JACC: HEART FAILURE
PUBLISHED BY ELSEVIER ON BEHALF OF THE AMERICAN
COLLEGE OF CARDIOLOGY FOUNDATION

VOL. 6, NO. 9, 2018

Predictors of Hospice Enrollment for Patients With Advanced Heart Failure and Effects on Health Care Use

Laura P. Gelfman, MD, MPH,[a,b] Yolanda Barrón, MS,[c] Stanley Moore, BS,[d] Christopher M. Murtaugh, PhD,[c] Anuradha Lala, MD,[e] Melissa D. Aldridge, PhD, MBA,[a,b] Nathan E. Goldstein, MD[a,b]

ABSTRACT

OBJECTIVES This study sought to: 1) identify the predictors of hospice enrollment for patients with heart failure (HF); and 2) determine the impact of hospice enrollment on health care use.

BACKGROUND Patients with HF rarely enroll in hospice. Little is known about how hospice affects this group's health care use.

METHODS Using a propensity score–matched sample of Medicare decedents with ≥2 HF discharges within 6 months, an Outcome and Assessment Information Set (OASIS) assessment, and subsequent death, we used Medicare administrative, claims, and patient assessment data to compare hospitalizations, intensive care unit stays, and emergency department visits for those beneficiaries who enrolled in hospice and those who did not.

RESULTS The propensity score–matched sample included 3,067 beneficiaries in each group with a mean age of 82 years; 53% were female, and 15% were Black, Asian, or Hispanic. For objective 1, there were no differences in the characteristics, symptom burden, or functional status between groups that were associated with hospice enrollment. For objective 2, in the 6 months after the second HF discharge, the hospice group had significantly fewer emergency department visits (2.64 vs. 2.82; $p = 0.04$), hospital days (3.90 vs. 4.67; $p < 0.001$), and intensive care unit stays (1.25 vs. 1.51; $p < 0.001$); they were less likely to die in the hospital (3% vs. 56%; $p < 0.001$), and they had longer median survival (80 days vs. 71 days; log-rank test $p = 0.004$).

CONCLUSIONS Beneficiaries' characteristics, including symptom burden and functional status, do not predict hospice enrollment. Those patients who enrolled in hospice used less health care, survived longer, and were less likely to die in the hospital. A tailored hospice model may be needed to increase enrollment and offer benefits to patients with HF. (J Am Coll Cardiol HF 2018;6:780–9) Published by Elsevier on behalf of the American College of Cardiology Foundation.

Heart failure (HF) is a leading cause of death in the United States, and the number of individuals who are older than 65 years of age with advanced HF continues to rise (1). The incidence of HF approaches 10 per 1,000 population after age 65 years (2). Among patients who were hospitalized with HF between 2005 and 2009, patients had a 5-year risk for cardiovascular and HF admission

From the [a]Brookdale Department of Geriatrics and Palliative Medicine, Icahn School of Medicine at Mount Sinai, New York, New York; [b]Geriatric Research Education and Clinical Center, James J. Peters VA Medical Center, Bronx, New York; [c]Center for Home Care Policy and Research, Visiting Nurse Service of New York, New York, New York; [d]Independent Contractor, Bonny Doon, California; and the [e]Divisions of Cardiology and Population Health Science and Policy, Icahn School of Medicine at Mount Sinai, New York, New York. Dr. Gelfman has received support from the National Institute on Aging (K23AG049930), The Mount Sinai Older Adults Independence Center (P30AG028741), and the National Palliative Care Research Center. The core dataset analyzed in this study was developed as part of a project supported by grant R01HS020257 from the Agency for Healthcare Research and Quality. The content is solely the responsibility of the authors and does not necessarily reflect the official view of the Agency for Healthcare Research and Quality or the National Institute on Aging or the U.S. Department of Veterans Affairs. The dataset for the zip code crosswalk was obtained from The Dartmouth Atlas, which is funded by the Robert Wood Johnson Foundation and the Dartmouth Clinical and Translational Science Institute, under award number UL1TR001086 from the National Center for Advancing Translational Sciences (NCATS) of the National Institutes of Health (NIH). All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received January 17, 2018; revised manuscript received April 3, 2018, accepted April 20, 2018.

ISSN 2213-1779/$36.00 https://doi.org/10.1016/j.jchf.2018.04.009

of 80.4% and a median survival of 2.1 years (3). Approximately 80% of patients hospitalized with HF are older than 65 years of age, and up to 44% of older patients with advanced HF are readmitted within 6 months after discharge (4,5). Furthermore, the clinical HF trajectory typically is a gradual functional decline with intermittent acute deteriorations, which often require hospitalization and can be life threatening (6). Patients with HF also face increased complexity as their disease worsens, with the concurrent use of expensive and invasive medical interventions, along with the ongoing possibility of advanced medical therapies such as mechanical circulatory support and cardiac transplantation; although these therapies may prolong life, they also create barriers to hospice enrollment and greater difficulty in predicting mortality, as compared with other end-stage illnesses, such as cancer (7,8). Nonetheless, these patients face a high mortality; in a population cohort study, 5-year survival for HF stage D was 20% (9). Finally, patients with HF have a poor quality of life with untreated dyspnea, pain, fatigue, and depression (10,11). As these statistics demonstrate, better models of care are needed for patients with advanced HF and their caregivers.

SEE PAGE 790

Hospice is a model of care that could address the needs of patients with advanced HF and their caregivers. Specifically, hospice is a health care model for patients with a limited prognosis that focuses on symptom management, care coordination, and caregiver support, with the goal of enabling individuals to remain at home at the end of life. Use of hospice has risen dramatically in the past 2 decades from 10% to almost 50% of decedents, and hospices are caring for more patients with a primary diagnosis of dementia, HF, and chronic obstructive pulmonary disease (12,13). Furthermore, the use of hospice is considered to be an indicator of high-quality end-of-life care (14), and many studies have demonstrated its benefits for patients and families (15–23). Not only is hospice a key home care model for seriously ill patients, but also it is cost saving to the Medicare program (24,25).

Although the use of hospice by patients with HF has almost doubled in the past decade (26,27), the proportion of HF decedents who use hospice remains lower than that of other major diseases. Cardiovascular professional societies have called for the increased and earlier integration of hospice care for patients with advanced heart disease (7). Little is known about the characteristics of patients with HF who use hospice versus those who do not, and whether or not hospice affects health care use by patients with HF at the end of life. In a sample of Medicare beneficiaries with advanced HF, we: 1) examined the predictors of hospice enrollment after the second HF hospitalization within 6 months; and then 2) compared outcomes of health care use and survival for those patients who subsequently enrolled in hospice and those who did not.

ABBREVIATIONS AND ACRONYMS

ADL = activity/activities of daily living

ED = emergency department

HF = heart failure

ICU = intensive care unit

NB = negative binominal

OASIS = Outcome and Assessment Information Set

SNF = skilled nursing facility

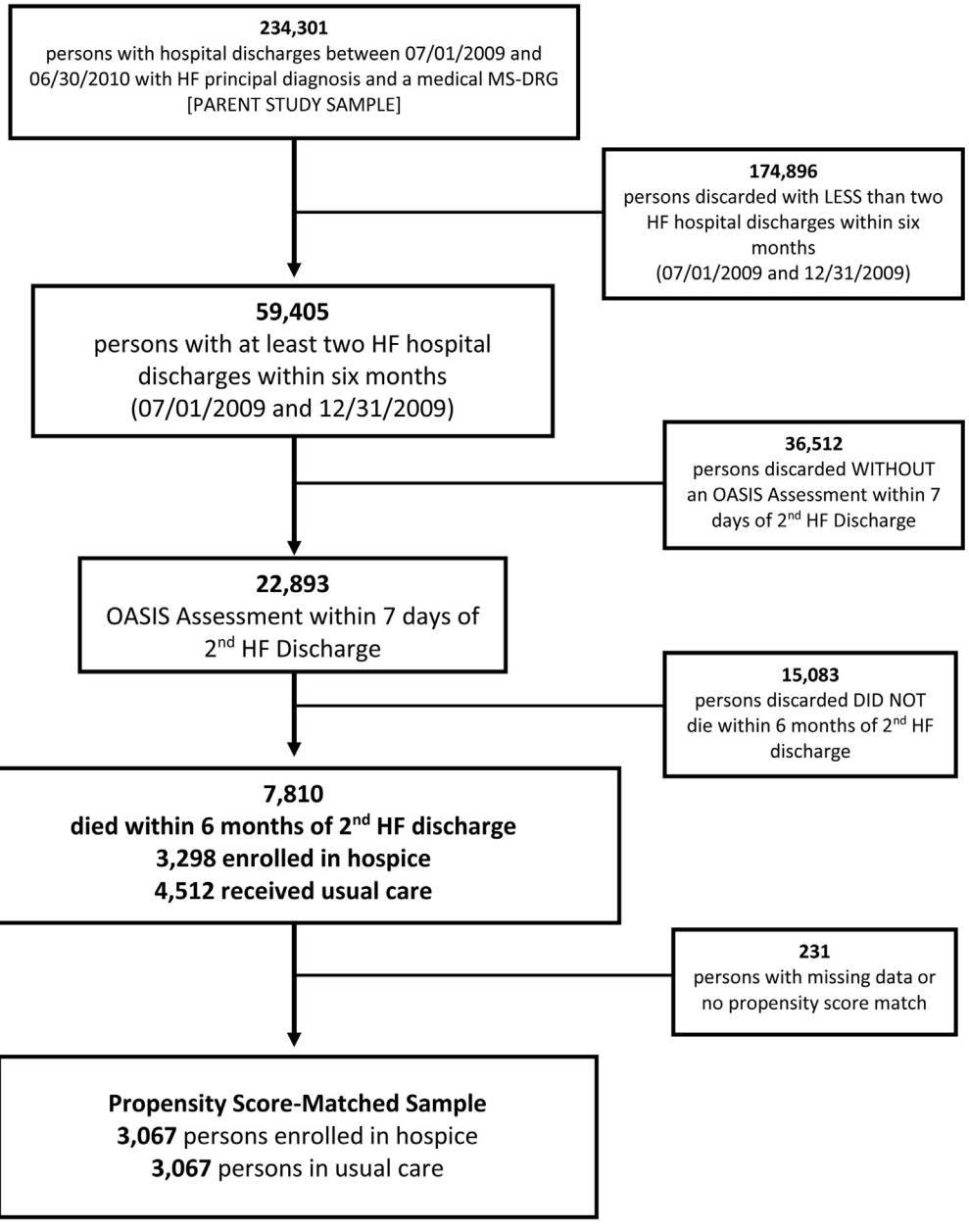
METHODS

STUDY GROUP. We conducted a secondary analysis of data from a longitudinal, observational study that examined patterns of care in a cohort of patients with HF by using Medicare claims and patient assessment data (28). This existing dataset, obtained by our collaborators from the Visiting Nurse Service of New York Center, used 2009 and 2010 Medicare administrative claims and home health patient assessment data to identify all HF hospitalizations with discharge to home health care between July 1, 2009, and June 30, 2010 (28). The International Classification of Diseases-9th Revision-Clinical Modification codes used by the federal Chronic Conditions Data Warehouse were used to identify patients admitted with a principal diagnosis of HF (28). HF hospitalizations assigned to a surgical Medicare Severity Diagnosis Related Group were excluded because wound care, rather than HF management, was likely the primary reason for home health care (28).

Because the occurrence of multiple HF hospitalizations has been established as a marker of increased HF severity and risk of death (29), we selected a subsample of individuals with 2 or more HF hospitalizations within a 6-month period (July 1, 2009, to December 31, 2009) to represent a cohort of patients with advanced HF. To obtain data about functional status and symptoms, only beneficiaries with an Outcome and Assessment Information Set (OASIS) assessment by a home care clinician within 7 days of the second HF discharge (July 1, 2009, to December 31, 2009) were included for analysis, using follow-up data in the subsequent year (2010). Finally, only those patients who died within 6 months of the second HF discharge were included in the study group (**Figure 1**).

SOURCES OF DATA. We constructed an analytic file of HF discharges of Medicare fee-for-service beneficiaries from 2009 to 2010 by linking data from the following Centers for Medicare & Medicaid Services administrative and claims files: 1) the Medicare Beneficiary Summary (Enrollment) file, which contains

FIGURE 1 Sample Selection Flow Diagram



The flow diagram describes: 1) beneficiaries who were discarded from the original sample; and 2) the sample of Medicare fee-for-service beneficiaries in our final sample. HF = heart failure; MS-DRG = Medicare Severity Diagnosis Related Group; OASIS = Outcome and Assessment Information Set.

demographic and enrollment information about each beneficiary enrolled in Medicare; 2) the Medicare Provider Analysis and Review (MedPAR) file, which contains data on services provided by Medicare-certified inpatient hospitals and skilled nursing facilities (SNFs), including hospital admission and discharge date, discharge site (i.e., home to SNF), diagnoses, Diagnosis Related Groups codes, and intensive care unit (ICU) length of stay; 3) the Medicare Beneficiary Annual Summary (chronic condition indicators) file; 4) the Hospice Standard Analytic File, which includes claims data on hospice use; 5) the

TABLE 1 Beneficiary Characteristics

	Unmatched*			Propensity Score Matched†		
	Hospice (n = 3,298)	Usual Care (n = 4,512)	p Value	Hospice (n = 3,067)	Usual Care (n = 3,067)	p Value
Age, yrs	82 ± 9 (30–109)	79 ± 11 (21–104)	<0.001	82 ± 9 (30–107)	82 ± 9 (38–104)	0.82
<65	148 (4)	436 (10)	<0.001	148 (5)	139 (5)	0.59
>85	1,484 (45)	1,519 (34)	<0.001	1,318 (43)	1,285 (42)	0.39
Female	1,748 (53)	2,343 (52)	0.35	1,619 (53)	1,613 (53)	0.88
Race or ethnicity			<0.001			0.25
White	2,830 (86)	3,513 (78)		2,610 (85)	2,596 (85)	
Black	348 (10)	754 (17)		342 (11)	359 (12)	
Asian	22 (1)	59 (1)		21 (1)	28 (1)	
Hispanic	64 (2)	103 (2)		62 (2)	44 (1)	
Patient lives alone	520 (16)	844 (19)	0.001	504 (16)	496 (16)	0.78
Medicaid	614 (19)	1,289 (29)	<0.001	611 (20)	615 (20)	0.90
Disabled entitlement	124 (4)	357 (8)	<0.001	124 (4)	119 (4)	0.74
Average median household income, $	53,193 ± 20,615	50,761 ± 20,398	<0.001	52,716 ± 20,451	52,502 ± 21,213	0.69
Average total Medicare spending, $	71,303 ± 12,862	72,781 ± 14,989	<0.001	71,332 ± 13,043	71,778 ± 13,855	0.19
Region			<0.001			0.92
Northeast	649 (20)	1,132 (25)		640 (21)	652 (21)	
Midwest	801 (24)	1,013 (23)		726 (24)	740 (24)	
South	1,530 (46)	1,935 (43)		1,407 (46)	1,391 (46)	
West	315 (10)	420 (9)		294 (9)	284 (9)	
Conditions in the prior 6 months to second HF hospitalization						
Acute MI	445 (13)	703 (16)	0.01	432 (14)	434 (14)	0.94
Metastatic cancer	292 (9)	262 (6)	<0.001	234 (8)	231 (8)	0.88
Diabetes	1,693 (51)	2,740 (61)	<0.001	1,635 (53)	1,661 (54)	0.51
Anemia	2,262 (69)	3,104 (69)	0.85	2,106 (69)	2,113 (69)	0.85
Dementia	719 (22)	809 (18)	<0.001	644 (21)	638 (21)	0.85
Depression	748 (23)	993 (22)	0.48	686 (22)	691 (23)	0.88
Hypertension	3,178 (96)	4,365 (97)	0.36	2,958 (96)	2,964 (97)	0.67
Atrial fibrillation	2,226 (68)	2,919 (65)	<0.001	2,057 (67)	2,081 (68)	0.51
Stroke	502 (15)	661 (15)	0.48	462 (15)	452 (15)	0.72
Vascular disease	911 (28)	1,322 (29)	0.11	851 (28)	862 (28)	0.75
COPD	2,009 (61)	2,791 (62)	0.40	1,884 (61)	1,845 (60)	0.31
Chronic kidney disease	2,499 (76)	3,494 (77)	0.09	2,323 (76)	2,337 (76)	0.68
Elixhauser mean number of comorbid conditions	2.4 ± 2.4	2.5 ± 2.6	<0.001	2.4 ± 1.2	2.4 ± 1.2	0.70
OASIS items						
Dyspnea at rest	432 (13)	556 (12)	0.021	394 (13)	399 (13)	0.99
Oxygen treatment at home	1,848 (56)	2,458 (55)	0.17	1,716 (56)	1,689 (55)	0.49
Pain interfering with activity daily or all of the time	1,341 (41)	1,855 (41)	0.38	1,245 (41)	1,211 (39)	0.42
Dependent toilet transfer	2,173 (66)	2,702 (60)	<0.001	1,981 (65)	1,943 (63)	0.31
Dependent ambulation	1,528 (46)	1,929 (43)	0.002	1,381 (45)	1,412 (46)	0.43
No. of ADL or IADL dependencies	4.1 ± 1.9 (0–7)	3.8 ± 2.0 (0–7)	<0.001	4.1 ± 1.9 (0–7)	4.0 ± 2.0 (0–7)	0.28

Values are mean ± SD (range), mean ± SD, or n (%). *The unmatched sample demonstrates the sample of beneficiaries with at least 2 or more HF discharges within 6 months, an OASIS assessment within 7 days of second HF discharge, and death within 6 months of second HF discharge. †The matched sample is the propensity score–matched sample, which demonstrates that we achieved a balance with all characteristics having no statistical difference between the hospice group and the usual care group.

ADL = activities of daily living; COPD = chronic obstructive pulmonary disease; HF = heart failure; IADL = instrumental activities of daily living; MI = myocardial infarction; OASIS = Outcome and Assessment Information Set.

Medicare Home Health and Outpatient Standard Analytic Files, which contains home and outpatient claims data; 6) the Carrier File (Part B Standard Analytic File), which includes physician services information; and 7) the federally mandated OASIS collected by home care clinicians on admission to home care, discharge from home care, and resumption of care following an inpatient stay that interrupted the home care episode. OASIS includes information on the following: 1) patient home care diagnoses; 2) symptom assessment; and 3) activities of daily living (ADLs). Finally, to obtain regional measures of total Medicare spending at the end of life, we used publicly available data from the

Dartmouth Atlas of Healthcare. The Institutional Review Boards of the Visiting Nurse Service of New York Center and the Icahn School of Medicine at Mount Sinai approved conduct of this study.

OUTCOMES. Our primary outcome was hospice enrollment after the second HF discharge. Other outcomes included health care use measures: number of inpatient days and stays, ICU days, SNF days, and emergency department (ED) visits; time to death after the second HF discharge; time to hospice enrollment after the second HF discharge; and location of death.

EXPOSURE TO HOSPICE. In addition to serving as the primary outcome, hospice enrollment was the main exposure in comparing health care use, and time to and location of death, for patients who enrolled in hospice and those who did not.

COVARIATES. We identified age, sex, and race from the Medicare administrative data. We measured comorbidity as a count of the number of conditions listed in Medicare claims for the 6 months before the index HF discharge. The specific comorbidities assessment included the Elixhauser score (30), as well as individual comorbidities including acute myocardial infarction, metastatic cancer, diabetes, Alzheimer's dementia and related dementias, atrial fibrillation, depression, chronic kidney disease, arthritis, chronic lung disease, and obesity. The specific OASIS assessment included the sum of Katz's ADLs (31), dyspnea assessment, pain assessment, use of oxygen treatment at home, and presence of impaired decision making. By linking beneficiaries' ZIP codes to census data, we obtained the median family income in the beneficiary's area of residence, as well as the total Medicare spending for each beneficiary's ZIP code.

STATISTICAL ANALYSIS. Predictors of hospice enrollment. To examine the predictors of hospice enrollment, we used chi-square or Student's *t* test where appropriate, to compare the relationship of functional status and symptom burden within 7 days of second HF discharge and use in the 6 months before the second HF discharge.

Propensity score matching. Because our study relies on observational data to assess how health care use and time until death after the second HF discharge differed by hospice enrollment, we conducted propensity score matching using the nearest neighbor method, also known as the greedy algorithm (32,33). Propensity score analysis controls for observed confounders that could influence group assignment by reducing the confounding covariates into a single variable, the propensity score. Matching methods balance the distributions of the observed covariates in the 2 groups, thus imitating what would have occurred in a randomized controlled trial. The propensity scores were created using the following variables: age, sex, race, income, whether patient lives alone, Medicaid enrollment, receipt of disability, census region, comorbidities, OASIS function and symptom assessment, and total Medicare spending. To account for regional health care use intensity, we also included regional total medical spending by matching the beneficiary ZIP code to hospital referral region level provided by the Dartmouth Atlas of Healthcare. Fifteen beneficiaries were excluded for missing ZIP codes. Next, we used a 3-group variable of total Medicare spending (lower quartile, 2 middle quartiles, and upper quartile) as an additional adjuster in the propensity score matching. All differences in beneficiaries' characteristics disappeared after performing the propensity score matching (Table 1). All variables achieved balance with standardized bias <0.02. Because of an inability to match, 231 beneficiaries were excluded.

Health care use and survival. Using the propensity score–matched sample, we conducted bivariate analyses to compare health care use in the 30 days and the 6 months after second HF discharge of those patients who enrolled in hospice and those who did not. We estimated negative binomial (NB) regression models to compare use outcomes because all data were overdispersed or underdispersed on the basis of the likelihood ratio test; these outcomes were measured as counts, including the number of ED visits, inpatient days and admissions, ICU days, and SNF days, of those patients who did or did not enroll in hospice. We used 0-truncated NB models for outcomes with no values of 0, including number of all-cause hospital stays and days in the 6 months before the second HF discharge, because our exclusion criteria excluded all beneficiaries with 0 HF discharges. For use outcomes with a disproportionate number of 0s, we estimated 0-inflated NB models. These outcomes included ICU and SNF days, because a large proportion of patients did not use these services. Use outcomes for the propensity score–matched sample were compared using panel NB regression. If 0-truncated or 0-inflated models were preferred, cluster robust confidence intervals were used to compare use outcomes for the propensity score–matched sample. Vuong tests (34) were used to determine whether the estimation of a 0-inflated component was appropriate. We report adjusted marginal means and 95% confidence intervals.

Next, we compared survival between those patients who enrolled and who never enrolled in

TABLE 2 Predictors of Hospice Enrollment Using Health Care Use in the 6 Months Before the Second HF Discharge

	Unmatched*			Propensity Score Matched†		
	Hospice (n = 3,298)	Usual Care (n = 4,512)	p Value	Hospice (n = 3,067)	Usual Care (n = 3,067)	p Value
ED visits	3.1 (2.9–3.3)	4.6 (4.4–4.8)	<0.001‡	2.38 (2.28–2.49)	2.59 (2.48–2.70)	0.01§
Inpatient stays	1.70 (1.63–1.77)	1.88 (1.82–1.95)	<0.001‖	1.73 (1.65–1.80)	1.77 (1.70–1.85)	0.302‖
Inpatient days	12.5 (12.1–12.9)	14.0 (3.7–14.4)	<0.001‖	12.6 (12.2–13.0)	13.2 (12.7–13.6)	0.08‖
ICU days	3.51 (3.31–3.71)	3.73 (3.55–3.91)	0.09¶	3.57 (3.35–3.78)	3.58 (3.35–3.81)	0.91¶
SNF days	6.93 (6.44–7.42)	6.88 (6.41–7.34)	0.85¶	7.13 (6.58–7.67)	7.27 (6.71–7.83)	0.67¶

Values are adjusted marginal mean (95% CI). *The unmatched sample demonstrates the health care use outcomes of beneficiaries with at least 2 or more HF discharges within 6 months, an OASIS assessment within 7 days of second HF discharge, and death within 6 months of second HF discharge. †The matched sample is the propensity score–matched sample, which demonstrates that we achieved a balance with all characteristics having no statistical difference between the hospice group and the usual care group, with the exception of the ED visits. ‡Negative binomial regression. §Panel negative binomial regression. ‖Zero-truncated negative binomial regression. ¶Zero-inflated negative binomial regression.

CI = confidence interval; ED = emergency department; ICU = intensive care unit; SNF = skilled nursing facility; other abbreviations as in Table 1.

hospice using Kaplan-Meier curves and the log-rank test. Finally, we compared the location of death for those patients who did and did not enroll in hospice the location of death included hospice (home, inpatient, or at unknown setting), hospital, SNF or rehabilitation facility, or home health care. We used Stata software version 12.1 (StataCorp, College Station, Texas) to estimate these models.

RESULTS

We identified 234,301 Medicare fee-for-service beneficiaries with at least 1 home health claim and 1 HF hospital discharge in the 1-year interval between July 1, 2009, and June 30, 2010. Among them, 59,405 (25.4%) beneficiaries had 2 HF hospitalizations in a 6-month period, and of those patients, 22,893 (38.5%) had an OASIS assessment completed within 7 days of the second HF discharge. Finally, 7,810 (34.1%) died within 6 months of the second HF discharge (Figure 1).

Of the 7,810 patients who met our inclusion criteria, 3,298 (42.2%) enrolled in hospice, and 4,512 (57.8%) received usual care. The inclusion criteria were as follows: 1) 2 or more HF discharges in a 6-month period; 2) OASIS assessment within 7 days of second HF discharge; and 3) death within 6 months of second HF discharge. The propensity score-matched sample included 3,067 beneficiaries who enrolled in hospice and 3,067 who did not. Fifteen beneficiaries had missing ZIP code data, and 216 beneficiaries could not be matched in the propensity score; all 231 of these individuals were dropped (Figure 1).

The beneficiaries in the final cohort of propensity score-matched beneficiaries (n = 6,134) had a mean age of 82 years, 53% were female, and 15% were Black, Asian, or Hispanic (Table 1). Although those patients who were not matched by propensity score were generally similar to those who were matched, those who could not be matched by propensity score (n = 216) were more likely to be older (>85 years of age), be sicker (metastatic cancer, dementia, renal failure), and have worse functional status (more ADL or instrumental ADL dependencies), and they were less likely to have Medicaid or receive a disability entitlement.

PREDICTORS OF HOSPICE ENROLLMENT. In the unmatched sample (n = 7,810), compared with those who did not enroll in hospice, beneficiaries who subsequently enrolled in hospice were more likely to be >85 years of age (45% vs. 34%; $p < 0.001$), white (86% vs. 78%; $p < 0.001$), have higher median household income ($53,193 vs. $50,761; $p < 0.001$), be sicker (metastatic cancer 9% vs. 6%; $p < 0.001$), have dementia (22% vs. 18%; $p < 0.001$), have dyspnea at

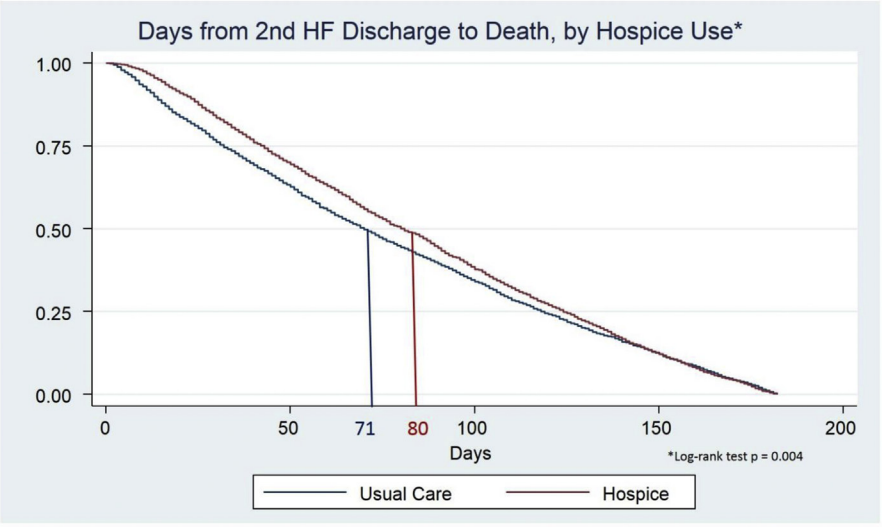
TABLE 3 Health Care Use in the 6 Months After the Second HF Discharge: Adjusted Marginal Means

	Hospice (n = 3,067)	Usual Care (n = 3,067)	p Value
Utilization within 30 days of second HF discharge*			
ED visits	2.64 (2.52–2.76)	2.82 (2.69–2.94)	0.04†
Inpatient stays	0.60 (0.57–0.64)	0.65 (0.61–0.69)	0.07†
Inpatient days	3.90 (3.72–4.09)	4.67 (4.44–4.91)	<0.001‡
ICU days	1.25 (1.14–1.35)	1.51 (1.37–1.64)	0.001‡
Utilization within 6 months of second HF discharge§			
ED visits	4.25 (4.06–4.45)	5.25 (5.01–5.48)	<0.001†
Inpatient stays	1.75 (1.67–1.83)	2.18 (2.08–2.28)	<0.001†
Inpatient days	11.7 (11.3–12.1)	14.8 (14.3–15.3)	<0.001‡
ICU days	3.75 (3.49–4.02)	4.86 (4.54–5.18)	0.04‡
SNF days	4.38 (3.99–4.76)	6.44 (5.96–6.92)	0.04‡

Values are adjusted marginal mean (95% CI). *Health care use within 30 days after the second HF discharge of patients who subsequently enroll in hospice and those who do not. †Panel negative binomial regression. ‡Zero-inflated negative binomial regression. §Health care use within 6 months after the second HF discharge of those who subsequently enroll and do not enroll in hospice.

CI = confidence interval; other abbreviations as in Tables 1 and 2.

FIGURE 2 Number of Days From Second HF Discharge to Death, by Hospice Use



Kaplan-Meier curve of the days from the second heart failure (HF) discharge to death for the propensity score–matched sample. Those who enrolled in hospice after the second HF discharge had a median survival of 80 days compared with 71 days for those who received usual care, with a median survival of 71 days.

rest or with minimal exertion (49% vs. 44%; $p = 0.021$), and have more functional dependencies (4.1 vs. 3.8; $p < 0.001$); they also were less likely to have Medicaid (19% vs. 29%; $p < 0.001$) and a disability entitlement (4% vs. 8%; $p < 0.001$) (Table 1).

In examining health care use in the 6 months *before* the second HF discharge, there were differences between the groups of beneficiaries who subsequently received and did not receive hospice. Compared with those patients who did not enroll in hospice, in the 6 months before the second HF discharge, those who subsequently enrolled in hospice had fewer ED visits (3.1 vs. 4.6; $p < 0.001$), all-cause inpatient admissions (1.70 vs. 1.88; $p < 0.001$), and all-cause inpatient days (12.4 vs. 14.0; $p < 0.001$), and there were no significant differences in the mean number of ICU days or SNF days for the unmatched sample (Table 2).

After propensity score matching, there were no significant predictors of hospice use, except that hospice patients still had fewer ED visits on average compared with beneficiaries who received usual care (2.38 vs. 2.59; $p = 0.01$) (Table 2).

HEALTH CARE USE *AFTER* THE SECOND HF DISCHARGE: HOSPICE GROUP VERSUS USUAL CARE GROUP. Table 3 reports the propensity score–matched and adjusted mean number of ED visits, all-cause hospital admissions (stays), mean number of all-cause hospital days, mean number of ICU days, and number of SNF days within 30 days after the second HF hospital discharge. Table 3 also presents the same outcomes after the second HF hospital discharge for the 6 months following hospital discharge. For the matched and adjusted sample within 30 days after the second HF hospital discharge, beneficiaries who enrolled in hospice had significantly fewer ED visits (2.64 vs. 2.82; $p = 0.04$) and spent fewer days on average in the hospital (3.90 vs. 4.67; $p < 0.001$) and in the ICU (1.25 vs. 1.51; $p < 0.001$) compared with those in usual care. There were no statistically significant differences in the number of inpatient stays within 30 days. When we examined similar outcomes for the 6 months *after* hospital discharge, beneficiaries who enrolled in hospice had on average significantly fewer ED visits, inpatient days, inpatient stays, ICU days, and SNF stays compared with beneficiaries who received usual care (Table 3).

Compared with those who received usual care, those who enrolled in hospice were less likely to die in the hospital (3% vs. 56%; $p < 0.001$) and less likely to die in an SNF (1% vs. 10%; $p < 0.001$). Of patients enrolled in hospice, 1,744 (57%) died with home hospice, 995 (32%) died in inpatient hospice, and 126

(4%) died in hospice in an unknown setting. The median number of days from second HF hospital discharge to enrollment in hospice was 51 (SD = 47 days). A total of 247 beneficiaries (8.1%) enrolled in hospice within 7 days after second HF hospital discharge, and 33.3% enrolled within 30 days after the second HF hospital discharge. The mean number of days from hospice enrollment to death was 22 ± 30 days. Nearly one-half (45%) died within 7 days. A total of 207 patients (6.7%) disenrolled from hospice during the 6-month study period, and of those, 95 (44.9%) disenrolled in the first 30 days after hospice enrollment. Those who ever enrolled in hospice had longer median survival compared with matched patients who received usual care (80 days vs. 71 days; log-rank test $p = 0.004$) (**Figure 2**).

DISCUSSION

Beneficiaries' characteristics, including symptom burden and functional status, do not predict hospice enrollment. Those who enrolled in hospice used less health care, had longer survival, and were less likely to die in the hospital. In a sample of ill older adults with advanced HF, we examined predictors of hospice enrollment and compared health care use for those who enrolled in hospice and those who received usual care in the 6-month period following hospital discharge. Because 2 HF hospital discharges within a 6-month period comprise a marker of advanced HF, we observed a high symptom burden and poor functional status for patients with HF. Although those who enrolled in hospice after the second HF hospital discharge were older, more likely to be white, and less likely to have Medicaid and disability entitlement than those who received usual care, these trends are similar to national statistics about hospice enrollment across all diagnoses (35). Of note, in the unmatched sample, both those who enrolled in hospice and those who did not had a similar number of comorbidities and a similar symptom burden and functional status. Furthermore, health care use *before* the second HF discharge did not predict subsequent hospice enrollment because those patients who did not enroll in hospice had less health care use in the 6 months before the second HF discharge.

Compared with those who received usual care, beneficiaries who enrolled in hospice used less acute health care (including ED visits, inpatient stays and days, ICU days, and SNF days), had a longer survival, and were less likely to die in the hospital setting. Compared with similar patients not receiving hospice services, there is an estimated average cost savings of $2,300 per hospice beneficiary, which yields an overall savings of more than $3.5 billion a year for the 1.6 million patients served (36). These estimates do not account for the burdensome costs of informal caregiving. Nonetheless, these data demonstrate how hospice reduces formal health care use and, in turn, costs. These observations support several other studies demonstrating that patients who enroll in hospice experienced a longer survival (37), and that hospice enrollment reduced health care use and costs. Although many factors, including racial, socioeconomic, cultural, and religious factors, among others, may influence where individuals want to die, patients have stated that they prefer to die outside of the hospital (38). Of those who did not enroll in hospice, 56% died in the hospital compared with 3% of those enrolled. Although <7% of the hospice group disenrolled from hospice, nearly one-half of those who disenrolled from hospice did so in the first 30 days. Given the limitations of these claims data, we are unable to distinguish whether those disenrollees were discharged from hospice or revoked the hospice benefit.

STUDY LIMITATIONS. Because our sample included only beneficiaries who received home health care before the 2 HF hospitalizations, this sample may have been sicker than other groups with advanced HF. In particular, these findings may not apply to patients referred to hospice who may be less sick (i.e., directly from the outpatient setting) and thus more likely spend more days enrolled in hospice. However, previous work suggests that patients and families with longer hospice lengths of stay report greater benefits from longer lengths of stay (39); therefore, our sample may underestimate these findings. Although the data are from 2009 and 2010, these results likely underestimate more current data because of the increased dissemination of hospice and palliative care into education, research, and clinical practice (7,8). Next, this sample included only Medicare beneficiaries who died; nonetheless, the mortality follow-back approach allowed us to characterize the use of resources for beneficiaries in the last 6 months of life. Finally, because the claims data did not include standard HF severity indicators, such as American College of Cardiology and American Heart Association HF stage or New York Heart Association HF functional class, advanced HF was represented by the history of 2 HF hospitalizations within a 6-month period as a surrogate for disease severity; despite the limitations of symptom reporting in claims data, such as OASIS, the high symptom burden and poor

functional status of our sample demonstrates that our inclusion criteria effectively selected a high-risk group.

CONCLUSIONS

These data demonstrate that the marker of 2 HF hospital discharges within a 6-month period is an important indicator of high symptom burden and poor functional status. Yet, these beneficiary-related characteristics of multiple comorbidities, high symptom burden, poor functional status, and health care use are not predictive of subsequent hospice enrollment. Furthermore, patients who enroll in hospice use less health care, are more likely to die out of the hospital, and have longer survival. Given these benefits to patients with advanced HF, a more inclusive model for hospice is needed, such that patients are not required to agree to forego Medicare services aimed at curing disease or prolonging life. In addition, because of how difficult it can be to predict survival in these patients, changes to hospice should also include more flexibility around this requirement. Such a model of hospice for patients with HF that is tailored to the needs of this group would need to be adequately studied, with the goal to ensure that more people with advanced HF have access to these benefits.

ADDRESS FOR CORRESPONDENCE: Dr. Laura Gelfman, Department of Geriatrics and Palliative Medicine, Icahn School of Medicine at Mount Sinai, One Gustave L. Levy Place, Box 1070, New York, New York 10029. E-mail: laura.gelfman@mssm.edu.

PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: In older adults with advanced HF, patients' characteristics, including symptom burden and functional status, do not predict hospice enrollment. Furthermore, those patients who enrolled in hospice used less health care, survived longer, and were less likely to die in the hospital. These findings suggest that a tailored hospice model may be needed to increase enrollment and offer benefits to patients with HF.

TRANSLATIONAL OUTLOOK: Future studies should evaluate the impact of a tailored hospice model for older adults with advanced HF that supports earlier enrollment in hospice to better support the needs of these patients.

REFERENCES

1. Lloyd-Jones D, Adams RJ, Brown TM, et al. Heart disease and stroke statistics–2010 update: a report from the American Heart Association. Circulation 2010;121:e46–215.

2. Liu L. Changes in cardiovascular hospitalization and comorbidity of heart failure in the United States: findings from the National Hospital Discharge Surveys 1980-2006. Int J Cardiol 2011;149:39–45.

3. Shah KS, Xu H, Matsouaka RA, et al. Heart failure with preserved, borderline, and reduced ejection fraction: 5-year outcomes. J Am Coll Cardiol 2017;70:2476–86.

4. Krumholz HM, Lin Z, Keenan PS, et al. Relationship between hospital readmission and mortality rates for patients hospitalized with acute myocardial infarction, heart failure, or pneumonia. JAMA 2013;309:587–93.

5. Heidenreich PA, Sahay A, Kapoor JR, Pham MX, Massie B. Divergent trends in survival and readmission following a hospitalization for heart failure in the Veterans Affairs health care system 2002 to 2006. J Am Coll Cardiol 2010;56:362–8.

6. Solano JP, Gomes B, Higginson IJ. A comparison of symptom prevalence in far advanced cancer, AIDS, heart disease, chronic obstructive pulmonary disease and renal disease. J Pain Symptom Manage 2006;31:58–69.

7. Kavalieratos D, Gelfman LP, Tycon LE, et al. Palliative care in heart failure: rationale, evidence, and future priorities. J Am Coll Cardiol 2017;70:1919–30.

8. Gelfman LP, Bakitas M, Warner Stevenson L, Kirkpatrick JN, Goldstein NE. The state of the science on integrating palliative care in heart failure. J Palliat Med 2017;20:592–603.

9. Ammar KA, Jacobsen SJ, Mahoney DW, et al. Prevalence and prognostic significance of heart failure stages: application of the American College of Cardiology/American Heart Association heart failure staging criteria in the community. Circulation 2007;115:1563–70.

10. Jones J, McDermott CM, Nowels CT, Matlock DD, Bekelman DB. The experience of fatigue as a distressing symptom of heart failure. Heart Lung 2012;41:484–91.

11. Bekelman DB, Rumsfeld JS, Havranek EP, et al. Symptom burden, depression, and spiritual well-being: a comparison of heart failure and advanced cancer patients. J Gen Intern Med 2009;24:592–8.

12. Aldridge MD, Canavan M, Cherlin E, Bradley EH. Has hospice use changed? 2000-2010 utilization patterns. Med Care 2015;53:95–101.

13. National Hospice and Palliative Care Organization. NHPCO Facts and Figures: Hospice Care in America. Alexandria, VA: National Hospice and Palliative Care Organization; 2015.

14. Earle CC, Park ER, Lai B, Weeks JC, Ayanian JZ, Block S. Identifying potential indicators of the quality of end-of-life cancer care from administrative data. J Clin Oncol 2003;21:1133–8.

15. Wright AA, Keating NL, Balboni TA, Matulonis UA, Block SD, Prigerson HG. Place of death: correlations with quality of life of patients with cancer and predictors of bereaved caregivers' mental health. J Clin Oncol 2010;28:4457–64.

16. Miller SC, Mor V, Teno J. Hospice enrollment and pain assessment and management in nursing homes. J Pain Symptom Manage 2003;26:791–9.

17. Baer WM, Hanson LC. Families' perception of the added value of hospice in the nursing home. J Am Geriatr Soc 2000;48:879–82.

18. Greer DS, Mor V, Morris JN, Sherwood S, Kidder D, Birnbaum H. An alternative in terminal care: results of the National Hospice Study. J Chronic Dis 1986;39:9–26.

19. Kane RL, Klein SJ, Bernstein L, Rothenberg R, Wales J. Hospice role in alleviating the emotional stress of terminal patients and their families. Med Care 1985;23:189–97.

20. Miller SC, Mor V, Wu N, Gozalo P, Lapane K. Does receipt of hospice care in nursing homes

improve the management of pain at the end of life? J Am Geriatr Soc 2002;50:507–15.

21. Godkin MA, Krant MJ, Doster NJ. The impact of hospice care on families. Int J Psychiatry Med 1983;13:153–65.

22. Teno JM, Clarridge BR, Casey V, et al. Family perspectives on end-of-life care at the last place of care. JAMA 2004;291:88–93.

23. Bradley EH, Prigerson H, Carlson MD, Cherlin E, Johnson-Hurzeler R, Kasl SV. Depression among surviving caregivers: does length of hospice enrollment matter? The Am J Psychiatry 2004;161:2257–62.

24. 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 Affairs 2013;32:552–61.

25. Taylor DH Jr., Ostermann J, Van Houtven CH, Tulsky JA, Steinhauser K. What length of hospice use maximizes reduction in medical expenditures near death in the US Medicare program? Soc Sci Med 2007;65:1466–78.

26. 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;21:55–61.

27. Aldridge MD, Bradley EH. Epidemiology and patterns of care at the end of life: rising complexity, shifts in care patterns and sites of death. Health Affairs 2017;36:1175–83.

28. Murtaugh CM, Deb P, Zhu C, et al. Reducing readmissions among heart failure patients discharged to home health care: effectiveness of early and intensive nursing services and early physician follow-up. Health Serv Res 2017;52:1445–72.

29. Setoguchi S, Stevenson LW, Schneeweiss S. Repeated hospitalizations predict mortality in the community population with heart failure. Am Heart J 2007;154:260–6.

30. Mehta HB, Sura SD, Sharma M, Johnson ML, Riall TS. Comparative performance of diagnosis-based and prescription-based comorbidity scores to predict health-related quality of life. Med Care 2016;54:519–27.

31. Katz S, Downs T, Cash H, Grotz R. Progress in development of the index of ADL. Gerontologist 1970;10:20–30.

32. Austin PC. A comparison of 12 algorithms for matching on the propensity score. Stat Med 2014;33:1057–69.

33. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivariate Behav Res 2011;46:399–424.

34. Long JS, Freese J. Regression Models for Categorical Dependent Variables Using Stata. 2nd edition. College Station, Texas: Stata Press, 2006.

35. National Hospice and Palliative Care Organization. NHPCO Facts and Figures: Hospice Care in America. Alexandria, VA: National Hospice and Palliative Care Organization, 2013.

36. Meier DE. Increased access to palliative care and hospice services: opportunities to improve value in health care. Milbank Q 2011;89:343–80.

37. Connor SR, Pyenson B, Fitch K, Spence C, Iwasaki K. Comparing hospice and nonhospice patient survival among patients who die within a three-year window. J Pain Symptom Manage 2007;33:238–46.

38. LeMond L, Allen LA. palliative care and hospice in advanced heart failure. Prog Cardiovasc Dis 2011;54:168–78.

39. Rickerson E, Harrold J, Kapo J, Carroll JT, Casarett D. Timing of hospice referral and families' perceptions of services: are earlier hospice referrals better? J Am Geriatr Soc 2005;53:819–23.

KEY WORDS health services, heart failure, palliative care, quality and outcomes