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Medicare Cost in Matched Hospice and Non-Hospice Cohorts

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Abstract
Hospice care is perceived as enhancing life quality for patients with advanced, incurable illness, but cost comparisons to non-hospice patients are difficult to make. The very large Medicare expenditures for care given during the end of life, combined with the pressure on Medicare spending, make this information important. We sought to identify cost differences between patients who do and do not elect to receive Medicare-paid hospice benefits. We introduce an innovative prospective/retrospective case-control method that we used to study 8,700 patients from a sample of 5% of the entire Medicare beneficiary population for 1999–2000 associated with 16 narrowly defined indicative markers. For the majority of cohorts, mean and median Medicare costs were lower for patients enrolled in hospice care. The lower costs were not associated with shorter duration until death. For important terminal medical conditions, including non-cancers, costs are lower for patients receiving hospice care. The lower cost is not associated with shorter time until death, and appears to be associated with longer mean time until death. J Pain Symptom Manage 2004;28:200–210. *© 2004 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.*

Key Words
Medicare, costs, hospice, duration until death

Introduction

The Medicare Hospice Benefit, enacted in 1982, was intended to provide compassionate and cost-effective care for Medicare beneficiaries with incurable advanced illnesses. Medicare's very large expenditures on dying beneficiaries,[1] combined with federal funding pressures, have given new prominence to end-of-life care. Since Medicare began its hospice benefit, it has been thought to be unethical to conduct randomized hospice/non-hospice studies, as a right to hospice care is presumed. Therefore, investigations have been limited to studies that can very closely match populations and overcome selection bias.

The Medicare hospice benefit is potentially available to all Medicare beneficiaries after a physician certifies that the beneficiary is expected to live fewer than 180 days. Hospice services are provided by the patient's choice of the

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Medicare-certified hospice agencies available in the patient's locale. Under the program, the vast majority of services are provided in the patient's place of residence. Approximately 95% of the days of hospice care delivered in the US are at the routine home care level.[2] The hospice provides all needed services, including prescription drugs and palliative care and receives a flat payment amount for each day the patient is enrolled in hospice. The amount varies somewhat by locale. The patient can elect to stop receiving hospice care and return to traditional Medicare coverage at any time.

The cost analysis of patients enrolled in the Medicare Hospice Benefit has been debated since the benefit began in 1982. Changes in hospice care such as the growth of palliative treatments (e.g., chemotherapy, radiation and pain management therapies) and increased enrollment of non-cancer beneficiaries (e.g., end-stage chronic obstructive pulmonary disease [COPD], congestive heart failure [CHF], Alzheimer's disease) have created a new context for the debate. Early studies of hospice care[3,4] implied Medicare savings with increased home care and reduced hospitalization, futile treatment and diagnostics. These studies were criticized for lack of rigorous matching criteria and the effects of selection bias.[5] More recent studies find mixed results. Hospice use is associated with decreased cost in oncology populations but may not be for some other diagnoses.[6–8]

The costs for patients enrolled in the Medicare Hospice Benefit vary depending on where services are rendered (home, nursing home or hospital) and duration of hospice enrollment, among other factors. Substituting hospice for conventional care is more likely to show hospice most favorably if patients are on hospice just long enough to avoid unnecessary services. Hospice services provided to patients just before death can be an additional expense, as can hospice care provided for many months or years. A period of at least 2–3 months of hospice care may be optimal from both a cost and clinical standpoint.[9,10]

In addition to cost analysis, the effect of hospice care on length of life has been raised in connection with the quality of care. Anecdotal evidence suggests that some patients live longer after receiving hospice care.[11–14] Patients with chronic organ failure may benefit from attention to psychosocial concerns and personal care from hospice programs. Terminally ill oncology patients who forego aggressive cure-directed therapies and who receive greater psychosocial support may have greater survival.[15] No definitive survival data has been previously presented to support these findings and reports of increased survival of breast cancer patients in support groups have been questioned.[16]

Effectively matching populations for cost and longevity comparisons requires identifying a similar point in patients' terminal decline.[17] Attempts to develop accurate tools to predict the timing of death have generally been unsuccessful.[18] SUPPORT investigators used a computer-generated algorithm to model the probability of death.[19] This method found that estimating probabilities of death was not clinically useful. The National Hospice and Palliative Care Organization (NHPCO) published expert opinion guidelines for determining 6-month prognosis for selected non-cancer terminal illnesses.[20] These guidelines were modified by Centers for Medicare and Medicaid Services (CMS) fiscal intermediaries for use as local medical review policies that define payment criteria. However, the NHPCO guidelines and subsequent payment policies have also been found to have weak predictive validity.[21] "Look-back studies," which compare costs for hospice and non-hospice patients for a set period before death, have been criticized because of inadequate control for potential selection bias and failure to account for survival differences. The use of algorithms applied to administrative data to predict future costs has likewise had limited success[22] and we have avoided such approaches. For these reasons, we conceived the methodology of the present study to examine cost for subsets of patients that most clinicians would recognize as suitable for hospice care.

Methods

In this study, we used established actuarial methods and administrative data to measure both costs and time until death starting from dates narrowly defined by claims data. We established cohorts of patients with diagnoses and, in most cases, paired treatments that indicated advanced illness. For each patient, unique dates for specific clinical events were used to measure the beginning point for time until death and cost through death.

The goal of our methodology was to identify patients who might, within days or months, reasonably choose hospice care. For each disease cohort, we sought to identify patients and, for each patient, a similar point in time from which we could begin to measure costs and length of life. Such a methodology avoids the biases of an approach of tabulating costs backwards from the date of death for a specified preceding time period, where the treatments received could bias the time until survival.

The use of administrative data allowed us to identify relatively large numbers of patients, even for very narrowly defined cohorts. The Medicare 5% sample database contains demographic and medical claim details for almost 2 million Medicare beneficiaries, of which about 100,000 die each year. While these data contain details of dates of service, diagnostic (ICD-9) and procedural (CPT or HCPCS) information, the data do not contain typical clinical information (such as laboratory values or stage of disease).

Physician advice is often an important element in a patient's decision to join a hospice, and we assembled a group of physicians active in hospice care who worked with medical coding and data experts. The group was charged with identifying patient characteristics, recognizable through the Medicare data that would strongly suggest the patient would soon be eligible for hospice care. While the majority of patients who choose the Medicare hospice benefit are dying of cancer, we did not limit the study to cancer patients. The advisory group ultimately developed subsets of 16 diagnoses (Table 1) where some combination of medical claims would define an unambiguous starting point for tabulating cost and time until death and where the patient could soon face a decision about enrolling in the Medicare Hospice Benefit. Within each diagnosis, we selected *an indicative marker* in the end-stage of these incurable, advanced diseases on the basis of specific diagnosis, treatments and response to treatments. These *indicative markers* represented unambiguous (from a data standpoint) points in the end stage of these 16 diagnoses. The criteria for creating indicative markers were:

- the defining event had to appear as medical claims. In practice, this generally meant some combination of a hospital admission or physician intervention, and
- the defining event would generally occur near the end of life but before an individual would have made a choice to enroll in the Medicare hospice benefit.

For most diagnoses, a minority of patients was selected for inclusion in the analysis, because most did not receive the pre-defined medical interventions. Within a given diagnostic cohort, we compared cost and time until death for patients choosing or not choosing hospice care—starting with the date of the indicative marker. We restricted the cohorts to patients who died within the calendar year of the indicative marker or the next calendar year.

The diagnostic definitions both described relatively narrow cohorts and allowed identification of a unique date for each individual. Our indicative marker methodology produced cohorts that, for most diseases, represent small subsets of patients who died of the disease. We believe that the complicated set of circumstances we used to define the cohorts provides a very significant degree of homogeneity within the cohorts. This complexity for identifying patients in effect lessens the need for risk adjustment, which is fortunate because the standard risk adjustment methodologies are not designed for use with dying patients.

Indicative Markers

We used the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM), the Current Procedural Terminology, Fourth Edition (CPT), and the Health Care Financing Administration Common Procedure Coding System (HCPCS) to create "indicative markers" for 17 diagnoses by an expert panel of oncologists, hospice medical directors, actuaries and Medicare insurance coding specialists. The indicative marker consisted of either an ICD-9-CM code alone or an ICD-9-CM code combined with CPT and/or HCPCS codes.

The panel was instructed to identify the circumstances, which could be identified with the available Medicare claims data, under which a patient could shortly thereafter be advised to consider obtaining hospice care. The majority of suggested circumstances proved impractical because they depended upon data that were

Table 1
Definitions of Indicative Conditions and Markers

Condition	Administrative Claims Data Indicative Marker for Study Inclusion
Malignant neoplasm of esophagus	Beneficiaries with ICD-9-CM (ICD-9) for cancer of the esophagus except those with CPT for radical esophagectomy with interpositioning. The exception was made because that procedure may be performed with the expectation of cure or long-term survival
Malignant neoplasm of stomach	Beneficiaries with ICD-9 for stomach cancer except those with CPT for partial or subtotal gastrectomy and have claims for chemotherapy (chemo) starting within 1st quarter of surgery
Malignant neoplasm of colon	Beneficiaries with ICD-9 for colon cancer and have claims for chemo and either: – no previous colon resection – colon resection >1 quarter before start of chemotherapy
Malignant neoplasm of rectum	Beneficiaries with ICD-9 for cancer of the rectum and have claims for chemotherapy and/or radiation therapy (RT) and either: – no previous rectal resection – rectal resection >1 quarter prior to chemo and/or RT
Malignant neoplasm of liver and intra-hepatic bile ducts	Beneficiaries with ICD-9 for liver and intra-hepatic bile duct cancer
Malignant neoplasm of gallbladder and extra-hepatic bile ducts	Beneficiaries with ICD-9 for gallbladder and extra-hepatic bile duct cancer
Malignant neoplasm of pancreas	Beneficiaries with ICD-9 for pancreatic cancer except cases with islet cell cancer
Malignant neoplasm of trachea, bronchus and lung	Beneficiaries with ICD-9 for lung cancer and have claims for chemotherapy, which indicate a switch to another combination of chemotherapy drugs within 1–2 quarters of the initial chemotherapy
Malignant neoplasm of female breast	Beneficiaries with ICD-9 for breast cancer and have claims for chemotherapy, which indicate a switch to another combination of chemotherapy drugs within 1–2 quarters of the initial chemotherapy
Malignant neoplasm of ovary and other uterine adnexa	Beneficiaries with ICD-9 for ovarian and uterine cancer and claims indicate treatment course (at minimum) of primary abdominal surgery followed by chemotherapy
Malignant neoplasm of prostate	Beneficiaries with ICD-9 for prostate cancer and HCPCs J codes for all chemotherapies except leuprolide (includes cases receiving strontium 89)
Malignant neoplasm of brain	Beneficiaries with ICD-9 for brain cancer and claims indicate a diagnostic/treatment sequence of brain biopsy or debulking or craniotomy, followed by RT
Congestive heart failure (CHF)	Beneficiaries with ICD-9 for CHF and have claims indicating 1 or >hospitalizations involving: – invasive monitoring – intubation and ventilatory management Exclusions: cases with CPT for CABG within 1 quarter prior to hospitalization and cases in which hospitalization for invasive monitoring or intubation indicate primary diagnosis of acute MI
Chronic obstructive pulmonary disease (COPD)	Beneficiaries with ICD-9 for COPD and have claims indicating 1 or more hospitalizations requiring intubation and ventilatory management
Alzheimer's disease	Beneficiaries claims indicating 1 or more admissions with primary diagnosis of sepsis and/or aspiration pneumonia along with a secondary diagnosis of Alzheimer's disease
Stroke	Beneficiaries with 1 or more admissions with primary diagnosis of sepsis and/or aspiration pneumonia along with a secondary diagnosis of stroke

not available in the Medicare 5% sample. For example, any cohort definitions that depended upon laboratory values, stage of a disease or other clinical measure were rejected.

We selected these markers based on the practicality of obtaining the required information from administrative data and perceived relevance to hospice (judged to have a life expectancy of less than one year but not facing imminent death). We established the indicative markers prior to conducting the data analysis. Data extraction for one of the 17 diagnoses resulted in fewer than 20 individuals; therefore, we report the results for 16 out of the 17 diagnoses.

For cancer of the liver, gallbladder and pancreas, the first hospital claim or the first of at least two physician outpatient claims, appearing with ICD-9-CM codes for these "indicative diagnoses," was used as the starting point to tabulate costs and longevity. Because the prognosis is typically poor for these conditions, the first appearance of the diagnosis is an effective starting point for which costs and longevity could be tabulated. For cancer of the esophagus and stomach, we excluded beneficiaries who

appeared to be receiving curative therapy as defined by particular surgical interventions, because certain types of esophagus and stomach cancer are considered curable through surgery.

For the remainder of the diagnoses, an "indicative event" that signaled the terminal phase of an incurable, advanced disease was chosen as the marker. The indicative event consisted of specific treatments (chemotherapy, radiation therapy and surgery as detailed in Table 1) or a hospitalization with specific interventions or diagnoses. The treatments identified for the cancer diagnoses suggested either failure of curative therapy or evidence for palliative therapy. The hospital treatments used to define indicative events for the non-cancer diagnoses suggested a serious decline in health status.

The vast majority of dying patients would not meet the criteria of the indicative diagnoses – whether or not they elected to receive the Medicare Hospice Benefit. The challenge of using the available data to identify a patient at the cusp of being faced with a decision about choosing hospice care severely limited the possible number of cohorts. Hospice physicians, including those who advised us, do not identify patients through medical claims coding, and rarely if ever treat patients before they decide to obtain hospice benefits. Because of these constraints, the authors feel that there was no deliberate bias in our methodology.

Data Source

Our analysis used Medicare health insurance claims and enrollment data from the 5% Sample Beneficiary Standard Analytic Files[23] for the years 1998, 1999, and 2000. The 5% sample, which is created by and available from the Centers for Medicare and Medicaid Services (CMS), was created from the 100% Medicare Standard Analytical Files. The 5% sample is created by CMS as a statistically representative, longitudinal dataset.

The 5% Medicare Sample contains claims for about two million enrollees. Members have unique identifiers that allow patient tracking from year to year. The claims sample comprises seven distinct databases, each containing claims from a particular provider type: Physician Supplier Part B, Outpatient Hospital, Inpatient Hospital, Home Health Agency (HHA), Hospice, Skilled Nursing Facility (SNF), and Durable Medical Equipment (DME). We extracted data from all patients who met our criteria.

Sample Selection

Our data selection criteria were chosen primarily to avoid biasing time until death or cost according to whether an individual chose hospice. Consequently, we caution the reader that the costs and time until death time shown should not be used as a guide for individual patient time until death or cost.

In our algorithm, assignment into one of the 16 diagnostic categories required two physician claims or one inpatient hospital claim with the relevant ICD-9-CM code. We used a disease hierarchy to set the category for a beneficiary who could fall into more than one category. Before applying narrowing criteria, these diagnoses accounted for approximately 55% of all Medicare beneficiaries' deaths in the 5% Medicare sample. Beneficiaries were designated as hospice users if they had one or more hospice claims.

The final sample size did not change significantly from the base sample for beneficiaries diagnosed with esophageal, stomach, liver, gallbladder and pancreatic cancer, as the date of the first appearance of the diagnostic ICD-9-CM code itself was used as the marker for each affected individual. For other diagnoses, the final sample was significantly smaller than the base sample, as specific treatments, "indicative events," were required. The percentage of individuals utilizing hospice services was similar for patients with or without the indicative event.

Because cost comparison analysis was the primary focus of this study, and because the last few days of life can be very expensive, especially if the patient is hospitalized, we included only patients whose death could be observed in the data. Costs (Medicare payments) were tabulated starting with the time of the "indicative diagnosis" or "indicative event" to the time of death. For years prior to 2000, Medicare Part B claims indicate a date of service, which was used as the marker date for cost and longevity comparison. Medicare Part A claims show only the quarter and year of service; Part A claims were attributed to the patient if the claim fell in the quarter of the indicative event or later. Medicare payments are the amounts that

Medicare pays—net of beneficiary coinsurance and deductibles.

We removed certain patients and their claims from the analysis as required by inherent data limitations or in order to avoid bias in favor of patients who chose or did not choose hospice care. In particular, we removed patients who incurred less than $4,000 in claims (approximating the low end cost of one Medicare-paid hospitalization) or greater than $115,000 in claims from the indicative event through death. This reduced the population by about 5% and total cost by about 20%. The removal of these patients reduces the possibility that the results reflect the influence of very large or very small claims. We also removed patients who died within 15 days after the indicative event. This removes from the analysis people who die very quickly, and, as a result, may incur very low costs, and may not have a chance to consider entering hospice. For congestive heart failure, COPD and stroke, the short-stay trim removed a significantly higher portion of patients. This is not surprising, because the indicative marker for each of these cohorts is an acute hospital stay with significant intervention, and those patients who die within 15 days of admission might not have the opportunity to consider hospice care. We note that hospice data show many patients enter hospice with only a few days to live, and hospice executives complain about the quality and cost impact this has.[24] We note that hospice practitioners inform us that many patients do choose hospice care under such circumstances.

We followed individuals identified in 1999 with indicative events through the year 2000. For esophageal, stomach, liver, gallbladder and pancreatic cancers, where we used the first appearance of the ICD-9-CM code in the data as the indicative marker, we examined 1998 data for earlier appearances of these diagnoses among the claims. For the other diseases, we identified each individual's first indicative event in 1999. Individuals with a first indicative event in 2000 were eliminated from our study, to avoid biasing the sample toward short survivors. It is possible, but for most conditions clinically unlikely, that some individuals may have had a first indicative event in 1998 and a second in 1999. We did not examine the data from 1998 to identify any such patients. As a result of this approach, we considered only patients who were age 66 and older if the indicative event occurred in 1999.

We eliminated any individuals who were not observed to die. While the data from such individuals would be useful for a survival study, costs are generally believed to be higher toward the end of life. Because of our focus on cost, we wanted to capture only people with observed deaths. As mentioned above, because the primary purpose of this study was to evaluate cost, we analyzed only patients who died. This limits the usefulness of the data for survival analysis purposes. Nonetheless, we report the mean and median time until death for the cohorts.

Statistical Analysis

We used the *t*-test to evaluate differences in means, which is the goal of this study, to measure the Type I comparison wise error rate. We did not attempt to develop predictive parameters for time until death or cost. We tested for the significance of the following variables: age, sex, Medicaid-eligibility, and use or nonuse of hospice cost. The significance of these variables was tested through a generalized linear model. The *P* values shown in Table 2 are based on unadjusted means tests using cost as the only independent variable. The significance of other variables was determined using multiple regression on hospice use, age, sex and dual eligibility for Medicare and Medicaid. Table 3 shows that the hospice group is slightly more female and slightly younger than the nonhospice group.

We did not perform any analysis to attempt to identify the impact of co-morbidities on cost or time until death. The patient cohorts were very narrowly chosen from approximately 200,000 Medicare deaths, and the hierarchy we used in assigning indicative markers does provide some control over co-morbidities. More fundamentally, the predictive models in commercial use have weak predictive power and all were designed to forecast future costs for general populations, not those with short-term terminal illness.[22] Similarly, the Charlson approach also seems inappropriate given the terminally ill characteristic of the population and the narrow population definitions.[25] The geographic distribution by state of the hospice and non-hospice groups was very similar, with a 93% correlation coefficient, 94% for dual-eligibles and 92% for non-dual-eligibles. Of the cancer cohorts, 53%

Table 2
Medicare Cost Per Patient for Studied Diseases

Disease Cohort	Choice[a]/Patient Count	Mean Cost/SD per Patient (US$)	Median Cost per Patient (US$)	Mean Time Until Death in Days/SD	Median Time Until Death in Days
Alzheimer's disease	H/29	29,828/16,986	29,309	221/177	166
	NH/122	30,925/21,268	24,034	175/155	117
Brain cancer	H/284	35,768/20,743	32,706	203/146	170
	NH/166	38,300/24,729	31,260	159/139	108
Breast cancer	H/144	37,968/22,426	34,428	353/172	362
	NH/111	41,269/24,641	38,349	306/184	293
Congestive heart failure[b]	H/174	46,793/24,469	41,136	185/163	136
	NH/1141	53,528/26,705	50,015	135/145	65
Colon cancer	H/327	31,819/20,727	41,136	310/168	292
	NH/199	33,979/22,283	50,015	266/182	226
Chronic obstructive pulmonary disease	H/33	43,744/22,830	37,495	136/143	96
	NH/292	51,831/26,991	45,458	132/151	57
Esophageal cancer	H/232	33,489/22,749	28,289	252/168	210
	NH/300	36,133/22,833	31,816	209/173	149
Gallbladder cancer	H/70	30,454/17,895	25,725	211/163	159
	NH/58	33,026/22,676	27,596	186/163	139
Liver cancer[b]	H/496	27,364/19,544	22,909	183/158	133
	NH/388	30,402/23,331	21,974	170/167	100
Ovarian cancer	H/24	45,296/22,272	35,946	296/141	303
	NH/17	54,231/30,387	43,197	248/133	246
Pancreatic cancer[b]	H/663	29,621/20,786	23,617	198/160	151
	NH/459	34,784/24,232	27,834	183/164	128
Prostate cancer	H/270	30,573/19,761	25,763	404/180	392
	NH/459	30,382/21,257	25,182	366/177	370
Rectal cancer	H/191	34,478/21,698	31,168	289/174	263
	NH/193	37,917/25,152	32,283	233/179	200
Stomach cancer	H/252	32,004/22,687	25,314	228/175	190
	NH/264	35,658/25,151	29,951	194/171	133
Stroke[b]	H/22	46,910/30,767	40,900	177/127	156
	NH/125	34,579/24,148	28,230	165/168	101
Trachea, bronchial & lung cancer	H/648	36,209/20,136	32,886	262/157	229
	NH/547	37,845/20,808	34,855	225/152	201

[a]H = patients choosing hospice; NH = patients not choosing hospice.
[b]$P < 0.05$ for mean cost differences.

of the patients were in the hospice cohorts, compared to 60% of all Medicare decedents in 2000, while for cancer plus non-cancer cohorts, 44% of patients were in the hospice cohorts compared to 23% for all Medicare decedents in 2000.[24]

SAS™ (SAS Institute Inc, Cary, NC) and Excel™ were used for all analyses. We conducted statistical tests on each disease separately and did not attempt cross-disease analysis to determine whether hospice use, age, sex or dual eligible status had significant impacts.

Results

For the diseases studied, we compared Medicare patients enrolled in the Medicare hospice benefit with those not enrolled in the Medicare hospice benefit for Medicare cost. Table 2

Table 3
Age–Sex Demographics of Cohorts

Age	Female	Male	Total
Patients Receiving Hospice Care			
64–69	412	476	888
70–74	462	578	1,040
75–79	449	481	930
80–84	299	297	596
>85	221	184	405
Total	1,843	2,016	3,859
Patients Not Receiving Hospice Care			
64–69	437	532	969
70–74	497	643	1,140
75–79	464	648	1,112
80–84	400	458	858
>85	401	361	762
Total	2,199	2,642	4,841
Grand Total	4,042	4,658	8,700

shows summaries of these measures for the narrowly defined patient populations shown in Table 1.

For all diseases except prostate cancer and stroke, mean cost was lower for patients who chose hospice but was significant ($P < 0.05$) only for CHF, liver cancer and pancreatic cancer. Patients choosing hospice had higher cost at this significance for stroke (Table 2). Median costs generally followed the same pattern. Mean and median costs for untrimmed data followed the same pattern as for trimmed data with few exceptions.

Because cost was the focus of this study, we included only patients who died during the study period. Consequently, the data are of limited value for a survival study. Nevertheless, the pattern of lower costs for patients who choose hospice does not appear to be associated with shorter survival. Patients who choose hospice showed longer mean and median time until death than their matched non-hospice cohorts—by days to months for all of the diagnoses studied.

We caution the reader that the time until death times shown in Table 2 are means for the cohorts studied. Because the criteria use administrative, not clinical data, clinicians may find it hard to know whether an individual patient meets the detailed criteria we used to select patients, and the results should not be used to predict time until death times for individual patients.

A multiple regression was used to evaluate the effect of the available variables (i.e., hospice/non-hospice, age, sex, and Medicaid dual eligibility status) on time until death, cost, and cost/day by disease category. For each condition, we show whether hospice status, age, sex or Medicaid dual eligibility were significant for cost. Table 3 presents age and sex demographics of the hospice and non-hospice cohorts. Overall, the hospice group had slightly more females than the non-hospice group (48% vs. 45%) and patients in the hospice group were slightly younger than patients in the non-hospice group (74% and 67% of patients were ≤79 years of age, respectively).

Discussion

This study provides evidence that, for certain well-defined terminally ill populations, costs are lower for patients who choose hospice care than for those who do not. Furthermore, for certain well-defined terminally ill populations, among the patients who died, patients who choose hospice care live longer on average than similar patients who do not choose hospice care. This pattern persisted across most of the disease states studied. Hospice care is widely used by patients with cancer, which was reflected in the high proportion of patients choosing hospice care in our cancer diagnoses groups. Notable among the findings, however, is that the CHF-related group, where relatively few patients receive hospice care, shows lower cost and higher time until death for the patients who choose hospice care.

Although the data suggest some longevity benefit to hospice, the causality for reduced cost seems stronger than for greater time until death, because patients who happen to live longer after their indicative event may have greater opportunity to choose hospice. Alternatively, these patients will also have greater opportunity to enter a track of aggressive, non-hospice treatment. While the study's design does not provide comprehensive results for longevity, the hypothesis that longer surviving patients may more likely choose hospice seems counterintuitive to the finding of lower costs for patients choosing hospice. This is an important area for further research.

A critical question is whether the selection criteria—either for the defined cohorts or for the individuals who choose hospice care—biased the results. The administrative data used

do not capture significant clinical measures or psycho-socio-economic data such as education or income. Hospice enrollment was not randomly assigned, and the individuals who choose hospice may have tended to avoid expensive care even if they had no access to the hospice benefit. One approach to identifying such bias is to assume that high spending (or low spending) before hospice enrollment is a predictor of an individual's probability of obtaining (or avoiding) aggressive medical treatment. However, certain of the indicative diagnosis definitions (for example, breast and ovarian cancers) required a history of obtaining aggressive medical treatment, so such look-back methods may have limited value for these cohorts. In addition, the attempt to use pre-hospice treatment to adjust for "propensity to treat" bias would discount the possibility that changes in their medical condition could cause some people to dramatically change their choices about the desired kind of medical care.

Although the Medicare 5% sample contains information about race, we did not include that factor in our analysis. African-American patients have been shown to be less likely to choose hospice services than non-minority patients.[26] Racial disparities deserve further investigation, although the authors do not have a strong intuitive sense of the cost bias that might have been introduced by failure to consider race.

We believe that our "indicative event" definitions identified individuals with similar health status, although the more complicated indicative events, which require a combination of circumstances, probably produced more homogenous cohorts than the simpler indicative events (for example, the first appearance of a pancreatic cancer diagnosis). For most indicative events, the individuals were well enough to have passed medical clearance to receive aggressive treatment. They were all sick enough to die within two years of the event. The limited success of predictive modeling[21] argues against using existing models (or simpler look-back approaches) to create matched cohorts and we did not attempt to do so. The analysis does exclude all individuals who die within 15 days of the indicative event, so that the non-hospice group would not include individuals who die immediately after the intervention, so have no opportunity to choose hospice.

Our trimming rules had almost no impact on which cohort had higher mean or median costs and no impact on which cohort had longer time until death. One of the few exceptions is cost for CHF, where a large number of non-hospice patients died within a few days after the indicative hospitalization event. For CHF, including these very short times until death patients would shift mean and median costs for the non-hospice cohort to be lower than for the hospice cohort. This exception does not weaken our view about the relative costs of hospice patients, as hospice would have had little opportunity to reduce costs for these patients.

The study does raise temporal bias issues. Patients who choose hospice care may incur lower expenses, with or without hospice care, because they may desire to avoid aggressive treatment. This may explain some of the cost findings for cancer of the esophagus, stomach, liver, gallbladder and pancreas, where the indicative event was defined by the appearance of a diagnosis, rather than a more aggressive medical intervention. However, for the other conditions studied, the indicative event screen required that all patients in both the hospice and non-hospice cohorts have a history of choosing aggressive treatment—and access to such aggressive treatment. For example, a diagnosis of brain cancer followed by a surgical intervention and radiation treatment does not suggest a patient who avoids aggressive treatment or one who has little access to aggressive care.

The question "How is it possible that hospice can prolong life?" is critically important to answer. Hospice care promotes itself as providing compassionate care, emphasizing pain management, comfort and quality of life. These kinds of support may tend to prolong life, although the evidence base for much of what hospice achieves has yet to be assembled. Terminally ill patients who choose hospice avoid the hazards of aggressive medical treatment, which may contribute to the longer time until death observed in these patients. We suggest, however, that the longer time until death may be due to significantly longer time until death by a relatively small number of patients, rather than short increases by a large number of patients. This hypothesis may find support through further data analysis or clinical research to identify whether some hospice patients survive

one or more crisis periods better than do non-hospice patients. We hope this study may prompt additional investigation into the appropriate length of hospice enrollment needed to achieve the goals of end-of-life care. The appropriate length continues to be debated, especially as the mean length of hospice enrollment has declined from a high of 74 days in 1992 to 59 days in 1998,[27] although the decline appears to have stopped in more recent years.[28]

Another important question to answer, which our study did not address, is "Do the differences in time until death matter to patients and families?" In our study sample, the average time until death from the indicative event ranged from about 6 months to about 1 year. The hospice patients had an increase in time until death compared with the non-hospice patients that ranged from days to months. This increase in time until death may be particularly important to family members if pain management, comfort and quality of life can be maintained.

Finally, the question "Do these results apply to other kinds of patients?" must be asked. In performing this study, we chose very narrowly defined patient cohorts and removed patients with short or long survival periods. These cohorts were unusual in that administrative data, by itself, was used to identify a precise point in the patient's treatment and course of disease. The diagnoses from which we chose patients account for a majority of Medicare deaths, but the criteria used to choose cohorts generally produce many fewer deaths. Further research should be undertaken to determine whether other kinds of patients follow disease courses similar to those reported in this study. Future research in this area will elucidate the applicability of these findings.

Although the use of administrative data presents some limitations, it also has strengths. Well-known weaknesses include incomplete or inaccurate coding by healthcare providers during the course of billing. However, we believe these weaknesses do not bias the results of our study. One important strength of using the Medicare 5% sample is that this administrative data is taken from actual Medicare payments for actual patients rather than modeled patients or expenses. These data were produced by the Medicare payment adjudication system, so, unlike using data from a small controlled study or charges generated by hospital charge masters, the findings require little translation to make them applicable to likely aggregate results for Medicare as a payer.

Most analyses of the cost of end-of-life care, including this study, have not considered the substantial out of pocket costs to families.[29] Medicare hospice services require minimal cost sharing, and, unlike the regular Medicare program, drugs are covered. Medicare cost sharing practically guarantees that, if our findings are true, the cost to patients will be less for hospice care, although this is a fertile topic for further investigation. Had we considered the value of the Medicare Part A deductible, the Medicare Part B coinsurance and deductible and the cost of prescription drugs, the total cost savings for hospice care would have been more dramatic than shown.

We caution that while the choice of hospice or non-hospice appears to have an important influence on average time until death time, the variance in time until death is very large for both cohorts. In other words, for an individual, the choice of hospice or non-hospice has very low predictive value for individuals. We hope that this study will generate hypotheses that can be tested in a clinical environment to produce evidence-based recommendations.

Predicting the date of an individual's death has been a challenge for the Medicare program's definition of hospice eligibility and the costs of care for Medicare beneficiaries at the end of their life is an immense cost issue for the financially-beleaguered program.[30] This study provides important information that may guide physician recommendations that are both compassionate and cost effective.

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