this study through 2012 finds similar results.

A study of national averages is not a strong test of hospice impact. That said, national trends show no evidence of substantial savings from hospice

2 Reconciling discrepancies in the modern literature on hospice use and cost.

The uniformly large hospice cost savings reported in some recent studies may be an artifact of the methodology used. Excluding those, the literature suggests that hospice on average produces no savings, or raises costs, in the last six months to year of life. This varies by cause of death (possible hospice savings for cancer decedents) and length of hospice enrollment (higher costs for long-term hospice enrollees).

A 2013 CMS-sponsored study characterized the recent literature on hospice and cost as "mixed" (Abt Inc., 2013). We tabulated and analyzed the results of those studies and found that the results of the studies depended strongly on the methods used (Table 2-1).

Four studies that looked at a *fixed time period prior to death* (e.g., last year or half-year) showed small costs or small savings for hospice users, depending on time period and population studied. (Henceforth, fixed-period methodology.)

By contrast, two studies that looked *only at the period of hospice enrollment* (and a similar pseudo-enrollment period created for non-hospice decedents) showed very large (e.g., 24 percent) cost savings for hospice decedents. (Henceforth, enrollment/pseudo-enrollment methodology.)

Using 2012-2013 Medicare claims data, we replicated both the fixed-period and pseudo-enrollment results. These two sets of results – no savings or large savings – were reconciled in a fairly obvious way: Hospice decedents spend more than non-hospice decedents in the period prior to hospice enrollment/pseudo-enrollment (Figure 2-1, Figure 2-2). In particular, there is a strong correlation between the timing of spending and hospice election. For example, most hospice enrollments occur immediately following discharge from an acute/postacute episode (Table 2-6).

The fixed-period studies apply a single methodology – costs in a fixed time interval (e.g., last year or half-year of life) – to hospice and non-hospice decedents alike. The study

[1] This is not adjusted for the impact of caps on hospice spending.

period is exogenously determined, that is, it does not depend on the choices made by the individuals being studied.

The pseudo-enrollment studies, by contrast, apply different methods to hospice and non-hospice decedents. For hospice decedents, the study interval is endogenously determined by their choice of hospice election date. For non-hospice decedents, the study interval is exogenously imposed by the researcher's random assignment of a pseudo-enrollment date.

Comparing two different populations using two different methods, as the enrollment/pseudo-enrollment studies do, raises a fundamental question. Is the cost difference measured by these studies due to the difference in populations or due to the difference in methods?

To assess the reliability of this approach, we first provided an example showing that the two methods (enrollment, pseudo-enrollment) can give radically different cost estimates for seemingly identical individuals. In effect, leaving spending unchanged but re-labeling the hospice spending category results in a substantial change in estimated cost (Table 2-9).

We then applied both methods (enrollment and pseudo-enrollment) to one population – hospice decedents. We first calculated costs during the period of hospice enrollment. We then assigned hospice decedents a pseudo-enrollment period (as if they were non-hospice decedents) and re-calculated costs during the period of pseudo-enrollment.

For this one population – hospice decedents – switching from enrollment to pseudo-enrollment raised estimated end-of-life costs by about 30 percent (Table 2-10). This difference is as large as that shown in pseudo-enrollment studies in the literature.

This analysis casts significant doubt on the validity of the enrollment/pseudo-enrollment studies. The methodology relies on the exact date of hospice enrollment, which is both endogenous (chosen by the beneficiary) and correlated with cost (typically follows an extended period of high spending). Those studies assert that the large and uniform cost differences they observe are the result of hospice enrollment. This analysis raises the possibility that the size and uniformity of the estimated savings are artifacts of the methodology.

3 A market-level approach to estimating the effect of hospice on cost.

We used a novel, market-level approach to estimate the impact of hospice on cost. We pooled hospice and non-hospice decedents, calculated decedent-to-survivor cost ratios by area (CBSA), and asked whether hospice market share affected market-average end-of-life costs. This approach validated the main findings of the person-level fixed-period studies. Hospice use raises end-of-life costs modestly, and that is due entirely to non-cancer decedents and to longer hospice stays.

The existing literature on hospice and costs has some substantial shortcomings. Whether fixed-period or pseudo-enrollment, these are all *person-level* studies examining *decedents' costs* for a fairly *short period of time.* This raises two sets of fundamental shortcomings.

First, because these studies contrast hospice users and non-users, they will always be subject to the criticism that the two populations (hospice and non-hospice) differ materially in ways not captured in administrative or other data sources. Second, these studies ignore the substantial fraction of hospice spending occurring outside of the last year of life (currently, about one-third of total Medicare hospice spending, Table 1-2).

For this section of the paper, we avoided these issues using a market-level approach, looking for a correlation between cost per decedent and hospice penetration across market areas and over time. This pools hospice and non-hospice decedents, and (in some formulations) allows total hospice cost (including costs outside the last year of life) to be factored into the analysis. Results from this approach matched the fixed-period studies. Hospice use appears to add modestly to Medicare cost, due to non-cancer decedents and long hospice stays (Table 3-1).

4 Summary.

The preponderance of evidence suggests that the hospice benefit has not reduced Medicare spending. That is based on the following analyses.

In section 1, for the past decade, we documented that Medicare hospice use grew substantially and that Medicare end-of-life costs rose. This continues a pattern that began in the mid-1990s, first documented by CMS Office of the Actuary staff (Calfo, Smith, and Zezza undated).

In Section 2, we showed that recent findings of large and uniform hospice cost savings in some studies are plausibly an artifact of the "pseudo-enrollment" methodology. The remainder of the literature examined costs over a fixed period of time, either the last year or half-year of life. Those fixed-period studies show no hospice cost savings on average, possibly modestly higher costs, with the costs concentrated in non-cancer and longer-stay decedents.

In Section 3, we validated the main findings of the fixed-period hospice cost studies using a completely novel approach. We studied the cost of all decedents, at the market-area level, as a function of the extent and composition of hospice enrollment. This alternative approach validated the principal findings of the fixed-period studies. Hospice appears to raise end-of-life costs modestly. It reduces costs for cancer decedents on average, but not for others, and not for individuals with long hospice stays.

1 Trends in spending in the last year of life and trends in hospice use.

This analysis continues work originated by CMS staff, tracking the share of Medicare spending for those in the last year of life (Lubitz and Riley, 1993). We follow the methods outlined in that work, with some accommodation for shortcomings of the Medicare limited data set (LDS) files used here. As noted in the methods section, the level of spending estimated here will be close to, but not identical to, that estimated in earlier work.

The context for the original analyses was "the high cost of dying", a phenomenon that predates Medicare and continues to be a subject of study (Scitovsky, 2005). At that time, analysts asked whether Medicare cost growth was being driven by increased end-of-life spending. Lubitz and Riley demonstrated that, to the contrary, end-of-life spending (as captured by spending in the last year of life) accounted for about one-quarter of Medicare outlays, and had changed little over time. There was little to suggest that these costs were uniquely a driver of Medicare spending growth (Lubitz and Riley, 1993).

The context here is the opposite: Has hospice reduced "the high cost of dying"? One recent study estimated that hospice use saves thousands of dollars per decedent, even for very short hospice stays (Kelley et al., 2013). If true, rapid growth of hospice over the past decade should have reduced last-year-of-life spending as a fraction of the total, all other things equal. This first section asks whether or not national trends reflect those estimated hospice cost savings.

Finally, we note that "the cost of dying" is a misleading way to characterize costs in the last year of life. With the exception of cancer decedents, unpredictability of date of death means that little spending is actually made in anticipation of death (Scitovsky, 2005). Instead, we are observing the costs of a severely ill population as it attempts to cope with particularly bad manifestations of disease. Decedents' costs are several multiples of survivors' costs, but virtually all of that is attributable to their high illness severity, not to the fact of dying. Decedents' costs are no more than 30 percent higher than a comparably ill survivor population (Hogan et al., 2001).

1.1 Methods

This analysis closely follows methods developed by CMS staff (Lubitz and Riley 1993). Counting backward from date of death, periods of enrollment are marked as in the last year or life or not.[2] Part A and Part B fee-for-service claims are attributed to periods of enrollment based on claim "through date", typically the date of the last service on the claim. (So, for example, hospital inpatient costs are attributed to the day of discharge, unless otherwise specified.) No Part D data costs are included. Payments are summarized from the claims in a standard fashion, showing Medicare program payment and beneficiary coinsurance liabilities separately. Only beneficiaries age 65 and older are included.

[2] Analysis therefore ends in the calendar year prior to the last year of available data, because it needs next year's death dates to determine which of this year's enrollment periods are in the last year of life.

In any calendar year, enrollment periods (and associated spending) in the last year of life and not in the last year of life were summarized separately. This gives the fraction of Medicare spending and enrollment in any year that is for the last year of life. Cost is cost per person-year of enrollment.

Over long time periods, the demographics and mortality rate of the Medicare elderly population will change. We re-weight the data to maintain the same population proportions (by age category, sex, and decedent/non-decedent status) as occurred in the first year of the analysis (2002). This avoids confounding trends in the population (e.g., falling mortality rates, older age at death) from trends in health care use and treatment patterns.

We used 5 percent sample limited data set standard analytic files (LDS SAF) and denominator files for this work. This requires some approximations and has some minor drawbacks.

- LDS files do not record date of death when the exact date is unknown. This has been estimated to omit roughly 4 percent of deaths. We verified this by comparison of Medicare data to National Center for Health Statistics mortality rate estimates for the 65+ population. This analysis will therefore slightly understate the fraction of Medicare spending attributable to last year of life.
- LDS files prior to 2009 do not contain exact dates, only year and quarter of service. To provide a consistent time series, we rounded dates in the later years and applied a consistent quarter-based methodology. To get at "last year of life" costs, we take the quarter of death, the three preceding quarters, and half the costs and enrollment in the fourth quarter prior to the quarter of death. Because beneficiaries die at random in the quarter of death, this should be on average a good approximation of costs in the exact last 12 months of life.

For this analysis, we did not separately screen out those without full A and B enrollment (that is, A-only or B-only enrollees). We did screen out those with any Part C (Medicare Advantage) enrollment. (Those individuals do not generate fee-for-service claims but may elect hospice and generate hospice claims.) We verified that the LDS Denominator (enrollment) file marks Part C hospice enrollees as Part C enrolled after hospice election.

Analysis is restricted to the elderly (age 65 and older). We used all data in a year for individuals whose denominator age for a given year was 64 or older. (The age on the denominator file is age at the end of the prior year). For elderly Medicare enrollees, this will in fact restrict enrollment and use to age 65 and older. A small amount of age 64 use and enrollment for disabled enrollees will also be captured, but the quantities are numerically insignificant, and the files were not separately screened to eliminate that.

Estimated share of spending will differ modestly depending on whether spending is based on total payments (including beneficiary deductible and coinsurance) or Medicare program payments (excluding those factors). For consistency with earlier estimates, we discuss the results for program payments. Tables include both sets of figures.

1.2 Results

Table 1-1 shows decedent and survivor Medicare Part A/B spending per person-year of enrollment, both total (including coinsurance) and program payment (excluding coinsurance). Over this period, the ratio of decedent spending to survivor spending rose slightly, as did the share of spending attributable to decedents. As noted on the table, our numbers for 2006 are within a few percent of the work we are attempting to replicate.

Table 1-1: Total and Program Payments per Person-Year, Decedents and Survivors

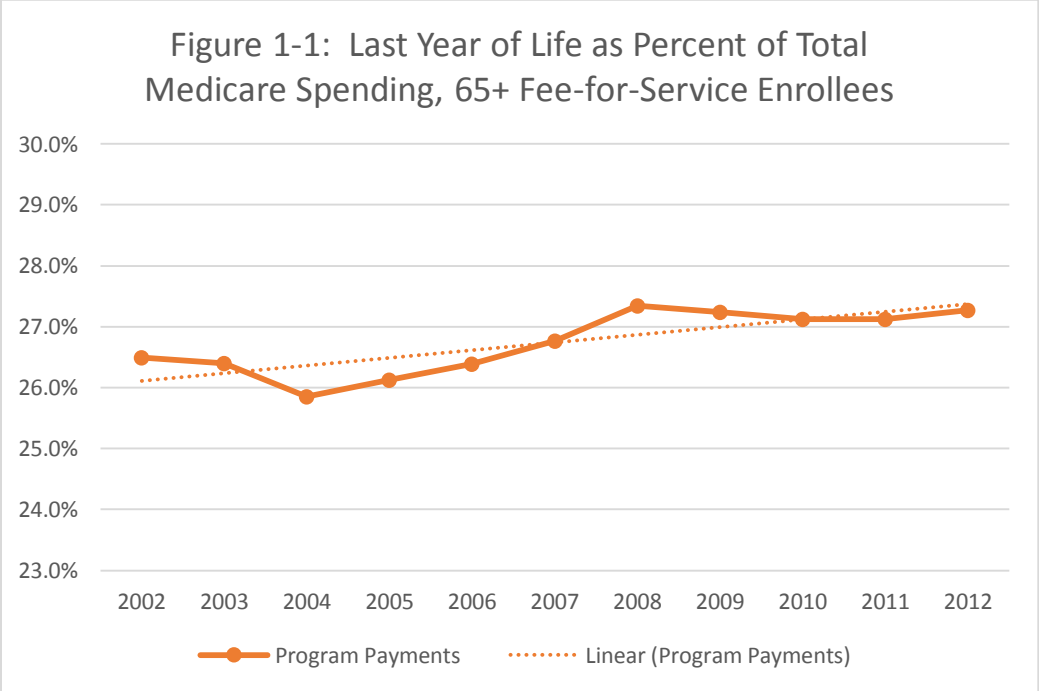
	Total payment per person-year			Program payment per person-year			Decedent Share of Payments	
	Decedent	Survivor	Ratio	Decedent	Survivor	Ratio	Total Pmt.	Program Pmt.
2002	$ 34,257	$ 5,785	5.92	$ 30,032	$ 4,742	6.33	25.2%	26.5%
2003	$ 35,691	$ 6,144	5.81	$ 31,242	$ 5,048	6.19	25.2%	26.4%
2004	$ 38,375	$ 6,719	5.71	$ 33,540	$ 5,516	6.08	24.7%	25.9%
2005	$ 42,609	$ 7,217	5.90	$ 36,211	$ 5,864	6.18	25.3%	26.1%
2006	$ 44,998	$ 7,541	5.97	$ 38,345	$ 6,134	6.25	25.5%	26.4%
2007	$ 46,080	$ 7,705	5.98	$ 40,406	$ 6,353	6.36	25.6%	26.8%
2008	$ 50,116	$ 8,088	6.20	$ 43,993	$ 6,673	6.59	26.1%	27.3%
2009	$ 52,301	$ 8,427	6.21	$ 46,092	$ 6,975	6.61	26.0%	27.2%
2010	$ 52,600	$ 8,632	6.09	$ 46,307	$ 7,122	6.50	25.9%	27.1%
2011	$ 54,017	$ 8,758	6.17	$ 47,668	$ 7,241	6.58	25.9%	27.1%
2012	$ 53,295	$ 8,681	6.14	$ 46,973	$ 7,181	6.54	26.0%	27.3%
% change	56%	50%	4%	56%	51%	3%	3%	3%

Source: Analsyis of LDS SAF 5% sample claims and enrollment data, fee-for-service enrollees age 65+

Note: For 2006, Riley and Lubitz (2010) show program payments of $38,975 and $5,993 for decedents and survivors, respectively, and 28.1 percent decedent share. Differences are likely due to different base year for demographic adjustment and limitations of the LDS data source used here.

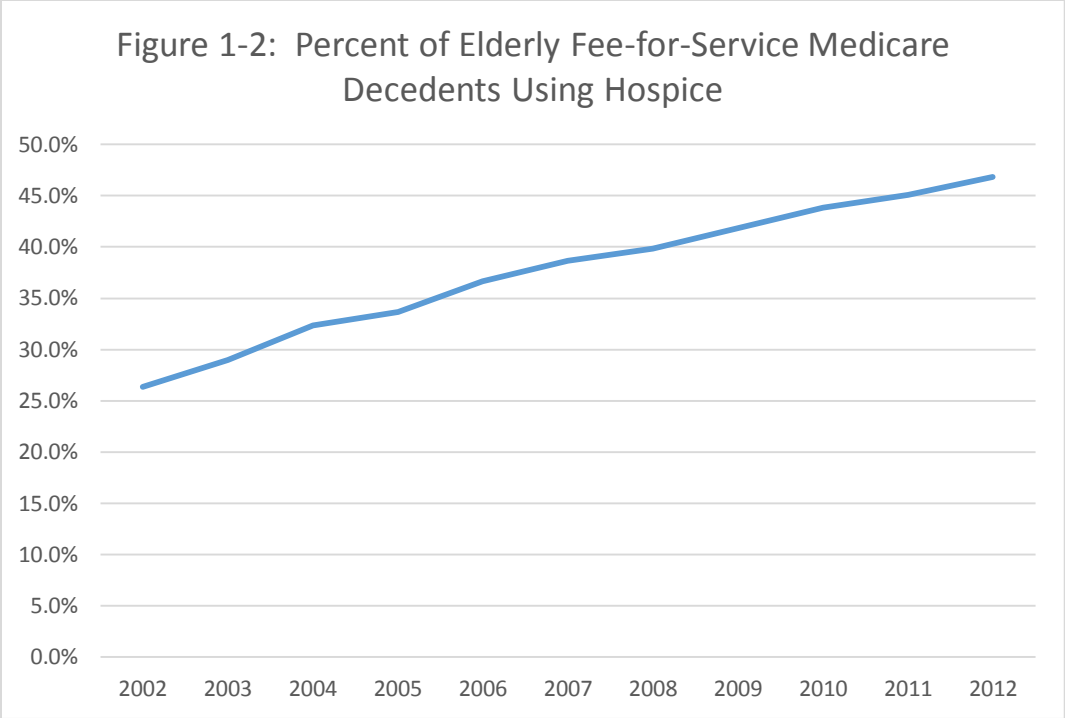
Figure 1 plots the share of spending by year, along with a fitted linear trend. The upward trend amounts to 1.1 percentage points per decade ($P < .01$, OLS regression, p-value adjusted for positive serial correlation using the method of generalized differences). Correspondingly (but not shown), the ratio of decedents' to survivors' per capita cost rose 0.41 percentage points per decade ($p < 0.01$, OLS regression, p-value adjusted for positive serial correlation using the method of generalized differences).

Arithmetically, these large and statistically significant total spending trends were primarily attributable to hospice spending. When we excluded hospice spending, both trend values fell by half and were no longer statistically significantly different from zero.



This upward trend in spending was noted earlier by researchers from the CMS Office of the Actuary. In their replication of this same method, they noted a steady rise in end-of-life costs beginning in the mid-1990s (Calfo, Smith, Zezza undated). The trend we observe here is modestly smaller than the point-to-point change noted in that study.

Hospice use continued to increase over the study period (Figure 1-2). Hospice use by elderly rose from 26 percent to 47 percent of Medicare fee-for-service decedents between 2002 and 2012.



Finally, all of the prior analysis excludes hospice spending occurring more than a year prior to death. The share of hospice spending prior to the last year of life has risen from about one-quarter of spending in 2002 to about a third of spending in 2012 (Table 1-2). In 2012, program payments for hospice before the last year of life accounted for roughly 1.2 percent of all Medicare fee-for-service Part A and Part B payments for the elderly (calculation not shown).

Table 1-2: Hospice Spending Outside of the Last Year of Life

Year	Percent of hospice spending	Estimated program payment in billions.
2002	25.4%	$ 0.9
2003	28.5%	$ 1.3
2004	31.1%	$ 1.7
2005	32.2%	$ 2.0
2006	33.5%	$ 2.4
2007	33.4%	$ 2.6
2008	34.3%	$ 2.8
2009	34.1%	$ 3.0
2010	33.0%	$ 3.1
2011	33.6%	$ 3.3
2012	32.1%	$ 3.4

Source: Analsyis of LDS SAF 5% sample claims and enrollment data, fee-for-service enrollees age 65+. Program payments multiplied by 20 to estimate Medicare FFS totals

1.3 Conclusion: National trends and claims of substantial hospice cost savings.

If hospice produced large average cost savings, we should have been able to see that in national trends, all other things equal. A 2013 study estimated (roughly) $3000 savings per hospice user, circa 2005 (Kelley et al., 2013). Table 1-3 shows that those claimed savings would have translated into a 0.4 percentage point decline in the share of spending for the last year of life. Referring back to Figure 1-1, a line falling by 0.4 percentage points over this period would have been visibly different from the actual spending path of 0.8 percentage point increase over the period.

Table 1-3: How should these figures have changed, if claimed hospice savings were true?

Claimed cost savings per hospice user (est.)	$	3,000
Last year of life total spending (2005 figure, Table 1-1).	$	42,609
Percent savings, per hospice user		7%
Increase in hospice percent over period (from Table 2).		20%
Total per-decedent cost savings that should have occurred		1.4%
Actual decedent share, 2002		26.5%
What decedent share would be, with projected cost reduction		26.1%
What should have occurred to end-of-life share (percentage points).		-0.4%
What actually occurred (percentage points).		0.8%
Discrepancy		1.2%
Note: Savings roughly interpolated from Kelley et al 2013.		

Our findings on national trends are consistent with the assumption that the hospice benefit has a net cost to Medicare. Over the past decade, the proportion of Medicare elderly decedents using hospice nearly doubled. This coincided with a modest but statistically significant upward trend in total end-of-life costs as a fraction of total Medicare spending. But after excluding hospice spending, there was no statistically significant trend.

By contrast, it requires three separate assumptions to reconcile national trends with an assumption of large net savings from hospice. The first is that hospice results in substantial per-person savings. The second is that some unknown factor has more-than-offset those savings. The third is that, by chance, the magnitude of that factor is roughly as large as hospice savings itself.

In that sense, the national trends cast doubt on hospice cost savings. Asserting that hospice substantially reduces costs now requires, in addition, an assertion that an unknown factor of just the right magnitude has steadily offset those savings.

2 Reconciling discrepancies in the modern literature on hospice use and cost.

This section starts from a recent CMS-sponsored review of the literature on hospice use and Medicare cost (Abt, 2013). The point of this analytic review of the literature is to show that the results of these studies depend *strongly* on the methods used. We then use 2012 and 2013 claims data to compare and contrast various approaches to estimating savings or cost from hospice.

2.1 Analysis of the Abt (2013) literature review.

Results from the Abt (2013) literature review are summarized in Table 2-1. Boldface cells show the consistent difference in findings based on methodology used.

Table 2-1: Tabulation of the Abt (2013) Literature Review on Hospice and Medicare Costs

		Hospice users' costs	
Study	Period	All	Cancer
Fixed time period (last year or last six months of life)			
Emanuel et al. (2002)	1996	**Not signif. lower**	8%-10% lower
Campbell et al. (2004)	1996-1999	**4% higher**	1% lower
Blecker et al. (2011)*	Before 2011	**7% higher**	
Taylor et al. (2007)**	1993 - 2003	**No difference**	
Period of hospice enrollment/pseudo-enrollment			
Taylor et al. (2007)**	1993 - 2003	**~24% lower**	Large savings
Kelley et al. (2013)	2002–2008	**~$2500 - $6500 lower**	
Other (excluded from analysis)			
Pyenson et al. (2004)***			
Weckman et al. (2012)****			

Source: Analysis of Medicare cost and hospice literature review, Abt 2013.

* Congestive heart failure patients only.

** Same study, listed twice, looked at last year of life and hospice enrollment period.

*** Not comparable to the other studies, and showed highly mixed results (large costs and large savings). Looked forward from a defined clinical event, not backward from date of death.

**** Seven hosice patients and numerous non-hospice patients in one medical center. Sample too small and not nationally representative.

Four of the studies compared costs for hospice and non-hospice decedents for a fixed time period prior to death (either six months or one year).[3] The studies differed in terms of time period and exact population studied. For hospice decedents as a whole, none of

[3] The Taylor et al. (2007) study is counted twice, as it looked both at the final year of life, and at the period of hospice enrollment.

these showed statistically significant savings. The shortest study (last six months of life) estimated a net cost of 7 percent (that is, hospice enrollees incurred Medicare costs 7 percent higher than their non-hospice counterparts). Collectively, among these four studies, there was some evidence of modest savings for cancer decedents, and net costs for older and long-stay hospice patients (which would be inversely correlated with cancer decedents).

Two studies measured costs only during the period of hospice enrollment, compared to a similar period (termed here pseudo-enrollment) for non-hospice decedents. These studies showed very large savings for hospice as a whole, across nearly all lengths of stay studied. Estimates of Medicare savings averaged 24 percent in one study, and on the order of $2500 to $6500 per hospice decedent (circa 2005) in the other.

It is evident that the results of these studies are strongly linked to methodology. Studies of a fixed period prior to death show no savings, and possibly costs, for Medicare decedents as a whole. Studies of the hospice enrollment/pseudo-enrollment period in isolation show large savings. Both sets of results cannot be correct as an estimate of the impact of hospice on Medicare spending. The focus of the remainder of the section is to determine which set of studies is correct.[4,5]

2.2 Replication of results from the literature.

The first task is to replicate the critical feature of the results – the strong dependence on methodology – using a single time period and data file. This demonstrates that the difference in results is attributable to that aspect of method (period of hospice enrollment versus last year or six months of life), and not to other differences.

The two sets of studies (hereafter fixed-period and pseudo-enrollment studies) vary along several dimensions. The fixed-period studies typically used Medicare claims (for the US or a few states), and time period varied over more than a decade. The enrollment-period studies used a few thousand decedents in the Health and Retirement Survey, and the time period for the most recent study centered on 2005. In addition, the enrollment-period studies matched hospice and non-hospice decedents based on projected likelihood of using hospice.

Here, we use a uniform dataset, uniform underlying population, and uniform methods for accounting for cost and timing of cost to compare the two types of studies.

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[4] We excluded two studies from this comparison. One of these (Weckmann et al., 2012) relied on the experience of seven hospice patients at a single academic medical center and so lacks generalizability. We exclude one other study because it was an outlier in terms of methods and findings (Pyenson et al 2004). Uniquely, that study did not look backward from date of death, but captured individuals dying within two years of treatment signaling likely incurable fatal disease (e.g., switch in cancer chemotherapy regimen). That study found very large costs and very large savings, depending on the disease. The only consistent finding from that study is that hospice decedents lived longer than non-hospice decedents.

[5] Taylor et al. (2007) noted that the last-year results differed strongly from the hospice-enrollment-period results within their own study. They dismissed the last-year-of-life findings as failing to account for variations in length of hospice enrollment.

In the next sections, we do the following:

Section 2.2.1 describes the methods we use to replicate the fixed period and enrollment/pseudo enrollment studies.

Section 2.2.2 replicates the studies that use a fixed period methodology. Consistent with these studies, we find no overall savings from hospice. By diagnosis, we find significant cost savings for cancer decedents, and significant costs for all others.

Section 2.2.3 replicates the studies that use an enrollment/pseudo enrollment methodology. Consistent with these studies, we find hospice decedents' costs are lower for all enrollment periods up to six months, and are lower both for cancer and non-cancer decedents.

Sections 2.2.4 and 2.2.5 conduct additional analysis to reconcile the apparent contradictory results from these two methodologies. Our analysis finds potential bias in the enrollment/pseudo-enrollment methodology that casts doubt on the validity of the studies that find large and uniform hospice cost savings.

2.2.1 Methods in Brief

The data source is Medicare LDS SAF 5 percent sample claims from 2012 and 2013. Except as noted below, we account for all bill costs on the final date of the claim ("through-date"). This tends to move the timing of spending modestly closer to date of death than other cost accounting methods, and is replaced by pro-rating bill cost on a per-diem basis for one portion of the analysis.

The study population is all fee-for-service elderly decedents in 2013 who had a full 12 months of fee-for-service enrollment prior to death. Dates on these claims are exact dates (not rounded to the nearest quarter), so intervals are based on counting backward from date of death. Payments include only Part A and Part B costs, and we track both total payment (including beneficiary coinsurance/deductible liabilities) and Medicare program payment (excluding the same). Medicare Advantage enrollees are excluded, and we note that the LDS denominator continues to carry the Part C indicator for such enrollees after hospice election.

Diagnosis-based risk adjustment. Diagnosis-based risk adjustment is problematical because the illness severity of long-stay hospice patients can easily be understated. For these individuals, typically the only bill observed is the hospice bill. This may only list the diagnosis that is the principal reason for hospice enrollment. By contrast, those remaining in traditional Medicare will generate a full range of fee-for-service bills and so are likely to show greater breadth of diagnoses reported (and so higher apparent illness severity).

We constrained the amount of diagnosis information used to try to keep hospice and non-hospice decedents on a more nearly equal footing. We constructed two measures. The broader measure uses only principal diagnoses (not secondary diagnoses) from claims, allowing an individual to trigger multiple diagnoses categories. The narrower measure allows each individual to trigger only one diagnosis category, chosen as the category appearing most frequently as principal diagnosis on claims. In all cases, diagnoses were grouped into the AHRQ Clinical Classification System categories. It was readily apparent that the broader measure exaggerated differences in health status between hospice and non-hospice decedents for shorter intervals, and was abandoned in favor of flagging a single diagnosis per beneficiary.

Throughout, we flag beneficiaries who had any (claim principal) diagnosis of cancer reported in the last year of life. It is well established that cancer decedents tend to be costlier than others, and shorter hospice stays than others, so this distinction appeared important. By taking any (claim principal) diagnosis in the entire last year of life, we modestly overstate "cancer decedents" as a fraction of all elderly decedents (about 30 percent), compared to estimated cause-of-death data (about 22 percent).

Hospice enrollment period and pseudo-enrollment period. The LDS files show hospice enrollment periods only on the hospice claims themselves. (The LDS denominator file does not show hospice enrollment periods.) Hospice decedents were defined as decedents using hospice in the last 30 days of life. Non-hospice decedents were those with no hospice use in the last 30 days of life. The start of the hospice enrollment period was taken as the earliest hospice start date mentioned on any claim 2011 to 2013.

For the enrollment/pseudo-enrollment analysis, we needed to construct a pseudo-enrollment period for the non-hospice decedents. We calculated span of hospice enrollment for hospice decedents (date of death less earliest date of hospice enrollment), truncating that at 365 days to ensure that it did not extend beyond the claims data available for all individuals in the sample. We then randomly assigned those spans to non-hospice decedents, separately for cancer decedents (defined above) and others.

The pseudo-enrollment period for non-hospice decedents began at the date of death less the randomly-assigned hospice span. This gives the hospice and non-hospice decedents the same distribution of enrollment (or pseudo-enrollment) periods prior to death. Because we wanted to do some comparisons between cancer decedents and others, we matched the pseudo-enrollment spans based on presence of any cancer diagnosis on the claim. No other attempt was made to match enrollment period by (e.g.) most common principal diagnosis, age, or other characteristics. Instead, we are relying on the risk adjustment factors in the resulting regression analysis to account for differences among decedents

Regression analysis. Ordinary least squares (OLS) regression was used to decompose total cost during the study period (either last N months of life, or period of hospice enrollment/pseudo enrollment). Explanatory variables included:

- Age categories
- Sex
- Race (Caucasian, African-American, Other)
- Medicaid (any Medicaid buy-in)
- Diagnosis-based risk adjustment category (one per person, discussed above)
- Geographic area (CBSA or rural-rest-of-state).

2.2.2 Replicating the fixed enrollment period studies.

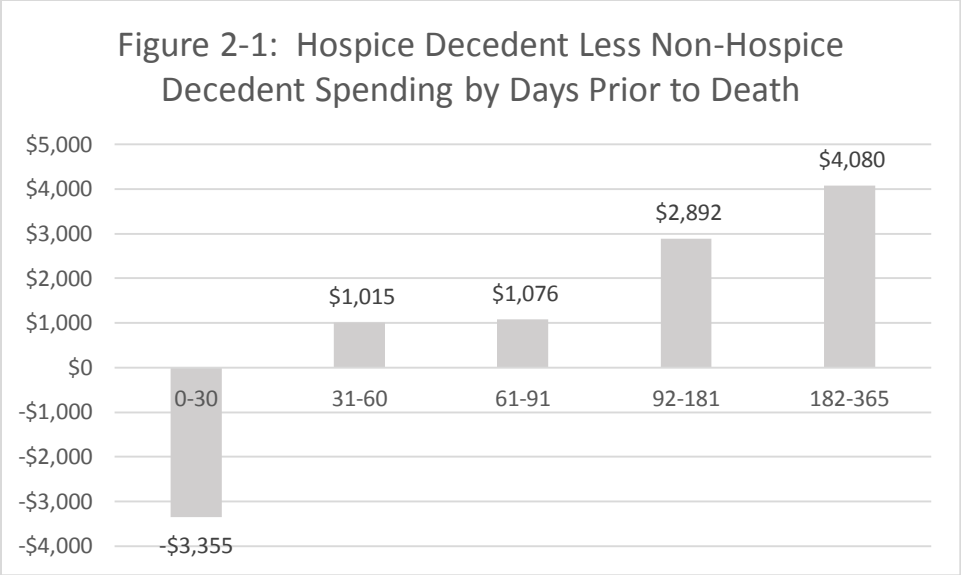
Table 2-2 contrasts total payments for hospice and non-hospice decedents for various periods from one month to one year prior to death. Results follow a clear pattern: The shorter the period examined prior to death, the lower the spending of hospice decedents relative to non-hospice decedents. The time period for which costs appear roughly equal is somewhere near the last half-year of life. If we look at fewer months prior to death, hospice decedents have lower spending. By contrast, if we look at the year prior to death, non-hospice decedents have lower spending. (Note that this is not the length of hospice enrollment that varies, but the period prior to death over which we summarize costs.)

These results appear similar to the portion of the Abt (2013) literature review that examined the last year or last six months of life, in that we show modestly higher costs for hospice decedents than for others. The 11 percent difference in Medicare program payments (for hospice decedents relative to others, last year of life) is higher than shown in the historical literature. This might plausibly relate to longer average hospice stays (and so, higher average hospice spending) in 2013 than in the historical data analyzed in the literature review.

Table 2-2: 2013 Decedent Spending in Various Periods Prior to Date of Death							
	Mean Values, No Adjustments				Regression Adjusted		
Period (days prior to death)	Non-hospice decedent	Hospice decedent	Diff.	P-value	Diff.	P-value	Memo: % diff
Medicare program payment							
30	$ 15,779	$ 12,423	-$3,355	<0.001	-$3,018	<.0001	-19%
60	$ 20,097	$ 17,757	-$2,340	<0.001	-$1,936	<.0001	-10%
91	$ 23,492	$ 22,228	-$1,264	<0.001	-$871	<.0001	-4%
182	$ 31,126	$ 32,755	$1,628	<0.001	$1,767	<.0001	6%
365	$ 43,725	$ 49,433	$5,708	<0.001	$4,888	<.0001	11%
Total payment							
30	$ 17,389	$ 13,157	-$4,232	<0.001	-$3,851	<.0001	-22%
60	$ 22,362	$ 19,021	-$3,340	<0.001	-$2,873	<.0001	-13%
91	$ 26,307	$ 24,001	-$2,306	<0.001	-$1,865	<.0001	-7%
182	$ 35,217	$ 35,881	$664	0.11	$782	0.0108	2%
365	$ 50,117	$ 55,124	$5,007	<0.001	$3,936	<.0001	8%
Memo: sample size	36856	32922					
Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.							

We can examine the data differently, breaking the last year of life into intervals: days 0-30, 31-60, 61-91, 92-181, and 182-365 for each decedent. That is, instead of combining the entire time period prior to death, we can ask how spending compared two months from death, three months from death, and so on. Unlike the last-N-months-of-life, this approach captures differences in the timing of spending relative to the date of death.

On average, hospice decedents spend less than non-hospice decedents only in the last month of life (Figure 2-1). In every other interval prior to death, they spend more than non-hospice decedents. When we look at the full year prior to death, it's not that hospice decedents spend less on average, it's that they incur their spending earlier in that year.



The immediate consequence of this is that our estimates of savings or cost for hospice as a whole will depend materially on the time period studied. (Again, note that this is not the length of hospice enrollment, but the period over which we are tracking spending.)

Finally, we can replicate the typical finding of hospice savings for cancer decedents. We do not have cause of death data, but instead split the file based on the presence of any principal diagnosis of cancer on a claim in the last year of life. (Compared to cause-of-death data, this overstates the number of cancer decedents by about 30 percent.)

Table 2-3 shows that hospice decedents with cancer cost less than non-hospice decedents with cancer, regardless of the period studied. For decedents without cancer, however, the study look back period at which hospice and non-hospice decedents appear to have equal costs is now the last three months of life – any period shorter than that, and hospice decedents have lower costs. Any longer look back period, and non-hospice decedents have lower costs.

Table 2-3: 2013 Decedent Program Payments in Various Periods Prior to Date of Death, Split by Presence of Cancer Diagnosis

	Mean Values, No Adjustments				Regression Adjusted		
Period (days prior to death)	Non-hospice decedent	Hospice decedent	Diff.	P-value	Diff.	P-value	Memo: % diff
No cancer diagnosis in final year							
30	$14,371	$12,099	-$2,271	< 0.001	-$1,795	<.0001	-12%
60	$18,181	$17,156	-$1,025	< 0.001	-$415	0.0769	-2%
91	$21,178	$21,436	$259	0.44	$935	0.0005	4%
182	$27,906	$31,322	$3,415	< 0.001	$4,090	<.0001	15%
365	$38,989	$46,244	$7,255	< 0.001	$7,488	<.0001	19%
Memo: Observations	28,593	19,531					
With cancer diagnosis in final year							
30	$20,651	$12,896	-$7,755	< 0.001	-$6,756	<.0001	-33%
60	$26,724	$18,633	-$8,092	< 0.001	-$6,795	<.0001	-25%
91	$31,500	$23,383	-$8,117	< 0.001	-$6,653	<.0001	-21%
182	$42,270	$34,845	-$7,425	< 0.001	-$5,733	<.0001	-14%
365	$60,109	$54,083	-$6,026	< 0.001	-$4,270	<.0001	-7%
Memo: Observations	8,263	13,391					

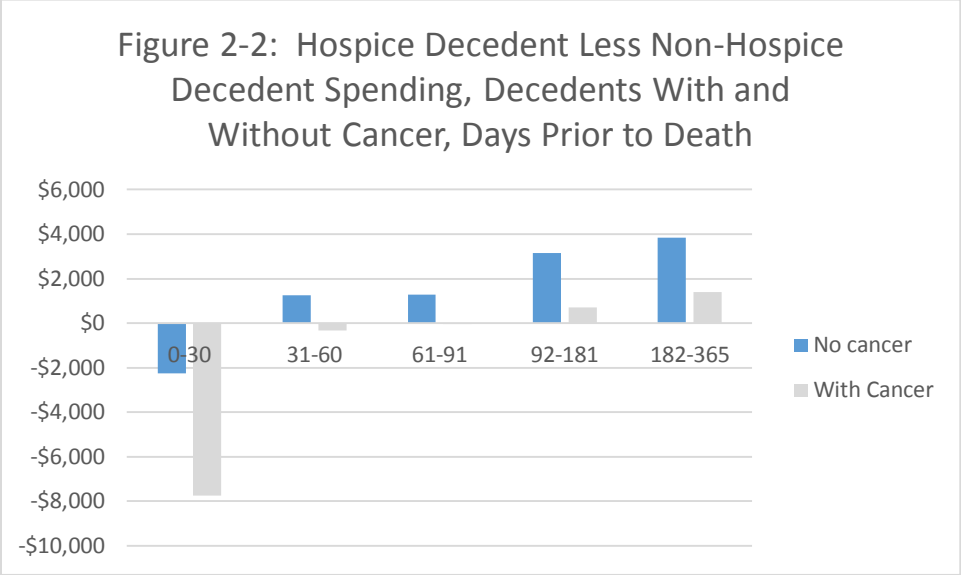
Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.

Figure 2-2 tabulates the data into intervals during the last year life to confirm the fundamental difference between cancer and non-cancer decedents in terms of spending patterns over time. For decedents with cancer, hospice patients on average show substantial cost savings in last month of life, then slightly lower or slightly higher costs in prior periods. For non-cancer decedents, by contrast, hospice decedents have slightly lower spending in the last month of life, but higher spending in every other period prior to death.

Heuristically, these findings mirror expert observation that hospice may either displace acute care costs (i.e., non-hospice Part A and Part B costs) or add to acute care, depending on circumstances.[6] For cancer decedents, hospice appears to displace acute care on average. Spending levels of (eventual) hospice and non-hospice decedents appear similar up to the month of death, at which point, hospice decedents' costs fall well below those of non-hospice decedents. By contrast, non-cancer decedents primarily appear to have obtained their acute care further from the date of death, with the hospice episode adding to prior acute costs.[7]

[6] "The relationship between hospice utilization and other services is not clear; in some cases hospice may substitute for other types of care, and in others it may be used in addition to conventional care services." (Riley and Lubitz, 2010).

[7] This type of relationship could arise purely from "survival bias". Early decedents have fewer opportunities to elect hospice, longer-term survivors have more. Plausibly, individuals who survived longer ended up in hospice more often than those who died early. An association between survival time



In summary, on average, we appear to be able to match the fixed-period studies reviewed by Abt (2013). The fact that our net cost of hospice decedents at one year is higher than typically reported may be an artifact of the changing mix of hospice decedents (more non-cancer decedents in hospice). We find significant cost savings for (our proxy for) cancer decedents, and significant costs for all others.

Additional analysis and robustness check. Table 2-4 summarizes the last-year-of life spending, regression-adjusted, looking separately at the cost of hospice itself, and then at all non-hospice Part A and Part B costs. Shown this way, hospice appears more efficient for cancer decedents. Acute care savings of nearly $12,000 more than offset the more than $7000 cost of hospice. For non-cancer decedents, by contrast, acute care savings appear to amount to just $2500, while hospice itself costs about $10,000 per decedent, leading to a substantial net cost of hospice use.

Table 2-4: The Apparent Economics of Hospice, Last Year of Life Spending

Regression-adjusted impact on the components of spending

	Acute care costs avoided	Cost of hospice itself	Net effect on Medicare outlays
Cancer decedents	-$11,626	$7,356	-$4,270
Non-cancer decedents	-$2,543	$10,031	$7,488

Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.

and probability of (eventual) hospice enrollment would appear in the claims data as a longer lag between acute care spending and death for hospice decedents.

Finally, although the mean spending of hospice and non-hospice decedents is similar, the distribution is quite different. In particular, non-hospice decedents have more of both low outliers (low or zero spending) and high outliers (extremely high spending).

The details of the regression methodology already substantially reduce the effect of low-cost cases through the geographic adjustment and diagnosis-based risk adjusters. A large fraction of non-US decedents (e.g., resident in US territories or possessions) show low or zero cost. These are isolated by the fixed effects for CBSA and rural-rest-of-state area. Further, all zero-cost cases are isolated in the "no known cause of death" category because no claims means no diagnosis information.

That said, because the finding of higher costs for non-cancer hospice decedents, we should check that the regression results are robust to dropping various categories of low-cost cases. This includes simply truncating the spending distribution (dropping all cases below some fixed level of spending), even though that approach is known to bias the estimated regression coefficients toward zero. (That is, we expect to see the difference between hospice and non-hospice decedents shrink, as a matter of statistics, as we truncate the spending distribution at higher and higher levels).

Table 2-5 shows the robustness check for the finding that non-cancer hospice decedents have higher cost. (To orient this table, find $7488 as the difference in cost for the non-cancer decedents on Table 2-3). Scenario 4 on that table shows that dropping individuals without 12 months of Part B, individuals outside the US, and individuals with no spending drops the estimated additional cost of hospice decedents by about $600. Beyond that, setting increasingly high thresholds for spending (at least $1000 to at least $5000) compresses the difference between hospice and non-hospice decedent spending, as statistical theory says it should. But even with that, at the highest level tested, last-year-of-life spending by non-cancer hospice decedents continues to exceed that of non-cancer non-hospice decedents.

Table 2-5: Check That Findings Regarding Non-Cancer Decedents are Robust		
Variant of regression:	Additional cost of hospice decedents, last year of life	p-value
1: All observations	$7,488	<.0001
2 : Require 12 months Part B	$7,145	<.0001
3: 2 + US resident	$7,141	<.0001
4: 3 + spending > $0	$6,892	<.0001
5: 3 + spending > $1K	$5,555	<.0001
6: 3 + spending > $2K	$4,377	<.0001
7: 3 + spending > $3K	$3,506	<.0001
8: 3 + spending > $4K	$2,911	<.0001
9: 3 + spending > $5K	$2,432	<.0001
Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.		

2.2.3 Replicating the hospice enrollment period results.

Terminal hospitalization and a significant accounting detail. Throughout this analysis, all costs on each bill have been attributed to the last date on the bill. This hardly mattered for the fixed-period analysis, because the period over which costs were summed had an arbitrary starting point (e.g., 182 days prior to death). The random relationship between bill dates and that fixed interval starting point means that this will capture the correct average cost.[8]

By contrast, that approach matters materially in this section due to the high correlation between hospital discharge date and hospice election date. The majority (54 percent) of short-stay (seven days or less) hospice decedents are literally discharged to hospice (Table 2-6, showing only those hospice elections for 2013 decedents that began in the 2011-2013 period.) That is, the hospice election date is the same as hospital discharge date. More broadly, the majority (62 percent) of all hospice episodes for decedents in a year start within three days of discharge from inpatient or post-acute care (skilled nursing, rehab or long-term hospital stay, or home health episode).

[8] Other approaches that may be used are a simple per-capita pro-rating of the total payment, or, for inpatient claims, literally mimicking the day-to-day change in IPPS payment that would occur if discharged on that day. The latter approach loads nearly all payment in the first few days of the stay.

Table 2-6: Fraction of Hospice Elections Following Acute Episodes

		Pct. of hospice elections within 3 days of:		Percent of hospice elections on the day of:	
Span of hospice prior to death	Number of persons	Hospital discharge	Hospital or postacute discharge	Hospital discharge	Hospital or postacute discharge
Under 7 days	11,960	61%	77%	54%	62%
8-14 days	4,237	47%	66%	39%	47%
14-28 days	3,791	37%	58%	28%	37%
29-91 days	5,753	28%	51%	20%	29%
92-182 days	2,623	22%	43%	15%	24%
Over 182 days	3,666	20%	41%	13%	21%
Total	32,030	42%	62%	35%	43%

Source: Analysis of 2011 - 2013 LDS SAF 5% sample claims and enrollment data.

For hospice decedents, then, the timing of hospice election is strongly inversely correlated with the timing of acute care spending. Hospice decedents in a year typically incur the costs of an inpatient/postacute episode, then elect hospice. By contrast, the pseudo-enrollment date for non-hospice decedents is assigned randomly and so will be uncorrelated with hospital or postacute bill discharge date.

As a result, the decision to include or exclude costs of bills terminating on the day of hospice election strongly affects our measure of cost for hospice decedents, but not for non-hospice decedents. As shown below, the apparent cost savings from hospice change materially depending on the inclusion or exclusion of such bills from the cost of the hospice episode.

Finally, for our analysis of the robustness of this method, we went back and pro-rated all claims on a per-diem basis to avoid this knife-edge effect of including or excluding claims literally on the hospice election date. Here, however, we present results including and excluding claims with discharge date literally on the hospice election date.

Results: Table 2-7 shows the difference in costs between hospice decedents (for the hospice election period, truncated at 365 days) and non-hospice decedents (for a pseudo hospice election period whose distribution of lengths of stay matches the hospice decedents', separately for those with and without cancer).

This provides a good qualitative match to the published literature, although the two sets of estimates appear to bracket the magnitudes of the published studies. For every length

of stay through six months, this method shows lower costs for hospice decedents than for non-hospice decedents. Further, estimated costs are substantially lower – somewhere between 12 and 36 percent lower on average, depending on the treatment of bills ending on the day of hospice election. In addition, however, we find that hospice decedents with stays over 6 months have higher costs than non-hospice decedents over a matched time period, and that hospice cancer decedents have much lower costs than non-hospice cancer decedents.

A final finding relevant for the next section is that the exact accounting for bills on the date of hospice admission materially affects the cost estimates. For example, if we include those as part of the hospice episode, the hospice/non-hospice cost difference for non-cancer decedents is no longer statistically significant (Table 2-7). This underscores how many individuals enter hospice immediately following an acute episode.

Note, however, that analysis of the next two sections finds significant potential bias in the enrollment/pseudo-enrollment methodology. That casts doubt on the validity of interpreting these results as evidence of large and uniform hospice cost savings. Table 2-7 merely demonstrates that we can replicate the cost calculations as shown in the literature, not that these cost differences actually measure Medicare program savings.

Table 2-7: Difference in Medicare Costs, Hospice Decedents (in Hospice Enrolllment Period) less Non-Hospice Decedents (in an Equivalent Period)							
Negative values mean spending is lower for hospice decedents.							
		Exclude non-hospice bills with through date on hospice election date			Include non-hospice bills with through date on hospice election date		
Population	Cases	Diff-erence	Pr > |t|	As % of non-hspc spend.	Diff-erence	Pr > |t|	As % of non-hspc spend.
No restriction	69,778	-$6,558	<.0001	-38%	-$2,103	<.0001	-12%
Baseline restriction*	65,227	-$6,829	<.0001	-36%	-$2,395	<.0001	-12%
Baseline restriction plus:							
By any diagnosis of cancer							
Cancer decedent	21,074	-$11,055	<.0001	-53%	-$6,343	<.0001	-30%
Non-cancer decedent	44,153	-$4,713	<.0001	-26%	-$448	0.11	-2%
By span of hospice enrollment							
Under 7 days	23,845	-$7,518	<.0001	-79%	-$668	0.0013	-6%
8-14 days	8,436	-$8,914	<.0001	-69%	-$4,229	<.0001	-32%
14-28 days	7,429	-$9,432	<.0001	-64%	-$5,777	<.0001	-39%
28-60 days	7,455	-$10,383	<.0001	-52%	-$7,792	<.0001	-39%
60-91 days	3,672	-$9,143	<.0001	-37%	-$6,922	<.0001	-28%
92-182 days	5,199	-$4,945	<.0001	-17%	-$3,121	0.0005	-11%
183-365 days	9,191	$10,810	<.0001	26%	$11,792	<.0001	28%
Note: Figures are OLS regression coefficients.							
* 12 months Part B, US resident, spending > 0							
Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.							

2.2.4 Reconciling the arithmetic of the two types of studies.

In Section 2.2.2, looking at a fixed period of time prior to death, we found that hospice decedents were costlier than non-hospice decedents, on average, when we looked at any period longer than the last three months of life. Further, there were net last-year-of-life savings only for cancer decedents. In Section 2.2.3, by contrast, looking only at the period of hospice enrollment, hospice decedents' costs are lower for all enrollment periods up to six months, and are lower both for cancer and non-cancer decedents.

Table 2-8 provides the obvious arithmetic reconciliation between the two sets of results: Hospice decedents spend more than non-hospice decedents *in the period prior to enrollment/pseudo-enrollment*. (Table 2-8 looks at everything *except* (i.e., prior to) the enrollment period, for the last year of life. Heuristically, if we were to add Table 2-7 and Table 2-8, we would arrive at total spending for the last year of life.)

Table 2-8 shows uniformly and substantially higher costs for hospice enrollees, *in the period prior to hospice enrollment*. Depending on where we count bills that end on the day of hospice election, hospice decedents' costs in the pre-enrollment period average roughly $11,000 higher (counting those bills in the pre-enrollment period) or $6500 higher (counting those bills as part of the hospice enrollment period). Hospice decedents' spending was higher for both cancer and non-cancer decedents (but more so for non-cancer decedents), and across all lengths of hospice enrollment. (Recall that analysis of Section 2.2.2. looked at spending month-by-month, while here, this is spending prior to the date of hospice election.)

Table 2-8: Difference in Medicare Costs, Hospice Decedents less Non-Hospice Decedents, Remainder of Last Year of Life Outside of Hospice Enrollment (or Pseudo Enrollment) Period

Positive values mean spending is higher for hospice decedents.

	Obser-vations	Include non-hospice bills with through date on hospice election date			Exclude non-hospice bills with through date on hospice election date		
Population	Cases	Diff-erence	Pr > |t|	As % of non-hspc spend.	Diff-erence	Pr > |t|	As % of non-hspc spend.
No restriction	69,778	$11,446	<.0001	43%	$6,991	<.0001	27%
Baseline restriction*	65,227	$11,031	<.0001	38%	$6,598	<.0001	23%
Baseline restriction plus:							
By any diagnosis of cancer							
Cancer decedent	21,074	$7,169	<.0001	18%	$2,458	<.0001	6%
Non-cancer decedent	44,153	$11,605	<.0001	46%	$7,340	<.0001	30%
By span of hospice enrollment							
Under 7 days	23,845	$10,661	<.0001	28%	$3,811	<.0001	10%
8-14 days	8,436	$9,666	<.0001	27%	$4,981	<.0001	14%
14-28 days	7,429	$9,657	<.0001	29%	$6,002	<.0001	18%
28-60 days	7,455	$8,340	<.0001	28%	$5,749	<.0001	19%
60-91 days	3,672	$11,761	<.0001	47%	$9,540	<.0001	39%
92-182 days	5,199	$13,546	<.0001	81%	$11,723	<.0001	71%
183-365 days	9,191	$5,891	<.0001	154%	$4,909	<.0001	131%

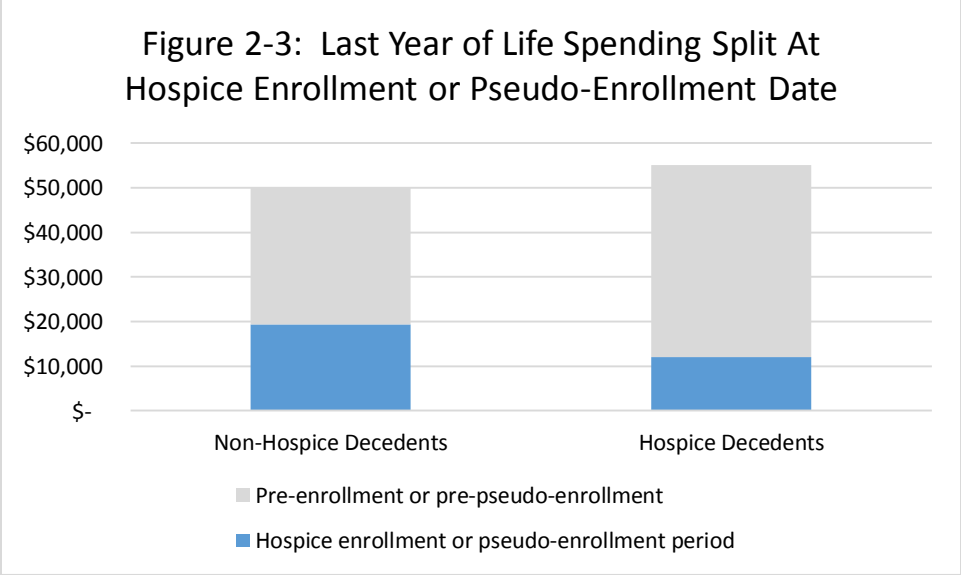
Note: Figures are OLS regression coefficients.

* 12 months Part B, US resident, spending > 0

Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.

Together, these tables show that the enrollment/pseudo-enrollment approach results in *two* large and uniform sets of apparent hospice impacts. We started with spending in the last year of life, where hospice decedents show modestly higher average costs. The year is then split at the point of hospice enrollment (or at an assigned pseudo-enrollment point for non-hospice decedents). Hospice decedents' costs in the *enrollment* period itself appear much *lower* than other decedents' costs in their pseudo-enrollment period (Table 2-7), with the exception of very-long-stay hospice enrollments. Hospice decedents' costs in the *pre-enrollment* period appear much *higher* than other decedents' costs in a similar period (Table 2-8).

The net result of the enrollment/pseudo-enrollment methodology is shown in Figure 2-3. This approach partitions hospice decedents' last year of life so that costs fall into the pre-enrollment period (top bar). Focusing solely on the enrollment (or pseudo-enrollment) period (bottom bar) then shows much lower costs for hospice decedents.



2.2.5 Bias in the enrollment/pseudo enrollment methodology.

In this section, we show that the enrollment/pseudo-enrollment methodology may produce a substantially biased estimate of the impact of hospice on Medicare spending. First, the method is not robust to arbitrary differences across otherwise identical individuals. Keeping spending constant, but switching choice of post-acute care from hospice to SNF, results in a vastly different estimate of enrollment/pseudo-enrollment period costs. (In effect, merely re-labeling the cost categories materially changes the cost estimate.) Second, we show that these individual differences do not "average out" over the entire dataset. We applied both the enrollment and pseudo-enrollment methods to the hospice decedent population. The estimated enrollment/pseudo-enrollment period costs (for the same population) differed by nearly 30 percent.

The enrollment/pseudo-enrollment approach will give very different cost estimates for seemingly identical individuals and populations. For the population at issue – hospice decedents – the difference is large enough potentially to account for the findings reported in the literature. This raises the possibility – but does not definitively prove – that the estimates of large hospice cost savings reported in the literature are an artifact of the enrollment/pseudo-enrollment methodology, and not an actual impact of hospice use on Medicare spending.

Analysis. One unusual aspect of the enrollment/pseudo-enrollment approach is that it applies two different methodologies to the two different populations. The start of the study period for hospice enrollees is endogenously determined (chosen by the hospice enrollees via the hospice election date), but the start of the study period for non-hospice decedents is exogenously imposed (by random assignment of the researcher).

While this results in the same distribution of time periods prior to death, the use of the endogenous (beneficiary-chosen) enrollment means that endogeneity bias may be a threat to the validity of the results. The statistical analysis assumes that hospice choice causes spending. But if the reverse is true -- if a beneficiary's spending prompts choice of hospice – then the resulting estimates will be biased. It is particularly troublesome that the timing of the hospice enrollment decision is clearly negatively correlated with the timing of acute-care spending. That is, the majority of elections for 2013 hospice decedents occurred immediately following discharge from an acute/postacute episode.

More simply, because we used two different methods (enrollment, pseudo-enrollment) to compare two different populations (hospice decedents, other decedents), how can we be sure that the observed difference in costs is due to the difference in the populations, and not the difference in the methods? Put another way, do the two methods produce identical costs for seemingly identical beneficiaries or populations?

First, the two methods produce substantially different costs for seemingly identical individuals. Table 2-9 shows two individuals with identical patterns of end-of-life spending. Both were discharged from the hospital eight days prior to death. One was discharge to hospice care costing $300 per day. The other was discharged to SNF care costing $300 per day. In effect, the individuals are identical, and we have simply re-labeled hospice spending as SNF spending for the second individual. The hospice enrollee will always show $2100 in enrollment-period costs. The SNF user will show $2100 or $12,100, depending on the pseudo-enrollment date assigned, with an average of $8444 based on the actual distribution of pseudo-enrollment dates in the file.

This example shows only that costs may differ, and does not address whether or not there is an average effect across the entire population. While this example shows much higher costs under pseudo-enrollment, we can easily construct examples where the reverse is true. In general, because the pseudo-enrollment method produces an average of all of the enrollment time periods, it compresses the results toward the average.

Table 2-9: Example Showing Different Costs for Seemingly Identical Beneficiaries		
	Beneficiary dies in hospice	**Beneficiary dies in SNF**
Last 7 days (hospice or SNF)	$ 2,100	$ 2,100
Final hospitalization	$ 10,000	$ 10,000
Last-year-of-life cost	$ 12,100	$ 12,100
Enrollment period cost	**$ 2,100**	
Pseudo-enrollment period cost if assigned an enrollment date:		
Under 7 days		$ 2,100
Over 7 days		$ 12,100
Weighted average		**$ 8,444**
Note: Costs are $300/day for SNF or hospice, enrollment periods rounded to the week for this example.		

The more important question is, do the two methods differ when averaged across the entire population? To test this, we applied both methods to the same population, the hospice decedents. We used the exact same methods as before, but instead of randomly assigning cancer- and non-cancer pseudo-enrollment periods to the *non-hospice decedents*, we assigned them to the *hospice decedents*. Then we calculated costs, for the same population, using the two different methods – enrollment and pseudo-enrollment.

To make the comparison as close as reasonable to published work, we made two changes from our previous analyses. First, we pro-rated all bills on a per-diem basis. This avoids the knife-edge instability of including or excluding large amounts of spending that happen to fall on the hospice election date. Second, this analysis excludes the long-stay (over-half-year) hospice periods, as long stays were excluded from the published pseudo-enrollment studies.

Table 2-10 shows apparent large and uniform hospice cost savings, *for the hospice decedent population compared to itself*. We apply no risk adjustment or regression analysis because we are looking at the same population on both halves of the table. The two different methodologies generate materially different estimates of cost. For the same population, spending appears uniformly and substantially lower when captured with the enrollment method as opposed to the pseudo-enrollment method. For hospice decedents as a whole, the difference in methods results in a 29 percent difference in estimated end-of-life costs. This is of the same magnitude as was reported in the literature for the hospice/non-hospice contrast.

Table 2-10: Difference in Medicare Costs, Hospice Decedents in Hospice Enrollment Period Versus Hospice Decedents in Pseudo-Enrollment Period

Positive values in final column indicate high costs using the pseudo-enrollment methodology

	Using Enrollent Period			Using Pseudo-Enrollment Period			Pct diff in cost (1-(Enrollment/Pseudo-Enrollment))
Category	count	Hospice span (days)	Program Payments	Pseudo count	Pseudo-hospice span (days)	Program payments	
All cases	28567	28.5	$6,130	28588	28.4	$ 8,652	29%
Non-cancer decedents							
Total	16193	28.1	$ 5,955	16193	28.2	$ 8,110	27%
0 to 7 days	7287	3.0	$ 1,560	7376	3.0	$ 1,657	6%
8 to 14 days	2374	10.5	$ 3,413	2229	10.5	$ 5,056	32%
15 to 28 days	1935	20.4	$ 4,832	1987	20.6	$ 8,575	44%
29 to 91 days	3027	53.3	$ 10,181	2998	53.4	$ 15,521	34%
91 to 182 days	1570	132.0	$ 23,430	1603	131.4	$ 27,619	15%
over 182 days	(excluded)						
Cancer decedents							
Total	12374	29.0	$ 6,359	12395	28.7	$ 9,360	32%
0 to 7 days	4741	3.2	$ 1,627	4716	3.2	$ 1,702	4%
8 to 14 days	1888	10.6	$ 3,411	1997	10.7	$ 5,491	38%
15 to 28 days	1884	20.5	$ 4,997	1887	20.6	$ 9,474	47%
29 to 91 days	2774	52.4	$ 10,693	2732	52.4	$ 17,064	37%
91 to 182 days	1087	128.8	$ 23,411	1063	129.3	$ 30,598	23%
over 182 days	(excluded)						

Note: Counts are not identical due to small differences in the number of enrollment and pseudo-enrollment periods exceeding 182 days

Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.

We believe this finding casts doubt on the validity of the enrollment/pseudo-enrollment approach. It raises the possibility – but does not prove – that much or all of the estimated cost difference in the published studies using the enrollment/pseudo-enrollment approach could be an artifact of the methodology.

In summary, the use of two different methods on treatment and control groups is usually cause for some concern. Here, the mixing of endogenously-determined start times for hospice decedents and exogenously determined times for non-hospice decedents stood out as a potential weakness. The finding that hospice election time was typically predated by high acute-care spending suggested a potential for endogeneity bias. We checked for that by first showing that the methods will give materially different answers for seemingly similar individuals. (That is, simply re-labeling the cost categories materially changes the cost estimate.) We then applied the two different methods (enrollment/pseudo-enrollment) to one population. We found that they generated a

difference in costs that was similar to that reported in the literature for the hospice/non-hospice contrast. For these reasons, we suggest that the findings of substantial cost savings from the enrollment/pseudo-enrollment studies should probably be set aside until such time as the robustness of that approach can be convincingly demonstrated.

3: A market-level approach to estimating the effect of hospice on cost.

This section was originally conceived as a sort of tie-breaker to follow the prior analysis. As discussed above, fixed-period (last-year-of-life) studies uniformly show no savings or net costs for hospice. Enrollment/pseudo-enrollment studies show large savings, but the methodology appears suspect. Here, we sketch out a third, completely different approach for estimating the impact of hospice on cost. Instead of separating hospice and non-hospice decedents, we pool all decedents at the market (core-based statistical area, CBSA) level for 11 years, throw away all cross-section and time-trend differences, and estimate the impact the variations in hospice market share have on the market-level ratio of decedent to survivor cost.

3.1 Shortcomings of person-level analyses.

The existing literature on hospice and costs discussed in Section 2 has some substantial shortcomings. Whether fixed-period or pseudo-enrollment, these are all *person-level* studies examining *decedents' costs* for a fairly *short period of time.* This raises three sets of fundamental shortcomings.

First, because these studies contrast hospice users and non-users, they will always be subject to the criticism of potential unobserved biased selection related to cost or choice. That is, the hospice and non-hospice populations may systematically differ in their propensity to consume health care, or in their opportunity to select hospice, in ways that cannot be captured from administrative or other data sources. Interpretation of the results of such studies is muddied further to the extent that probability of hospice enrollment might be a function of longevity within the terminal episode. Because of these factors, one can always argue that the cross-sectional difference in cost between hospice and non-hospice populations may or may not yield an unbiased estimate of the effect of hospice on cost.

Second, these studies ignore a substantial fraction of hospice spending. That ignored portion of spending consists of hospice spending for non-decedents and hospice spending in episodes that are longer than the time period studied. Currently, about a third of Medicare hospice outlays are for individuals not in the last year of life. If hospice election is viewed as a prediction that a beneficiary is approaching death, then these studies ignore the cost of false positive predictions (hospice spending remote from the date of death).

Third, for the hospice enrollment period studies (at least), the exact timing of spending matters. Seemingly minor changes in which dollars are or are not counted as part of the

hospice "episode" reversed the finding of lower cost in the hospice stay for non-cancer decedents.

For this section of the paper, we tried a different approach, looking for a correlation between cost per decedent and hospice penetration across market areas and over time. We do not separate hospice and non-hospice decedents. Instead, we pool them and look at the influence of hospice market share on the average cost of all decedents in a market. This avoids the need to separate hospice and non-hospice decedents, and (in some formulations) allows total hospice cost (including costs outside the last year of life) to be factored into the analysis.

3.2 Methods. We used the same methods as were used in the first section of this paper to summarize costs and person-years of enrollment, separating the last year of life from the remainder of Medicare costs. Instead of doing this nationally, we did this separately for each core-based statistical area (CBSA, formerly MSA) and rural-rest-of-state, allocating all costs by beneficiary place of residence. We also summarized measures characterizing the decedents in each CBSA – demographics, cancer present in the last year of life, and various measures of the extent of hospice use.

Our outcome measure in each CBSA is the ratio of decedent to survivor cost per person-year. Taking the ratio of decedent to survivor cost inherently removes most of the effects of Medicare geographic price variation, and removes the effects of regional practice pattern variation or overall intensity of service delivery. This, along with CBSA fixed effects (described below), means that variation in prices and practice patterns across areas should not matter.

Analysis is a simple panel data approach, often termed least-squares dummy variables (LSDV). Each year-CBSA observation is the average for all persons in that CBSA that year. We weight the individual CBSAs by the number of decedents in each CBSA in each year. We have roughly 450 CBSA areas, and 11 years of data. We included fixed effects (dummy variables) for CBSA and year. The inclusion of the dummy variables removes all purely cross-sectional variation. The inclusion of year removes any national trends.

The estimated impact of hospice is derived entirely from the within-CBSA variation in hospice use and decedent costs (relative to survivors). At root, we are asking whether above-average hospice use in a CBSA (relative to each CBSA's own norm, and national trend) is associated with higher or lower cost of decedents. If hospice reduces Medicare costs, there should be an average association between higher hospice use and lower Medicare end-of-life costs.

The strength of this LSDV approach is that it removes all of the cross-sectional variation, effectively comparing each area to its own average. For example, rural areas historically have lower hospice use and lower Medicare per-capita spending. Similarly, areas of the country with historically high managed care penetration tend to have both higher hospice use and lower per-capita costs. In yet a third example, the mix of causes of death varies

across regions of the country, and also affects cost per decedent. Regional variation in these factors is removed before estimating the impact of hospice on costs.

This does not come without a penalty, however. First, because we have just 11 observations per CBSA, we will slightly "overfit" the data, and remove some of the true within-CBSA variation. Second, because cross-sectional and national time-series variations are thrown away, we are obtaining the estimates from observations with a much smaller range of variation. Third, there is likely to be positive serial correlation of the error terms within each CBSA, and so we may overstate true significance tests.

3.3 Results

Table 3-1 shows the results of the analysis. We ran the overall analysis twice, once calculating the ratio of decedent to survivor costs in the normal fashion (top half of table), and then a second time attributing all hospice costs in a market area to the decedents in that market area (bottom half of the table). The second run accounts for the full cost of the hospice benefit per decedent, including costs outside of the last year of life. (Shifting the hospice costs in that fashion raised the decedent-to-survivor ratio about 5 percent, from 5.98 to 6.25). Within each run, we accounted for hospice use overall (Model 1), split by cancer and non-cancer decedents (Model 2), and split by short, medium, and long-stay hospice patients (Model3).

Qualitatively, the fixed-effects (LSDV) estimate replicate key findings of the fixed-period studies and rejects the hypothesis that hospice results in an overall reduction in Medicare cost. Across formulations, we find that:

- Older decedents are less costly.
- Cancer decedents in general are costly.
- There are significant racial differences in average end-of-life costs.
- And for hospice:
    - Model 1: Higher hospice use is associated with higher cost.
    - Model 2: That is due solely to non-cancer hospice use.
    - Model 3: That is mostly attributable to very long hospice stays.

The only material effect of loading all hospice cost onto decedents is that the effect sizes are larger. In addition, long hospice stays were statistically significant predictors of higher ratio of decedent to survivor costs.

Table 3-1: Panel Data Fixed Effects (Least Squares Dummy Variables) Estimated of Impact of Hospice on Ratio of Decedent to Survivor Cost						
Observations are CBSA-year averages						
The predicted or left-hand-side variable is the ratio of decedent to survivor cost.						
Positive parameter values = higher decedent cost.						
	Model 1		Model 2		Model 3	
parameter	Effect	P value	Effect	P value	Effect	P value
Ignoring hospice costs outside of last year of life						
decedent age	-0.11	<.0001	-0.11	<.0001	-0.11	<.0001
decedent male	0.35	0.2026	0.35	0.1950	0.36	0.1892
decedent medicaid	0.30	0.2563	0.30	0.2572	0.27	0.3143
decedent race African-American	1.29	0.0124	1.34	0.0096	1.26	0.0147
decedent race other	-3.13	0.0472	-2.95	0.0613	-3.20	0.0425
fraction deaths with cancer	1.41	<.0001	2.05	<.0001	1.43	<.0001
Alternative specification of fraction of decedents using hospice:						
1: fraction using hsp	0.51	0.0231				
2: fraction using hsp with cancer			-0.44	0.3021		
2: fraction hsp noncancer			1.03	0.0006		
3: fraction with short hospice stay (two weeks or less)					0.28	0.3665
3: fraction with medium hospice stay (15 days to 6 months)					0.37	0.2508
3: fraction with long hospice stay (> 6 months)					1.84	<.0001
Loading all hospice costs onto decedents (including costs outside of last year of life)						
decedent age	-0.11	<.0001	-0.11	<.0001	-0.11	<.0001
decedent male	0.36	0.2125	0.37	0.2036	0.38	0.1891
decedent medicaid	0.25	0.3870	0.24	0.3885	0.18	0.5194
decedent race African-American	1.50	0.0063	1.56	0.0046	1.41	0.0099
decedent race other	-3.99	0.0175	-3.78	0.0245	-4.16	0.0129
fraction deaths with cancer	1.16	0.0001	1.93	<.0001	1.18	<.0001
Alternative specification of fraction of decedents using hospice:						
1: fraction using hsp	1.03	<.0001				
2: fraction using hsp with cancer			-0.11	0.8152		
2: fraction hsp noncancer			1.65	<.0001		
3: fraction with short hospice stay (two weeks or less)					0.34	0.3121
3: fraction with medium hospice stay (15 days to 6 months)					1.02	0.0026
3: fraction with long hospice stay (> 6 months)					3.60	<.0001
Note: Model includes dummy variables for CBSA and year						
Source: Analysis of 2012 and 2013 LDS SAF 5% sample claims and enrollment data.						

4 Brief Summary.

The preponderance of evidence suggests that the hospice benefit has not reduced Medicare spending. That is based on the following analyses.

In section 1, we documented that Medicare hospice use grew substantially for the past decade and that Medicare end-of-life costs rose. This continues a pattern that began in the mid-1990s, first noted by CMS Office of the Actuary staff (Calfo, Smith, and Zezza, undated).

In Section 2, we showed that recent findings of large and uniform hospice cost savings in some studies are plausibly an artifact of the enrollment/pseudo-enrollment methodology. The remainder of the literature examined costs over a fixed period of time, either the last year or half-year of life. Those fixed-period studies show no hospice cost savings on average, possibly modestly higher costs, with the costs concentrated in non-cancer and longer-stay decedents.

In Section 3, we validated the main findings of the fixed-period hospice cost studies using a different approach. We studied the cost of all decedents, at the market-area level, as a function of the extent and composition of hospice enrollment. This alternative approach reproduced the main findings of the fixed-period studies. Hospice appears to raise end-of-life costs modestly. It may save costs for cancer decedents on average, but not for others, and not for individuals with long hospice stays.

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Addendum A: The enrollment/pseudo-enrollment methodology generates spurious estimates of cost savings.

In the body of this report, we concluded that the large cost savings from hospice reported in two published studies were probably an artifact of the methodology used in those studies. That is, the savings estimates were not real, but instead were generated by the methodology itself. This addendum provides additional analysis that further supports this finding.

The enrollment/pseudo-enrollment approach looks at costs only during the hospice enrollment period (for hospice decedents), and compares that to costs in a randomly-assigned pseudo-enrollment period (for non-hospice decedents). Uniquely, that approach appeared to find large hospice cost savings. By contrast, studies that looked at some fixed period of time for both hospice and non-hospice decedents (last year or last six months of life) found either no savings or modest net costs for hospice.

We suspected that the use of different methods for hospice and non-hospice decedents actually created the measured difference in costs. The start of the study period for hospice decedents is endogenously determined (chosen by the beneficiary), and is strongly correlated with costs (typically excludes significant prior acute care costs). By contrast, for non-hospice decedents, the start of the pseudo-enrollment period is exogenous determined (randomly assigned by the researcher) and may or may not include significant acute-care spending.

In the main report, we showed that these two methods (enrollment and pseudo-enrollment) generated quite different costs for seemingly identical individuals. Further, we demonstrated that these differences do not "average out" for the hospice population as a whole. For hospice decedents, costs during their actual enrollment period and during a randomly-assigned pseudo-enrollment period differed by about 30 percent, or roughly the size of the cost savings reported by those two studies. Because of this, and because those findings of large cost savings are so strongly at odds with all other evidence, we suggested that those savings were probably an artifact of methods. That is, the savings were not real; they were created by a flawed methodology.

A shortcoming of that analysis of the enrollment/pseudo-enrollment methodology is that only one population -- hospice decedents -- had an enrollment date. The best we could do was to show that the estimated cost per decedent for that population depended strongly on whether actual enrollment dates or pseudo-enrollment dates were used.

Here, by contrast, we identify two decedent populations with well-defined episode start dates. With two such populations, we can now show the estimated cost savings will flip-flop depending on which population uses actual enrollment dates and which uses pseudo-enrollment dates. The enrollment/pseudo-enrollment methodology will generate the contradictory finding that *either* population is less expensive than the other. This demonstrates that the methodology will generate large, but illusory estimates of cost savings.

To show this, we used individuals who died in a skilled nursing facility (SNF) or under home health agency (HHA) care in 2013. In effect, we took the typical end-of-life pathway of hospital-hospice-death, and substituted SNF and HHA for hospice. The start of the terminal SNF or terminal HHA episode is the "enrollment date" for that site of care.

There are two key points to bear in mind before presenting the results. First, as with hospice decedents, the "enrollment date" for SNF and HHA decedents tends to leave expensive acute care in the pre-enrollment period. So the same spending pattern that drove the hospice findings is present for these two populations. Second, unlike the hospice analysis, there is no facile explanation for large differences in costs between the two populations. No one stands ready to claim that "SNF cost savings" or "HHA cost savings" explain the results.

We replicated the hospice analysis of the main report using these two populations (SNF and HHA decedents). We did the cost calculation twice. First, we used actual SNF enrollment dates as the basis for the calculation, and imposed pseudo-enrollment periods on HHA decedents. Next, we turned the method around and used actual HHA enrollment dates, and imposed pseudo-enrollment dates on the SNF decedents.

Table A-1 shows the results. When we use actual enrollment periods for the SNF decedent population (and assign pseudo-enrollment periods to HHA decedents), it appears that dying in the SNF reduces end-of-life costs by 36 percent, relative to dying in the care of a home health agency. But when we use actual enrollment periods for HHA (and assign pseudo-enrollment periods to SNF), dying in the care of an HHA appears to reduce end-of-life costs by 20 percent, compared to SNF.

This is clearly logically inconsistent. We could not simultaneously have true cost savings for SNF over HHA, and true cost savings for HHA over SNF. The only plausible conclusion is that the apparent savings are actually an artifact of the enrollment/pseudo-enrollment methodology and do not represent true cost savings. For all three populations (hospice, SNF, HHA decedents), using the actual enrollment dates yields a much lower estimate of cost than using a researcher-assigned pseudo-enrollment date.

Table A-1: Enrollment/Pseudo-Enrollment Method Generates Spurious Estimates of Savings			
Individuals dying in SNF or in HHA.			
With actual and pseudo-enrollment periods modeled on length of final SNF stay and length of final HHA stay.			
All enrollment or pseudo-enrollment periods of 182 days or fewer.			
	Cost in period	**Memo: Cases**	**Memo: Length of period**
Using actual SNF enrollment period, constructing pseudo-enrollment for HHA			
SNF patients, costs in SNF "enrollment period"	$ 9,616	4082	23.4
HHA patients, cost in HHA "pseudo enrollment period"	$ 15,006	1554	23.2
Extent to which SNF appears to reduce end-of-life costs, compared to HHA.	**-36%**		
Memo: SNF costs in SNF "pseudo-enrollment period".	$ 14,490	4070	22.5
Using actual HHA enrollment period, constructing pseudo-enrollment for SNF			
HHA patients, costs in HHA "enrollment period"	$ 17,073	1485	44.1
SNF patients, costs in SNF "pseudo-enrollment period"	$ 21,417	3691	45.1
Extent to which HHA appears to reduce end-of-life costs, compared to SNF	**-20%**		
Memo: HHA costs in HHA "pseudo-enrollment period".	$ 20,708	1501	45.6
Source: Analysis of Medicare 2012 and 2013 5% sample data.			
Note: Case counts vary due to cutoff based on 182 days of actual enrollment or pseudo-enrollment			
Note: SNF = skilled nursing facility, HHA = home health agency.			

In short, this method favors whichever population uses its own actual enrollment dates. And the reason for that appears fairly clear. The enrollment date tends to leave expensive acute care costs outside of the time interval over which costs are captured. The pseudo-enrollment date does not.[1]

In conclusion: The main report showed that switching from actual enrollment dates to pseudo enrollment dates dramatically raised estimated end-of-life costs for hospice patients. We suggested that hospice "savings" measured with that approach were therefore likely to have been created by the methodology, and were not an estimate of actual savings.

Here we have demonstrated that this is a generic flaw in this methodology. Not only did we show the same phenomenon for SNF and HHA decedents, we showed that we can use this methodology to create end-of-life "savings" in either setting (versus the other),

[1] A simple numerical example illustrates the logic. Assume a total time period of 10 days, split into acute and post-acute periods. In this example, beneficiaries spend $2/day during acute care, and $1/day during post-acute care. Assume 10 beneficiaries. Beneficiary 1 enrolls on day 1, beneficiary 2 enrolls on day 2, and so on. Using actual enrollment dates, cost per episode is $5.50. Using pseudo-enrollment dates, the expected value of cost per episode is $7.15. Why? Actual enrollment and pseudo-enrollment include the same number of days. But actual enrollments only include $1 days, while the pseudo-enrollments include a mix of $1 and $2 days. In this numerical example, average cost per pseudo-episode *must* be higher than average cost per true episode. Our findings indicate that this is true empirically, when using actual costs and the actual distribution of episode lengths.

simply by choosing which site uses its actual enrollment dates. The only logical conclusion is that the "savings" estimated by this method are spurious.