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# The Effect of Hospice on End-of-Life Costs for Terminal Medicare Patients With HIV

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## Abstract

One-quarter of annual Medicare expenses in the traditional program (non-Medicare Advantage) are expended for 5% of Medicare enrollees, with much of this expenditure occurring in the last year of life. Hospice use may reduce end-of-life costs. However, evidence has been inconclusive due to sample selection and differences in insurance coverage for hospice. Claims data for HIV-positive Californians enrolled in Medicare who died in the period 2008 to 2010 were used to examine the relationship between hospice use and costs in the last 6 months of life. Logit estimates related hospice use to sickness levels and demographics. Inpatient and outpatient costs were analyzed separately. Logit regressions examined hospitalization probability. Robust regressions were used to examine the determinants of conditional inpatient costs and non-inpatient costs. Bootstrapped post-estimates were then used to determine the marginal probability of costs for the sample by hospice use. Hospice users have greater disease burden and are less likely to be African American. Controlling for disease burden, hospice users would have non-inpatient costs that were \$14771 greater than hospice non-users, but inpatient costs that were \$20522 lower. Thus, hospice reduces costs on net. Hospice is chosen by patients with more comorbidities. Controlling for these comorbidities, hospice use is associated with lower inpatient costs, greater non-inpatient costs and reduced end-of-life costs.

## Keywords

hospice, Medicare, HIV, hospitalization, medical expenditures

### What do we already know about this topic?

End-of-life costs account for a large share of Medicare expenditures, but there is conflicting evidence on whether hospice reduces medical costs.

### How does your research contribute to the field?

Patients with fewer co-morbidities and African American patients were less likely to use hospice; hospice users had higher inpatient costs, but lower outpatient costs.

### What are your research's implications toward theory, practice, or policy?

Hospice improves the quality of life for terminal patients and their surviving family members and reduces costs in the last year of life relative to the standard of care.

## Introduction

In the United States, one-quarter of governmental health insurance expenses for the aged and long-term disabled enrollees of the Medicare program are expended for 5% of Medicare enrollees.<sup>1–4</sup> Much of this expenditure occurs in the last year of life. Although the share of medical costs expended in the final year of life has fallen from 18.6% in 2000 to 13% in 2011, the amount per decedent remains high, averaging \$80 000.<sup>5,6</sup>

Hospice is a program for patients with a terminal illness who want to receive palliative care but no further curative treatment. The goal of hospice is to reduce unnecessary hospitalization and futile interventions while providing palliative care

with enhanced services delivered in an outpatient setting.<sup>4</sup> Medicare will pay for hospice services for enrollees whose

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physician has certified they are terminally ill with a prognosis of 6 months or less if the disease runs its normal course.<sup>7</sup> Hospice use has increased dramatically in recent years, rising from 15.9% of Medicare decedents in 2000 to 48% of Medicare beneficiaries who died in 2016.<sup>4,8,9</sup>

There is conflicting evidence on whether hospice users in the US have lower end-of-life costs than hospice non-users. Some studies have documented lower mean and median end-of-life costs for Medicare hospice enrollees with cancer or with end-stage renal disease (ESRD).<sup>10-17</sup> However, an analysis of Medicare beneficiaries who died of heart failure found they had 4% higher expenditures, after adjustment for covariates.<sup>18</sup> Still, other analyses have found that hospice did not significantly affect medical expenditures.<sup>19-21</sup>

To expand the set of diseases for which hospice use has been studied, we examined hospice use by Medicare beneficiaries with HIV/AIDS. The individuals studied all are covered under the same insurance plan and all share a common diagnosis, though they may have other comorbidities as well.

Although life expectancy for people living with HIV (PLWH) has improved in recent years, PLWH still experience higher mortality rates than the general population (16.9 per 1000 PLWH vs 7.3 per 1000 US residents).<sup>22,23</sup> Yet little is known about their use of medical care and costs during this terminal phase.<sup>24</sup> The aims of this paper are to characterize medical care use and spending in the final year of life among Medicare enrollees with HIV by:

1. Determining the annual mortality rate for Medicare enrollees with HIV for the period 2008 to 2010
2. Determining the percentage and characteristics of Medicare enrollees with HIV who used hospice services in their last year of life
3. Examining how hospice use by Medicare-enrolled PLWH in their last 6 months of life relates to inpatient use, inpatient costs (conditional on any hospitalization), non-inpatient costs, and total costs.

## Methods

### Data

Insurance claims data for HIV-positive Californians enrolled in Medicare for the period 2007 to 2010 were acquired through a confidential data use agreement with the Center for Medicare and Medicaid Services (CMS). The claims data include all expenses covered under Part A, Part B, and Part D. We also included Medicaid claims for the low-income Medicare enrollees who also received supplemental coverage from Medicaid to help them pay for any required cost-sharing.

The sample includes Medicare beneficiaries continuously enrolled in Medicare for at least a year prior to their death between 2008 and 2010, as documented by CMS. We applied a case-identification algorithm to create an analysis file of

adult beneficiaries with verifiable HIV.<sup>25</sup> Our analyses were limited to fee-for-service Medicare enrollees since available data for Medicare managed care enrollees lack diagnosis fields needed to confirm HIV status.

Data acquisition was approved by the CMS Privacy Board and by the University Institutional Review Board (IRB #10-000823). Data were obtained in research identifiable files, with storage, analysis, and reporting procedures meeting all CMS data security requirements.

### Measures

**Outcome variables.** We calculated the death rate for Medicare enrollees by dividing the number of enrollees who died in each year (2008, 2009, 2010) as reported in the Medicare files by the number of PLWH enrolled in Medicare on the first day of the year. A weighted average over the 3 years provided a summary mortality rate.

We constructed a 12-month history of each decedent's total medical expenditures during their last year of life by compiling claims data for the 12 months prior to their death date. Costs included all expenditures reimbursed by Medicare in Parts A, B, and D and Medicaid, plus patient charges for deductibles and coinsurance. Codes for place of service, claim type, and type of service allowed us to categorize expenditures as either inpatient or non-inpatient. Non-inpatient costs included all medical expenditures besides inpatient costs (ie, outpatient, drugs, hospice, long-term care (LTC)/skilled nursing facility (SNF), home care, and durable medical equipment (DME)).

Monthly Medicare expenditures were summed for the last 6 months of life and for the prior 6 months (ie, months 7-12 before death) and adjusted to 2010 dollars using the medical component of the consumer price index. Our analysis of Medicare costs among decedents focuses on health care use in the last 6 months of life since Medicare covers hospice costs within this period. Determinants of non-inpatient costs were estimated separately from inpatient costs because a stated goal of hospice is to reduce futile hospitalizations while providing additional medical care outside the hospital beyond that which Medicare would ordinarily cover.

Inpatient use was indicated by whether or not the decedent had claims for inpatient services in the last 6 months of life.

**Main regressor.** Hospice use was defined by whether the decedent had Medicare claims in the last year of life in the hospice file or Carrier claims files. Six enrollees with no Medicare claims in the year before their death were dropped from the analyses since hospice use could not be determined.

**Demographic characteristics.** CMS enrollment data provided information on patient age at death, race/ethnicity, sex, enrollment type (ie, Medicare only or Dual), zipcode, and

date of death. Zipcodes were categorized based on Rural-Urban Commuting Area (RUCA) codes and used to determine urbanicity. Eighteen observations that were missing race/ethnicity codes were excluded from the sample.

**Comorbidities.** The Charlson Comorbidity Index (CCI), a validated method of classifying comorbidity documented in medical records to predict long- and short-term mortality, was calculated for each subject based on the presence of ICD-9 diagnoses other than AIDS-defining conditions documented in the medical claims. The CCI score weights conditions by their severity to measure the burden of comorbid disease.<sup>26</sup> Medical expenditures in months 7 to 12 before death and presence of a cancer diagnosis are included as additional measures of sickness. Enrollees with missing diagnosis codes (n=44) were excluded from the sample since their comorbidities could not be determined.

### Statistical Analysis

We compared patient characteristics and mean expenditures on outpatient care, drugs, inpatient care, and supportive services in the last 6 months prior to death by hospice use using bivariate tests of association. We separated total costs in the last 6 months into inpatient costs and non-inpatient costs.

We used multivariable methods to assess the relationship between expenditures on inpatient and non-inpatient care in the final 6 months of life and hospice use, controlling for expenditures in the prior six-month period, age, race/ethnicity, sex, urban residence, enrollment type, year of death, and having a cancer diagnosis and comorbidities. Inpatient costs were further disaggregated into the probability of hospitalization and costs incurred in the hospital conditional on being hospitalized.

The literature has documented that African Americans and Hispanics are less likely to opt for hospice or to have advance directives than white patients,<sup>17,27,28</sup> Women are more likely to choose hospice care than men.<sup>29</sup> Among decedents covered by Medicare, women represented 58.4% of hospice users, in contrast to 41.6% who were men.<sup>8</sup> Cancer patients' greater likelihood of enrolling in hospice has been attributed to the greater predictability of length of survival for patients with this diagnosis.<sup>9</sup> To test for self-selection of patients who preferred less intensive treatment into hospice, we tested race/ethnicity, any cancer diagnosis, and sex and as potential candidates for instrumenting hospice use.

We tested if hospice use was endogenously determined with inpatient and non-inpatient care since unobserved variables, such as preferences for aggressive medical interventions, can affect both.<sup>3,20</sup> For our binary outcome of any hospitalization in the last 6 months, we used the Wald test of correlation as suggested by Knapp and Seaks (1998).<sup>30</sup> A significant test would indicate the presence of selection bias.<sup>30</sup> The correlation between the error terms of the hospice use and probability of hospitalization equations was 0.527 and

the Wald test of the correlation between the hospice selection and the outcome equations yielded a chi-square ( $\chi^2$ ) of 3.28 ( $P=.070$ ), which does not support the presence of selection bias in hospice use in our analysis.<sup>30,31</sup> Additionally, although race/ethnicity ( $F=8.83$ ,  $P=.032$ ) and cancer diagnosis ( $F=40.75$ ,  $P<.001$ ) were strongly related to hospice choice, they could not be excluded from the hospitalization regression and thus violates the exclusion restriction assumption of using an instrumental variables approach. As a result, a logit equation was used to estimate the probability of hospitalization. The odds of using any hospice services were also estimated using logit regression.

For our continuous cost outcomes, we used the Wu-Hausman test to determine endogeneity. The results also showed that hospice use was not endogenously determined with either non-inpatient costs ( $F=0.06$ ,  $P=.809$ ) or conditional inpatient costs ( $F=2.31$ ,  $P=.129$ ). For both outcomes, we estimate an OLS regression where the dependent variable was logged to account for the skewed distribution of medical expenditures. To minimize the impact of extreme outliers and influential observations not uncommon in expenditure data, we used robust regression, which is similar to ordinary least squares (OLS) but gives lesser weight to observations with large residuals.<sup>32-34</sup> Bootstrapped post-estimates were then used to determine the costs if all patients in the sample had elected to use hospice and costs if all patients had not.

The effect of hospice use on total costs was determined by using the multivariable regression results to predict the levels of inpatient and non-inpatient spending that each individual in the estimation sample would have had if they had used hospice.

## Results

### Descriptive and Bivariate Results

**Sample characteristics.** We identified 1375 HIV-positive Medicare enrollees who died between 2008 and 2010. The mean annual mortality rate was 4.5% for Medicare-Only enrollees and 4.0% for Duals over the 2008 to 2010 period. Table 1 describes the characteristics of the sample and compares these characteristics by hospice use. The majority of the decedents with HIV were male (86.3%) and younger than 55 (81.4%). More than half of the sample was non-Hispanic white (57.7%), nearly a quarter were non-Hispanic African American (23.9%), 15.8% were Hispanic and 2.6% were some other non-Hispanic race. More than a quarter of the sample had any cancer diagnosis (28.4%), and the average Charlson Comorbidity Index (CCI) score was 3.8 which ranged from 0 to 18. Most (80.5%) were hospitalized at least once in their last 6 months of life. Less than one quarter (24.6%) of Medicare recipients with HIV who died used some hospice services. The hospice users had similar distributions to non-hospice users for age ( $P=.173$ ), sex ( $P=.085$ ), enrollment type ( $P=.0497$ ), urban residence ( $P=.303$ ), and

**Table 1.** Characteristics of Medicare Decedents with HIV.

Variables	Any hospice	No hospice	Total	Range	Test statistic <sup>a</sup>	P-value
	24.6% (n=338)	75.4% (n=1037)	100% (n=1375)			
<b>Demographic</b>						
Age (% , n)					3.5102	.173
<55	78.1% (264)	82.5% (855)	81.4% (1119)	—		
55-64	10.4% (35)	9.0% (93)	9.3% (128)	—		
≥65	11.5% (39)	8.6% (89)	9.3% (128)	—		
Sex (% , n)					2.9608	.085
Male	89.1% (301)	85.3% (885)	86.3% (1186)	—		
Female	11.0% (37)	14.7% (152)	13.8% (189)	—		
Race/Ethnicity (% , n)					9.8568	.020
Non-Hispanic white	64.2% (217)	55.5% (576)	57.7% (793)	—		
Non-Hispanic African American	20.4% (69)	25.1% (260)	23.9% (329)	—		
Hispanic	14.2% (48)	16.3% (169)	15.8% (217)	—		
Non-Hispanic other race	1.2% (4)	3.1% (32)	2.6% (36)	—		
Enrollment type (% , n)					.4612	.497
Dual	69.2% (234)	71.2% (738)	70.7% (972)	—		
Medicare only	30.8% (104)	28.8% (299)	29.3% (403)	—		
Lives in large urban area (% , n)					1.0591	.303
No	3.6% (12)	2.6% (26)	2.8% (38)	—		
Yes	96.4% (319)	97.5% (994)	97.2% (1313)	—		
Year of death					0.3392	.844
2008	29.9% (101)	31.4% (326)	31.1% (427)	—		
2009	34.3% (116)	33.0% (342)	33.3% (458)	—		
2010	35.8% (121)	35.6% (369)	35.6% (490)	—		
<b>Disease comorbidity</b>						
Charlson Comorbidity Index (CCI) score (mean)	4.8	3.5	3.8	0-18	-5.6230	<.001
Any cancer diagnosis (% , n)					81.1579	<.001
No	52.4% (177)	77.8% (807)	71.6% (984)	—		
Yes	47.6% (161)	22.2% (230)	28.4% (391)	—		
Any hospitalization in last 6 months of life (% , n)					2.9589	.085
No	16.3% (55)	20.5% (213)	19.5% (268)	—		
Yes	83.7% (283)	79.5% (824)	80.5% (1107)	—		
<b>Medical expenditures in last year of life (in 2010 dollars) (mean)</b>						
Total (Months 1-12)	\$175,578	\$166,794	\$168,953	\$169-\$882,258	-1.014	.311
<b>Last 6 months (Months 1-6)</b>						
Total expenditures	\$111,588	\$108,382	\$109,170	\$0-\$775,900	-2.282	.023
Inpatient	\$55,707	\$66,131	\$63,568	\$0-\$762,065	0.900	.368
Inpatient, conditional	\$66,534	\$83,225	\$78,958	\$4-\$762,065	2.837	.005
Non-inpatient	\$55,881	\$42,252	\$45,602	\$0-\$479,084	-7.075	<.001
Hospice	\$10,373	\$0	\$2,549	\$0-\$172,129	-36.103	<.001
Outpatient	\$16,094	\$15,160	\$15,390	\$0-\$154,977	-1.256	.209
Drugs	\$14,434	\$14,415	\$14,420	\$0-\$186,490	-0.225	.822
SNF/LTC	\$11,465	\$10,457	\$10,705	\$0-\$202,241	-2.466	.014
Home care	\$2483	\$1200	\$1515	\$0-\$403,263	-2.381	.017
DME	\$1032	\$1018	\$1022	\$0-\$95,281	-2.206	.027
<b>First 6 months (Months 7-12)</b>						
Total expenditures	\$63,989	\$58,412	\$59,783	\$0-\$914,381	-2.995	.003
Inpatient	\$23,384	\$24,025	\$23,867	\$0-\$886,288	-1.886	.059
Inpatient, conditional	\$45,952	\$54,161	\$51,927	\$12-\$886,288	0.230	.818
Non-inpatient	\$40,605	\$34,387	\$35,609	\$0-\$291,359	-3.205	.001
Hospice	\$1,843	\$0	\$453	\$0-\$137,611	-9.360	<.001
Outpatient	\$13,919	\$12,503	\$12,851	\$0-\$149,675	-1.577	.115
Drugs	\$15,219	\$14,969	\$15,030	\$0-\$219,049	-0.286	.775
SNF/LTC	\$7203	\$5106	\$5621	\$0-\$202,797	-2.063	.039
Home care	\$1515	\$1027	\$1147	\$0-\$285,175	-1.429	.153
DME	\$907	\$782	\$813	\$0-\$130,028	-0.772	.440

<sup>a</sup>Wilcoxon-Mann-Whitney test for continuous variables, Chi-square test for dichotomous variables.

year of death ( $P = .844$ ). A higher proportion of hospice users were non-Hispanic white compared to hospice non-users ( $P = .020$ ). On average, hospice users exhibited greater disease comorbidity than hospice non-users ( $P < .001$ ).

**Health care costs.** High medical expenditures in the final 6 months accounted for much of the spending in the last year of life, as demonstrated in both Figure 1 and Table 1. On average, total medical expenditure in the last year of life was \$168,953. The total for hospice users was \$175,578, and the total for non-hospice users was \$166,794. In the last 6 months before death, decedents had mean expenditures of \$109,170, nearly twice the level of their expenditures in the 7 to 12 months before death (\$59,783) (Table 1). The final 6 months accounted for 64.6% of final year spending. In particular, mean hospitalization costs were twice as high in the last 6 months than in months 7 to 12 before death, rising from \$23,384 to \$55,707 for hospice users and from \$24,025 to \$66,132 for hospice non-users (Figure 1, Table 1).

Total medical costs in the last 6 months of life averaged over \$111,588 in 2010 dollars for hospice users and \$108,382 for decedents who did not use hospice (Table 1). Costs in the last 6 months of life for hospice users were nearly evenly divided between inpatient and non-inpatient costs, but inpatient costs accounted for 61% of non-hospice users' expenditures. Surprisingly, the bivariate means of spending in the last 6 months before death show higher average spending for hospice users than for hospice non-users (Table 1), although costs directly attributable to hospice were a modest \$10,373 (Table 1).<sup>3,20</sup> There were no statistically significant differences in outpatient ( $P = .209$ ) or drug spending ( $P = .822$ ) in the last 6 months by hospice status. However, hospice users had significantly greater spending on home care ( $P < .017$ ), skilled nursing facility and long-term care (SNF/LTC) ( $P < .014$ ), and durable medical equipment ( $P < .027$ ) in the last 6 months.

## Multivariable Results

**Predictors of hospice use.** The logit regression for hospice use (Column 1 of Table 2) shows that African Americans and other non-white non-Hispanic racial/ethnic groups were significantly less likely to use hospice services than whites ( $P < .05$ ). In addition, patients with a cancer diagnosis ( $P < .001$ ) were significantly more likely to be hospice users. Age, sex, enrollment type, urban residence, year of death, greater comorbidities, and previous spending were not statistically significantly related to the probability of hospice use.

**Inpatient use.** Hospitalization was common in this group of terminal patients. Of the 1375 in the sample, 1107 (80.5%) had at least 1 hospital stay in their final 6 months. Columns 2 and 3 of Table 2 show that hospitalization rates were greater for African Americans and other race/ethnicities and patients who lived in urban areas. In the specification that does not

include the illness variables (Column 2), hospice use was *positively* related to hospitalization ( $P = .04$ ). However, when measures of disease comorbidity are added to the equation in Column 3, hospice loses significance ( $P = .731$ ) while greater comorbidities becomes a highly significant predictor of hospital admission ( $P < .001$ ), as would be expected. African-American race ( $P = .002$ ) and urban residence ( $P = .016$ ) remain strong predictors of hospitalization.

**Conditional inpatient costs.** Column 1 of Table 3 shows that for the 1059 patients who had any hospitalization in the last 6 months of life, inpatient expenditures conditional on being hospitalized were significantly lower for hospice users ( $P < .001$ ). Non-Hispanic African American and Hispanic patients who were hospitalized had significantly greater inpatient costs compared to non-Hispanic white patients ( $P = .001$  and  $P < .001$ ), consistent with hypothesized preferences for more intensive treatment. As expected, patients with more comorbidities had greater inpatient expenses ( $P < .001$ ), but prior year spending did not relate significantly to conditional inpatient costs. ( $P = .086$ ). Costs were significantly lower for Medicare enrollees who did not also have Medicaid coverage ( $P = .025$ ). Predicted expenditures for hospice users who were hospitalized are \$64,696 compared to \$90,189 for patients not using hospice (end of Table 3). This difference of \$25,493 was statistically significant ( $P < .05$ ).

**Non-inpatient costs.** In contrast to the inpatient arena, non-hospital expenditures were significantly higher for hospice users ( $P < .001$ , Column 2 of Table 3). Ambulatory care costs were higher for persons with greater prior expenditures ( $P < .001$ ) and with more chronic conditions ( $P < .001$ ). African Americans had greater outpatient costs ( $P = .002$ ) as compared to whites. Hispanic patients had similar outpatient costs as non-Hispanic white patients ( $P = .734$ ). Costs were significantly lower for Medicare enrollees who did not also have Medicaid coverage ( $P < .001$ ). Those who died in 2010 had significantly lower outpatient costs than those who died in 2008 ( $P = .017$ ). Ambulatory costs did not differ significantly by age or sex. Predicted non-hospital medical costs for hospice patients exceed those for non-hospice patients. If all patients used hospice, average outpatient costs would be \$61,608 versus \$46,837 if no one chose hospice (end of Table 3). This difference of \$14,771 is significantly different from zero ( $P < .05$ ).

**Total costs.** To estimate whether hospice yielded overall cost savings, we compare the greater per capita outpatient costs if everyone used hospice (\$14,771) with the expected savings on inpatient care. Since we found that hospice use was not significantly related to hospitalization rate, we assume the rate of hospitalization does not vary with hospice use. However, costs while in the hospital are significantly lower for hospice users who are hospitalized. Multiplying the

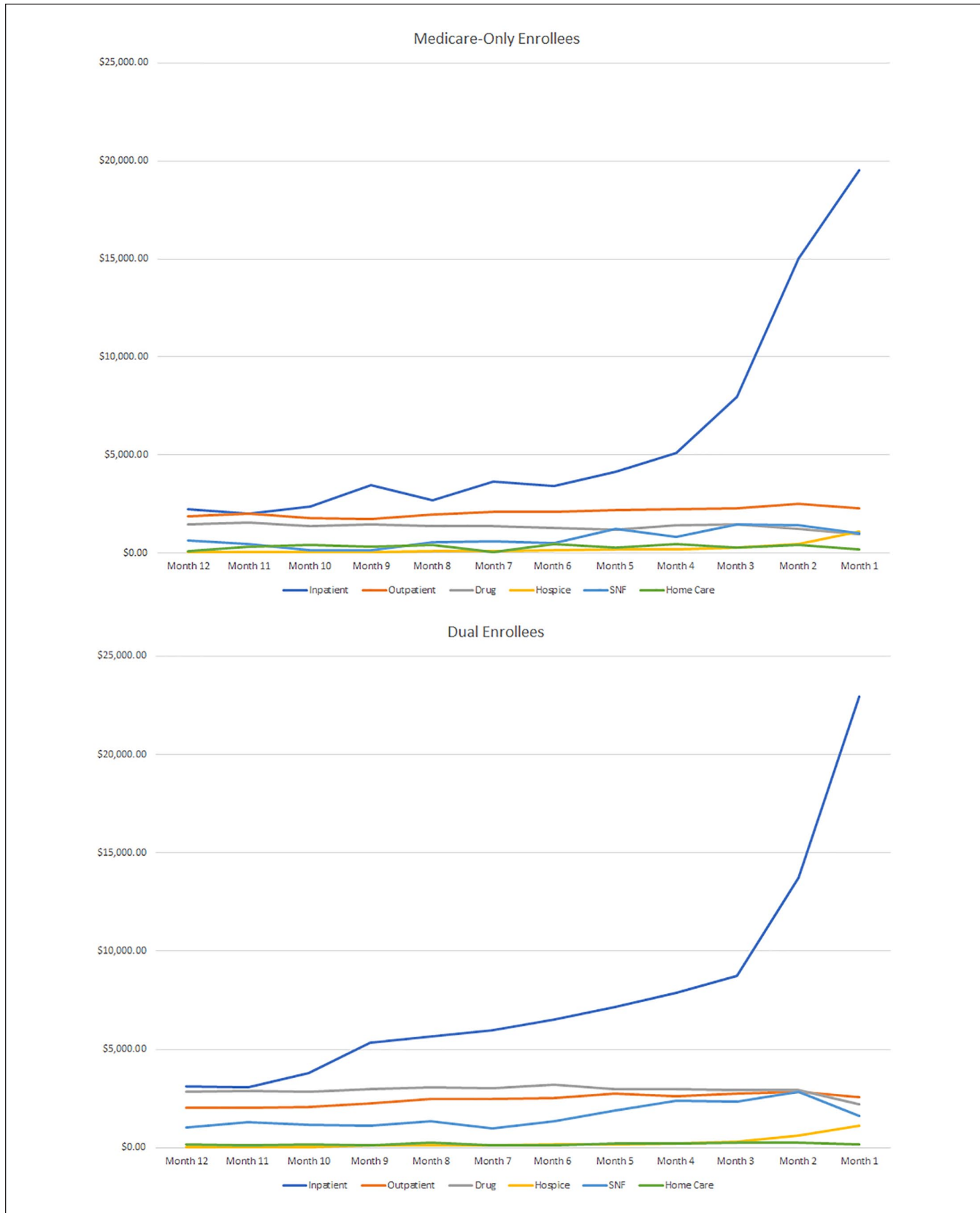


Figure I. Average monthly costs in the last 12 months of life (in 2010 dollars).

**Table 2.** Multivariable Logistic Regressions of any Hospice Use in the Last Year of Life and Any Hospitalization in the Last 6 Months of Life.

Variables	Any hospice use (n = 1351)		Any hospitalization (without disease comorbidity) (n = 1351)		Any hospitalization (n = 1351)	
	(1)		(2)		(3)	
	B (SE) <sup>a</sup>	P-value	B (SE) <sup>a</sup>	P-value	B (SE) <sup>a</sup>	P-value
Any hospice use in last year of life (ref = No)	—	—	0.352 (0.172)	.040	0.062 (0.181)	.731
<b>Demographics</b>						
Age (ref = <55)						
55-64	0.165 (0.275)	.547	0.051 (0.299)	.864	-0.129 (0.308)	.675
≥65	0.399 (0.275)	.147	-0.211 (0.291)	.470	-0.699 (0.309)	.024
Sex: Female (ref = Male)	-0.180 (0.209)	.388	0.446 (0.236)	.059	0.391 (0.245)	.111
<b>Race/ethnicity (ref = Non-Hispanic white)</b>						
Non-Hispanic African American	-0.368 (0.171)	.031	0.718 (0.194)	<.001	0.610 (0.199)	.002
Hispanic	-0.242 (0.192)	.209	0.463 (0.208)	.026	0.338 (0.216)	.118
Non-Hispanic other race	-1.122 (0.547)	.040	1.616 (0.736)	.028	1.603 (0.745)	.032
Enrollment type: Medicare only (ref = Dual)	-0.084 (0.156)	.592	0.065 (0.163)	.689	-0.158 (0.170)	.354
Lives in a large urban center (ref = No)	-0.183 (0.376)	.626	0.831 (0.346)	.016	-0.187 (0.182)	.016
<b>Year of death (ref = 2008)</b>						
2009	0.027 (0.165)	.870	0.024 (0.174)	.889	-0.187 (0.182)	.304
2010	-0.228 (0.209)	.276	0.066 (0.757)	.757	-0.117 (0.597)	.597
<b>Disease comorbidity</b>						
Charlson Comorbidity Index	0.034 (0.023)	.139	—	—	0.255 (0.035)	<.001
Any cancer diagnosis (ref = No)	1.010 (0.158)	<.001	—	—	0.204 (0.213)	.338
Total medical costs during months 7 to 12 before death (in log \$)	0.033 (0.035)	.348	—	—	-0.036 (0.033)	.273
Constant	-1.559 (0.504)	—	-0.314 (0.452)	—	0.081 (0.486)	—

Note. SE = standard error.

<sup>a</sup>B = coefficient.

hospitalization rate (80.5%) by the average reduction in costs for those who are hospitalized (\$25,493), yields an estimate of \$20,522 lower costs for hospice users. Thus, the net effect is estimated to be a cost reduction of \$5750 per capita.

## Discussion

Hospice care is one strategy for limiting unnecessary hospital care and futile interventions at the end of life. Providing palliative care for patients with terminal illness also has benefits in increasing symptom control and improving family bereavement outcomes.<sup>12,35</sup> Despite these advantages, only 1/4 of Medicare enrollees with HIV in our sample used hospice services in the year before they died—a rate that is about half that of the general population of Medicare decedents.<sup>8</sup> Hospice use was particularly low among African Americans and Hispanics, which has been attributed to having less knowledge about hospice.<sup>28</sup> This suggests a need to better educate racial and ethnic minority PLWH about the benefits of hospice.

Varying conclusions in prior studies about the effect of hospice on costs may result from differences in the underlying trajectories of the diagnoses studied, the scope of services

examined, and differences across settings in unobserved characteristics of patients who selected hospice. Indeed, randomized trials of hospice have failed to document cost reductions.<sup>19,20</sup> Our analyses address these issues by examining patients with the same hospice coverage under Medicare and with a single underlying diagnosis of HIV. Our analyses suggest 2 types of selection into hospice care: on the one hand, patients with preferences for more intensive medical interventions (such as African Americans) may be less likely to elect hospice care. As we have shown, patients with more comorbidities, particularly cancer, were more likely to use hospice.<sup>3,15,20,36</sup> They also had higher inpatient costs when they were hospitalized. Indeed, both the summary statistics and the logit regressions that did not control for disease burden showed *higher* costs for hospice users. In evaluating the relationship between hospice use and end-of-life costs, it is vital to account for the greater sickness of those who choose to use hospice services. Although we were unable to find an appropriate statistical instrument for hospice use, we have provided strong supporting evidence for the importance of self-selection in hospice use. Disease burden measures were strong predictors of both electing hospice and of inpatient costs and failing to control for these factors often led to counterintuitive results.



**Table 3.** Robust Regression of Costs in the Last 6 Months of Life (in 2010 log \$).

Variables	Conditional inpatient costs (n = 1059)		Non-inpatient costs (n = 1311)	
	(1)		(2)	
	B (SE) <sup>a</sup>	P-value	B (SE) <sup>a</sup>	P-value
Any hospice use in the last year of life (ref = No)	-0.310 (0.070)	<.001	0.209 (0.044)	<.001
Demographic				
Age (ref = <55)				
55-64	0.067 (0.122)	.583	0.055 (0.076)	.466
≥65	-0.087 (0.128)	.494	-0.006 (0.078)	.936
Sex:Female (ref = Male)	0.019 (0.086)	.827	-0.027 (0.055)	.616
Race/ethnicity (ref = Non-Hispanic white)				
Non-Hispanic African American	0.240 (0.074)	.001	0.143 (0.047)	.002
Hispanic	0.310 (0.085)	<.001	-0.018 (0.054)	.734
Non-Hispanic other race	0.034 (0.177)	.849	0.278 (0.116)	.017
Enrollment type: Medicare only (ref = Dual)	-0.161 (0.072)	.025	-0.230 (0.045)	<.001
Lives in a large urban center (ref = No)	0.313 (0.206)	.128	0.211 (0.112)	.060
Year of death (ref=2008)				
2009	-0.037 (0.075)	.620	0.006 (0.047)	.905
2010	-0.176 (0.091)	.052	-0.135 (0.056)	.017
Disease comorbidity				
Charlson Comorbidity Index	0.058 (0.011)	<.001	0.047 (0.007)	<.001
Any cancer diagnosis (ref = No)	0.032 (0.075)	.672	0.091 (0.048)	.061
Total medical costs during Months 7 to 12 before death (in log \$)	0.024 (0.014)	.086	0.330 (0.010)	<.001
Constant	10.197 (0.243)	—	6.612 (0.149)	—
Predicted costs				
Hospice	\$64,696 (\$4050)	—	\$61,608 (\$3966)	—
No hospice	\$90,189 (\$3322))	—	\$46,837 (\$1560)	—
Difference	-\$25,493 (\$5013)	<.05	+\$14,771 (\$4152)	<.05

Note. SE = standard error.

<sup>a</sup>B = coefficient.

Documenting how medical costs increase over the final year of life provides important context for understanding the cost-reducing potential of hospice. Decedents' total medical costs are driven by inpatient costs, which accelerate in the last 6 months of life. For Medicare patients with HIV, inpatient costs account for 61% of costs for hospice non-users in the final 6 months of life. Hospice users in this study averaged on 2 months of hospice use. However, even short exposure to hospice can reduce medical costs substantially because inpatient costs rise so steeply as death approaches. Nationally, over half (54%) of Medicare decedents who used hospice, were enrolled for 30 days or less.<sup>8</sup> Some studies have documented even shorter durations of hospice enrollment. A study of patients with poor prognoses found a median length of hospice enrollment of 11 days.<sup>14</sup> Furthermore, the duration of 28.4% of hospice stays was 3 days or less.<sup>21</sup> Nationally, the median length of hospice enrollment among Medicare enrollees in 2017 was 24 days.<sup>8,12,37</sup> One study found that hospice enrollment of 15 to 30 days had the greatest effect in reducing costs for Medicare recipients over 65.<sup>12</sup>

We estimated that hospice users would have lower inpatient costs, but these reductions were largely offset by hospice users' higher outpatient costs. This finding is entirely consistent with the goals of hospice: to reduce excessive hospitalization while providing additional outpatient services not regularly covered by Medicare.

When examining the impact of hospice on costs, it is important to analyze separately the effects of hospice in the inpatient and outpatient sectors. Taken together, hospice enrollees had lower total costs in their final year of life, largely attributable to lower inpatient costs, which rise steeply in the final 6 months before death. Whereas simple means showed that hospice users incur higher medical costs, analyses that account for comorbidities show the opposite.

This study had a number of limitations. The lack of random assignment of patients to receive hospice services may have led to unobserved differences in the populations compared despite having a similar underlying diagnosis (HIV) and insurance coverage (Medicare). Thus, we cannot draw causal inferences from this analysis about the effect of hospice use on medical costs.

Our analyses controlled for observed health differences such as comorbidities, but we were unable to examine the effect of substance use, since CMS has redacted substance use diagnoses from the public use files. Our findings reflect utilization of PLWH and may not generalize to other populations covered by Medicare. The high rates of hospitalization in this population may have limited our ability to detect the effect of hospice, although the effect of multiple hospitalizations is reflected in the conditional cost calculations. Further, the sample included only Medicare enrollees from California, so results may not generalize to other states. In addition, our sample was younger than the average Medicare decedents since many qualified for Medicare through long term disability provisions.

## Conclusion

Use of hospice was associated with reduced total spending in the last 6 months of life, primarily due to lower inpatient costs, resulting from lower levels of spending while hospitalized. Inpatient costs accounted for more than half of the last year of life medical expenditures for PLWH and for 3/4 of costs in the final month of life. Thus, even short periods of hospice enrollment could have dramatic impacts on costs because, in the absence of hospice, inpatient costs rise rapidly as death approaches. Our findings suggest that hospice may be successful in achieving one of its primary goals, reducing unnecessary hospitalizations for terminal patients. These inpatient cost savings are partially offset by increased costs of care outside of the hospital setting. Annual mortality rates of 4% to 4.5% make PLWH an important group to educate about hospice, which not only averts futile hospitalizations but also improves quality of life for terminal patients and their surviving family members.<sup>12,35,38</sup>

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## References

- Riley GF, Lubitz JD. Long-term trends in medicare payments in the last year of life. *Health Serv Res.* 2010;45(2):565-576.
- Hogan C, Lunney J, Gabel J, Lynn J. Medicare beneficiaries' costs of care in the last year of life. *Health Aff.* 2001;20(4):188-195.
- Buntin MB, Huskamp H. What is known about the economics of end-of-life care for medicare beneficiaries? *Gerontologist.* 2002;42 Spec No 3:40-48.
- Griffin S, Cubanski J, Neuman T, Jankiewicz A, Rousseau D. Medicare and end-of-life care. *JAMA.* 2016;316(17):1754.
- Aldridge MD, Epstein AJ, Brody AA, Lee EJ, Morrison RS, Bradley EH. Association between hospice spending on patient care and rates of hospitalization and medicare expenditures of hospice enrollees. *J Palliat Med.* 2018;21(1):55-61.
- French EB, McCauley J, Aragon M, et al. End-of-life medical spending in last twelve months of life is lower than previously reported. *Health Aff.* 2017;36(7):1211-1217.
- Centers for Medicare and Medicaid Services. Medicare hospice benefits. Published 2018. Accessed April 13, 2018. <https://www.medicare.gov/Pubs/pdf/02154-Medicare-Hospice-Benefits.pdf>
- National Hospice and Palliative Care Organization. Facts and figures: hospice care in America. Published 2016. Accessed December 14, 2017. [https://www.nhpco.org/sites/default/files/public/Statistics\\_Research/2016\\_Facts\\_Figures.pdf](https://www.nhpco.org/sites/default/files/public/Statistics_Research/2016_Facts_Figures.pdf)
- Aldridge MD, Canavan M, Cherlin E, Bradley EH. Has hospice use changed? 2000-2010 utilization patterns. *Med Care.* 2015;53(1):95-101.
- Unroe KT, Sachs GA, Dennis ME, et al. Effect of hospice use on costs of care for long-stay nursing home decedents. *J Am Geriatr Soc.* 2016;64(4):723-730.
- Pyenson B, Connor S, Fitch K, Kinzbrunner B. Medicare cost in matched hospice and non-hospice cohorts. *J Pain Symptom Manage.* 2004;28(3):200-210.
- Kelley AS, Deb P, Du Q, Aldridge Carlson MD, Morrison RS. Hospice enrollment saves money for medicare and improves care quality across a number of different lengths-of-stay. *Health Aff.* 2013;32(3):552-561.
- Zuckerman RB, Stearns SC, Sheingold SH. Hospice use, hospitalization, and medicare spending at the end of life. *J Gerontol B Psychol Sci Soc Sci.* 2016;71(3):569-580.
- Obermeyer Z, Makar M, Abujaber S, Dominici F, Block S, Cutler DM. Association between the medicare hospice benefit and health care utilization and costs for patients with poor-prognosis cancer. *JAMA.* 2014;312(18):1888-1896.
- Schuler MS, Joyce NR, Huskamp HA, Lamont EB, Hatfield LA. Medicare beneficiaries with advanced lung cancer experience diverse patterns of care from diagnosis to death. *Health Aff.* 2017;36(7):1193-1200.
- May P, Garrido MM, Cassel JB, et al. Palliative care teams' cost-saving effect is larger for cancer patients with higher numbers of comorbidities. *Health Aff.* 2016;35(1):44-53.
- Thomas BA, Rodriguez RA, Boyko EJ, Robinson-Cohen C, Fitzpatrick AL, O'Hare AM. Geographic variation in black-white differences in end-of-life care for patients with ESRD. *Clin J Am Soc Nephrol.* 2013;8(7):1171-1178.
- Blecker S, Anderson GF, Herbert R, Wang NY, Brancati FL. Hospice care and resource utilization in medicare beneficiaries with heart failure. *Med Care.* 2011;49(11):985-991.

19. Kane RL, Wales J, Bernstein L, Leibowitz A, Kaplan S. A randomised controlled trial of hospice care. *Lancet*. 1984; 1(8382):890-894.
20. Emanuel EJ. Cost savings at the end of life. What do the data show? *JAMA*. 1996;275(24):1907-1914.
21. Teno JM, Gozalo PL, Bynum JP, et al. Change in end-of-life care for medicare beneficiaries: site of death, place of care, and health care transitions in 2000, 2005, and 2009. *JAMA*. 2013; 309(5):470-477.
22. Centers for Disease Control and Prevention. Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 dependent areas, 2015. *HIV Surveillance Supplemental Report*. 2017;22(2).
23. National Center for Health Statistics. Health, United States, 2016 :With Chartbook on Long-term Trends in Health. Report No.: 2017-1232, May 2017. Hyattsville, MD: National Center for Health Statistics (US).
24. Adih WK, Hall HI, Selik RM, Guo X. HIV care and viral suppression during the last year of life: a comparison of HIV-infected persons who died of HIV-attributable causes with persons who died of other causes in 2012 in 13 US jurisdictions. *JMIR Public Health Surveill*. 2017;3(1):e3.
25. Leibowitz AA, Desmond K. Identifying a sample of HIV-Positive beneficiaries from medicaid claims data and estimating their treatment costs. *Am J Public Health*. 2015;105(3): 567-574.
26. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987; 40(5):373-383.
27. Greiner KA, Perera S, Ahluwalia JS. Hospice usage by minorities in the last year of life: results from the national mortality followback survey. *J Am Geriatr Soc*. 2003;51(7): 970-978.
28. Boucher NA, Raghavan M, Smith A, Arnold R, Johnson KS. Palliative care in the African American Community #204. *J Palliat Med*. 2016;19(2):228-230.
29. Connor SR, Elwert F, Spence C, Christakis NA. Racial disparity in hospice use in the United States in 2002. *Palliat Med*. 2008;22(3):205-213.
30. Knapp LG, Seaks TG. A hausman test for a dummy variable in probit. *Appl Econ*. 1998;5(5):321-323.
31. Monfardini C, Radice R. Testing exogeneity in the bivariate probit model: a monte carlo study. *Oxf Bull Econ Stat*. 2008; 70(2):271-282.
32. Berk RA. A primer on robust regression. In: Fox J, Long JS, eds. *Modern Methods of Data Analysis*. Newbury Park, CA: Sage; 1990.
33. Goodall C. M-Estimators of location: an outline of the theory. In: Hoaglin DC, Mosteller CF, Tukey JW, eds. *Understanding Robust and Exploratory Data Analysis*. New York, NY: Wiley; 1983: 339-431.
34. Rousseeuw PJ, Rogers WH. *Robust Regression and Outlier Detection*. New York, NY: Wiley; 1987.
35. Wright AA, Zhang B, Ray A, et al. Associations between end-of-life discussions, patient mental health, medical care near death, and caregiver bereavement adjustment. *JAMA*. 2008;300(14):1665-1673.
36. Taylor DH Jr, Ostermann J, Van Houtven CH, Tulskey JA, Steinhauer K. What length of hospice use maximizes reduction in medical expenditures near death in the US medicare program? *Soc Sci Med*. 2007;65(7):1466-1478.
37. Aldridge MD, Epstein AJ, Brody AA, Lee EJ, Cherlin E, Bradley EH. The impact of reported hospice preferred practices on hospital utilization at the end of life. *Med Care*. 2016; 54(7):657-663.
38. Wright AA, Keating NL, Ayanian JZ, et al. Family perspectives on aggressive cancer care near the end of life. *JAMA*. 2016;315(3):284-292.