

*Original Article*

## Enrollment and Events of Hospice Patients With Heart Failure vs. Cancer

Winson Y. Cheung, MD, MPH, FRCPC, Kristen Schaefer, MD, Christopher W. May, MD, Robert J. Glynn, PhD, Lesley H. Curtis, PhD, Lynne W. Stevenson, MD, and Soko Setoguchi, MD

*Division of Medical Oncology, British Columbia Cancer Agency (W.Y.C.), Vancouver, British Columbia, Canada; Dana-Farber Cancer Institute (K.S.) and Brigham and Women's Hospital (R.J.G., L.W.S.), Boston, Massachusetts; Duke Clinical Research Institute (C.W.M., L.H.C., S.S.), Durham, North Carolina, USA*

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### **Abstract**

**Context.** Hospice care is traditionally used for patients with advanced cancer, but it is increasingly considered for patients with end-stage heart failure.

**Objectives.** We compared enrollment patterns and clinical events of hospice patients with end-stage heart failure with those of patients with advanced cancer.

**Methods.** Using Medicare data linked with pharmacy and cancer registry data, we identified patients who were diagnosed with either heart failure or advanced cancer between 1997 and 2004, admitted to hospice at least once after their diagnosis, and died during the study period. We compared patterns of referral, use of acute services, and site of death of hospice patients with heart failure with those of patients with advanced cancer. Logistic regression models were constructed to determine the factors associated with late hospice enrollment as well as the use of and death in acute care.

**Results.** We identified 1580 heart failure patients and 3840 advanced cancer patients: mean ages were 86 and 80 years, 82% and 68% were women, and 97% and 94% were white, respectively. Compared with patients with advanced cancer, those with heart failure were more frequently referred to hospice from hospitals (35% vs. 24%) and nursing facilities (9% vs. 7%) (both  $P < 0.01$ ). Discharge from hospice before death was similar for patients with heart failure and patients with advanced cancer (10% vs. 9%,  $P = 0.03$ ). Among patients remaining in hospice, patients with heart failure were more likely to have been enrolled within three days of death (20% vs. 11%,  $P < 0.01$ ). The prevalence of death in acute care settings was low in both groups after hospice enrollment (4% heart failure vs. 2% advanced cancer,  $P < 0.01$ ). Although the median interval between enrollment and death was shorter for heart failure patients (12 vs. 20 days,  $P < 0.001$ ), emergency department visits and hospitalizations after hospice enrollment were more frequent in patients with heart failure (13% vs. 10% and 9% vs. 6%, respectively, both  $P < 0.01$ ).

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*Address correspondence to:* Winson Y. Cheung, MD, MPH, FRCPC, Division of Medical Oncology, British Columbia Cancer Agency, 600 West 10th Avenue,

Vancouver, British Columbia V5Z4E6, Canada.  
E-mail: [wcheung@bccancer.bc.ca](mailto:wcheung@bccancer.bc.ca)

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**Conclusion.** Compared with patients with advanced cancer, referral to hospice is more often initiated during acute care encounters for patients with end-stage heart failure, who also more frequently return to acute care settings even after hospice enrollment. *J Pain Symptom Manage* 2012;■:■–■. © 2012 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.

### **Key Words**

*Hospice, enrollment, heart failure, advanced cancer*

## **Introduction**

Advances in life-sustaining measures in cardiology and oncology mean that an increasing number of patients will survive well into the late stages of heart failure and cancer, respectively, which can frequently last for a protracted length of time.<sup>1,2</sup> For these patients, symptom burden near the end of life can be significant and can contribute to suffering and poor quality of life for both patients and their caregivers.<sup>3,4</sup> This observation emphasizes the importance of promoting interventions that can better address their physical symptoms and psychosocial needs. The use of hospice services by patients with terminal cancer increases their satisfaction, improves their quality of death, and minimizes their personal as well as their family's physical and psychological distress.<sup>5</sup> Studies, however, suggest that the delivery of similar hospice care to end-stage heart failure patients appears to lag behind that of cancer patients.<sup>6–8</sup>

Bain et al.<sup>7</sup> reported that patients with heart failure were more likely to be discharged from hospice alive and significantly more likely to be enrolled in hospice care for more than six months before death when compared with patients with cancer. A similar report by Medicare indicated that the mean number of days in hospice was longer for heart failure patients than for cancer patients (63 vs. 46 days).<sup>9</sup> We previously described that these differences in hospice use may have been partly attributed to the more unpredictable disease trajectory of end-stage heart failure, which can be characterized by a series of disease exacerbations and remissions that might span from several months to many years.<sup>10,11</sup> In contrast, the natural history of end-stage cancers is often marked by a quick and sharp functional decline.<sup>10,11</sup> To better understand the basis for

the differences in hospice care, other important aspects of end-of-life care must be carefully examined in these two populations.

The goals of the present study were to describe the patterns of referral, acute services utilization, and death of hospice patients with either heart failure or cancer and to compare the clinical courses between heart failure and cancer patients after hospice enrollment. Furthermore, we aimed to identify potential factors associated with different patterns of enrollment to and clinical events after hospice care. The results of this study may enhance our understanding of this vulnerable patient population and improve their end-of-life care in the future.

## **Methods**

### *Overview of Data Sources*

Data for this study were obtained by linking U.S. Medicare (i.e., Part A, Part B, inpatient, outpatient, long-term care, hospice, and enrollment files), the state cancer registry, and pharmacy dispensing information from the government-sponsored Pharmaceutical Assistance Contract for the Elderly (PACE) program in Pennsylvania. PACE is the largest state prescription benefits program for the elderly with low to middle range incomes. It was established in 1984 to assist residents of Pennsylvania 65 years or older who are not eligible for Medicaid and may be unable to pay for their prescription medications. PACE provides complete pharmacy benefits for all drugs for qualifying residents. The 2007 income ceiling for eligibility was \$27,676 for a married couple. There are no deductibles, no maximum annual benefits, and only modest co-payments (i.e., \$6 for generic and \$9 for brand name medications)

for its beneficiaries. Basic demographic information, date and cause of death, as well as coded diagnostic, procedural, and pharmacy dispensing information were derived from these linked data sources. We limited the analyses to beneficiaries who were aged 65 years or older and living in the U.S. Only claims filed during periods of fee-for-service coverage were included. Ethical approval was obtained from the Institutional Review Boards of the Brigham and Women's Hospital and data-use agreements were established before performing this study. To ensure patient confidentiality, all potentially traceable personal identifying information was removed before conducting the analyses.

#### *End-of-Life Study Populations*

We retrospectively identified an end-of-life cohort of heart failure patients and a separate end-of-life cohort of cancer patients among the beneficiaries of Medicare and PACE.<sup>8,12</sup> Patients were entered into the heart failure cohort if they had at least two or more hospitalizations for heart failure between 1997 and 2004 while residing in Pennsylvania, died during this time period, and whose cause of death was listed as related to cardiac diseases on the death certificate. Only hospital admissions with a primary discharge diagnosis of heart failure (*International Classification of Diseases, Ninth Revision, Clinical Modification* code 428.xx) were considered to represent true heart failure hospitalizations. This definition of heart failure has been previously validated and shown to be associated with a positive predictive value of 94% based on the Framingham criteria.<sup>13</sup> Similarly, the cancer cohort included patients who were diagnosed with one of the four most common solid tumors (breast, lung, colorectal, and prostate) between 1997 and 2004 based on diagnosis information from the state cancer registry, died during the study period, and whose cause of death was cancer according to the death certificate. To be eligible for analyses in either cohort, patients must have been continuously enrolled in Medicare and PACE for at least 12 months before the incident date. They also must have been enrolled in hospice care at least once after their qualifying heart failure hospitalization or cancer diagnosis and before their death.

#### *Main Outcomes*

We determined the date of first hospice enrollment that occurred between the date of index heart failure hospitalization or cancer diagnosis and the date of death. As primary study end points, we were interested in evaluating 1) the time interval between hospice enrollment and death, which was evaluated both as a continuous variable and then as a categorical variable based on cutoffs used in prior hospice literature,<sup>14,15</sup> 2) disenrollment from hospice before death, which was defined as any hospice claim indicating a patient discharge to a nonhospice location, 3) the use of acute care after hospice enrollment, which was defined as any visits to the emergency department or any acute care hospitalizations after first hospice use, and 4) death in one of these acute care settings. For this study, late enrollment in hospice care was defined as admission to hospice within seven days before death. These measures are based on those established as benchmarks for quality of care at the end of life in cancer patients.<sup>14,15</sup> For sensitivity analyses, we used a range of time intervals for our definition of late enrollment in hospice care. We also tested alternate definitions of acute care by examining the emergency department visits and hospitalizations as separate outcomes.

#### *Definition of Covariates*

Demographic variables such as age at death (continuous), gender, and race (white vs. black vs. other) were obtained from both Medicare and PACE. Information regarding various comorbid conditions at one year before the date of death was collected and defined using previously described coding algorithms that were based on inpatient, outpatient, and carrier claims.<sup>13</sup> Measured comorbidities comprised the following: prior heart failure, atrial fibrillation, coronary artery disease, chronic pulmonary disease, cerebrovascular disease, dementia, depression, diabetes mellitus, dialysis, gastrointestinal bleed, hypertension, prior myocardial infarction, peripheral vascular disease, and chronic kidney disease. In addition, we considered measures of health services utilization in the year before death, including average number of physician visits, number of medications, duration of

hospital stays, Charlson comorbidity index,<sup>16</sup> and use of nursing home. Finally, we determined the source of hospice referrals and enrollment (emergency department vs. acute care hospital vs. nursing home vs. other sites, such as a patient's home).

### Statistical Analyses

Descriptive statistics that included frequencies and means with SDs were used to summarize baseline clinical characteristics. Univariate comparisons between the heart failure and cancer cohorts were conducted with Chi-square and Wilcoxon rank sum tests for categorical and continuous variables, respectively. To identify potential factors associated with late hospice enrollment, early discharge from hospice, use of acute care, and death in an acute care setting, separate multivariate logistic regression models were constructed to estimate odds ratios (ORs) with corresponding 95% CI. Multivariate analyses adjusted for demographic variables, prior medical diagnoses, health services utilization, year of hospice admission, and source of hospice referral. All statistical analyses were performed with SAS version 9.2 (SAS Institute, Inc., Cary, NC).

## Results

### Baseline Patient Characteristics

We identified 7930 heart failure patients and 7565 cancer patients who were enrolled in PACE between 1997 and 2004 and died of cardiac and cancer causes, respectively. From these groups, 1580 (20%) heart failure patients and 3840 (51%) cancer patients were admitted to hospice at least once before their death. Compared with hospice patients with cancer, those with heart failure were older (mean age 86 vs. 80 years) and more likely to be women (82% vs. 68%). In addition, heart failure patients were substantially more likely to have diagnoses of cognitive disorders (36% vs. 19%), diabetes (50% vs. 30%), and chronic kidney disease (53% vs. 18%) than those of cancer patients (Table 1). Chronic lung diseases and hypertension were equally prevalent in both patient cohorts. Interestingly, 33% of patients who enrolled with cancer also had a history of heart failure. Individuals who enrolled with heart

Table 1  
Baseline Characteristics of Hospice Patients With End-Stage Heart Failure and Terminal Cancer

Baseline Characteristics	Heart Failure Cohort (N = 1580)	Cancer Cohort (N = 3840)
<b>Demographics</b>		
Age (years)	86.0 (6.7)	80.1 (6.9)
Gender (female)	1291 (82)	2608 (68)
Race (white)	1526 (97)	3610 (94)
<b>Medical diagnoses</b>		
Prior CHF	1221 (77)	1452 (38)
Atrial fibrillation	1077 (68)	896 (23)
Coronary artery disease	1414 (89)	1821 (47)
Chronic pulmonary disease	966 (61)	1909 (50)
Cerebrovascular disease	680 (43)	976 (25)
Dementia	573 (36)	641 (17)
Depression	561 (36)	836 (22)
Diabetes mellitus	792 (50)	1144 (30)
Dialysis	34 (2)	21 (1)
GI bleed	216 (14)	335 (9)
Hypertension	1097 (69)	2040 (53)
Prior MI	294 (19)	105 (3)
Peripheral vascular disease	798 (51)	917 (24)
Chronic kidney disease	833 (53)	687 (18)
<b>Health services use</b>		
Number of physician visits	8.5 (8.1)	13.7 (11.7)
Number of medications	13.9 (8.7)	13.2 (6.6)
Number of hospital days	25.7 (22.5)	13.4 (15.2)
Charlson comorbidity score	5.8 (2.6)	7.4 (2.9)
Nursing home use	489 (31)	1058 (28)
<b>Hospice admission year</b>		
1997	138 (8)	640 (17)
1998	144 (9)	534 (14)
1999	158 (10)	515 (13)
2000	194 (12)	523 (14)
2001	217 (14)	478 (12)
2002	234 (15)	534 (14)
2003	260 (17)	339 (9)
2004	235 (15)	277 (7)

CHF = congestive heart failure; GI = gastrointestinal; MI = myocardial infarction.

Values represent *n* (%) for categorical variables and mean (SD) for continuous variables.

failure had longer average hospital stays, but fewer outpatient physician visits than those with cancer.

### Enrollment Patterns and Clinical Courses

Substantial differences were observed in the enrollment patterns and subsequent clinical courses for the two cohorts of patients (Table 2). In comparison to cancer patients, heart failure patients were more frequently referred to hospice care from acute care hospitals (35% vs. 24%,  $P < 0.001$ ) and from nursing homes (9% vs. 7%,  $P < 0.001$ ). Conversely, it was more common for those with cancer to be referred from home (67% vs. 53%,  $P < 0.001$ ). Slightly more heart failure patients were

Table 2  
Enrollment Patterns and Clinical Courses of Hospice Patients With End-Stage Heart Failure vs. Terminal Cancer

Enrollment/Clinical Course	Heart Failure Cohort (N= 1580), %	Cancer Cohort (N= 3840), %	P-value
Referral to hospice from			
Emergency department	3	2	0.12
Acute care hospital	35	24	<0.001
Nursing home	9	7	<0.001
Other (including home)	53	67	<0.001
Discharge from hospice before death	10	9	0.03
Time between hospice enrollment and death			
Median (range), in days	12 (4–41)	20 (8–51)	<0.001
≤3	20	11	<0.001
4–7	19	13	<0.001
8–30	31	37	<0.001
31–180	25	35	<0.001
>180	5	4	0.30
≥1 visit to the emergency department after hospice enrollment	13	10	0.004
≥1 acute care hospitalization after hospice enrollment	9	6	<0.001
Death in acute care setting	4	2	<0.001

discharged from hospice before death. Among those who remained in hospice until death, the median interval between enrollment and death was shorter for heart failure patients (12 vs. 20 days,  $P < 0.001$ ). A higher proportion of heart failure patients were admitted in the terminal days of disease (seven days or less before death). After hospice enrollment, emergency department visits and hospitalizations were more prevalent in the cohort of patients with heart failure (13% vs. 10%,  $P = 0.004$  and 9% vs. 6%,  $P < 0.001$ , respectively). Although the overall percentage was low, death in acute care settings was twice as common in heart failure patients (4% vs. 2%,  $P < 0.001$ ).

#### Factors Associated With Enrollment to and Events After Hospice

Table 3 illustrates the factors associated with late enrollment in and early discharge from hospice care, and Table 4 depicts the factors associated with the use of and death in acute care. After considering observed differences in the characteristics of heart failure patients and cancer patients, those with heart failure had significantly higher odds of enrolling in hospice late in the disease course (OR 1.49, 95% CI 1.20–1.85), being discharged from hospice before death (OR 1.11, 95% CI 1.02–1.35), and using acute care after hospice (OR 1.46, 95% CI 1.09–1.94) compared with those with cancer. Later calendar year of hospice admission was associated with a greater probability of enrollment within seven days of death (OR 1.05 per

subsequent calendar year, 95% CI 1.02–1.09) and a similar reduced probability of discharge from hospice before death (OR 0.91 per year, 95% CI 0.87–0.95). It also was correlated with patterns of care after hospice enrollment whereby patients in more recent years were less likely to use (OR 0.93 per year, 95% CI 0.90–0.97) and die in (OR 0.87 per year, 95% CI 0.80–0.94) acute care settings.

Source of hospice enrollment also was a determinant of outcomes. In comparison with referrals from home, patients referred from either acute care or nursing homes were more likely to be enrolled late (OR 1.81, 95% CI 1.56–2.09 and OR 1.84, 95% CI 1.45–2.35, respectively). However, those referred from hospitals or nursing homes had decreased odds of leaving hospice early (OR 0.69, 95% CI 0.54–0.87 and OR 0.45, 95% CI 0.30–0.69, respectively) or using acute care (OR 0.71, 95% CI 0.58–0.88 and OR 0.65, 95% CI 0.45–0.93, respectively) after hospice enrollment, likely because they had extreme end-stage disease. In our sensitivity analyses, similar results were obtained when we modified the definition of late enrollment to three days or less before death and explored emergency department visits and hospitalizations individually as markers of acute care use.

#### Discussion

The present study used U.S. health care utilization data to compare patterns of referral,

Table 3  
Factors Associated With Late Enrollment in and Early Discharge From Hospice in Heart Failure and Cancer Patients

Clinical Characteristics	Enrollment Within Seven Days of Death		Discharge From Hospice Before Death	
	OR (95% CI)	P	OR (95% CI)	P
<b>Illness</b>				
Heart failure (vs. cancer)	1.49 (1.20–1.85)	<0.001	1.11 (1.02–1.35)	0.04
<b>Demographics</b>				
Age (per year)	1.00 (0.99–1.01)	0.85	1.00 (0.98–1.01)	0.65
Gender (women)	0.93 (0.80–1.08)	0.33	0.96 (0.77–1.20)	0.73
Race (white)	1.13 (0.84–1.53)	0.41	0.78 (0.52–1.15)	0.21
<b>Medical diagnoses</b>				
Prior CHF	1.00 (0.86–1.16)	0.99	1.20 (0.96–1.49)	0.11
Atrial fibrillation	1.10 (0.95–1.28)	0.19	1.00 (0.80–1.25)	0.99
Coronary artery disease	1.02 (0.87–1.19)	0.85	1.10 (0.87–1.38)	0.45
Chronic pulmonary disease	1.14 (1.00–1.31)	0.06	0.97 (0.79–1.19)	0.74
Cerebrovascular disease	1.09 (0.94–1.27)	0.25	0.87 (0.70–1.09)	0.23
Dementia	1.02 (0.87–1.20)	0.80	1.05 (0.82–1.33)	0.71
Depression	0.98 (0.84–1.14)	0.77	1.15 (0.92–1.44)	0.22
Diabetes mellitus	0.97 (0.84–1.13)	0.71	1.10 (0.89–1.37)	0.38
Dialysis	2.67 (1.50–4.75)	0.001	0.44 (0.13–1.47)	0.18
GI bleed	1.21 (1.00–1.48)	0.06	1.02 (0.75–1.39)	0.91
Hypertension	1.10 (0.95–1.26)	0.20	0.86 (0.70–1.06)	0.16
Prior MI	1.05 (0.83–1.32)	0.71	1.07 (0.75–1.54)	0.70
Peripheral vascular disease	0.99 (0.85–1.14)	0.85	0.87 (0.70–1.08)	0.20
Chronic kidney disease	1.05 (0.90–1.24)	0.52	1.20 (0.95–1.51)	0.13
<b>Health services use</b>				
Number of physician visits	1.01 (1.00–1.02)	0.001	0.99 (0.98–1.00)	0.01
Number of medications	0.99 (0.98–1.00)	0.06	1.00 (0.98–1.01)	0.61
Number of hospital days	1.01 (1.00–1.01)	0.02	1.00 (0.99, 1.00)	0.19
Charlson comorbidity score	1.01 (0.98–1.05)	0.53	1.07 (1.02–1.13)	0.005
Nursing home use	1.04 (0.89–1.22)	0.64	1.78 (1.42–2.22)	<0.001
<b>Hospice admission year</b>				
Per subsequent calendar year	1.05 (1.02–1.09)	0.001	0.91 (0.87–0.95)	<0.001
<b>Referral to hospice from</b>				
Emergency department	2.96 (2.03–4.31)	<0.001	0.63 (0.30–1.32)	0.22
Acute care hospital	1.81 (1.56–2.09)	<0.001	0.69 (0.54–0.87)	0.002
Nursing home	1.84 (1.45–2.35)	<0.001	0.45 (0.30–0.69)	<0.001

CHF = congestive heart failure; GI = gastrointestinal; MI = myocardial infarction.

use of acute services, and death among hospice patients with either heart failure or cancer over a period of multiple years. Whereas patients with advanced heart failure or cancer are known to experience significant symptom burdens near the end of life, few studies have directly compared the clinical courses of these two populations after hospice enrollment. This is the first population-based study to our knowledge that specifically compares sources of hospice referrals and examines acute care utilization after hospice enrollment between heart failure patients and cancer patients. Overall, individuals with end-stage heart failure were more frequently referred to hospice from acute care hospitals and nursing facilities than from the patient's home. We also found that heart failure patients were referred to hospice services later in the course of their

disease, were slightly more likely to leave hospice before death, and had higher rates of acute care use and death in acute care compared with cancer patients.

Our findings on timing of referrals in both the heart failure and cancer cohorts are largely consistent with prior research. In a preliminary study, Bain et al.<sup>7</sup> described suboptimal hospice use in those who died of heart failure compared with those who died of cancer. Specifically, heart failure patients were more likely to receive hospice care for six months or more (7.6% vs. 1.1%,  $P < 0.001$ ), and they also were more likely to be discharged from hospice alive (19.0% vs. 11.3%,  $P < 0.001$ ).<sup>7</sup> A Medicare report also indicated that the mean duration in hospice was longer for heart failure patients than for cancer patients.<sup>9</sup> Similarly, we have previously reported that only

Table 4  
Factors Associated With Use of and Death in Acute Care Among Heart Failure and Cancer Patients Enrolled in Hospice

Clinical Characteristics	Use of Acute Care		Death in Acute Care	
	OR (95% CI)	P	OR (95% CI)	P
<b>Illness</b>				
Heart failure (vs. cancer)	1.46 (1.09–1.94)	0.01	1.40 (0.80–2.46)	0.24
<b>Demographics</b>				
Age (per year)	0.99 (0.98–1.01)	0.25	0.99 (0.97–1.02)	0.74
Gender (women)	1.03 (0.85–1.25)	0.78	0.97 (0.66–1.42)	0.88
Race (white)	0.80 (0.56–1.14)	0.21	0.81 (0.40–1.64)	0.56
<b>Medical diagnoses</b>				
Prior CHF	1.32 (1.09–1.60)	0.005	1.16 (0.78–1.70)	0.47
Atrial fibrillation	1.09 (0.89–1.32)	0.41	1.37 (0.94–2.02)	0.10
Coronary artery disease	1.05 (0.86–1.29)	0.64	1.66 (1.05–2.63)	0.03
Chronic pulmonary disease	1.05 (0.88–1.25)	0.61	1.34 (0.92–1.95)	0.12
Cerebrovascular disease	0.85 (0.70–1.04)	0.11	0.84 (0.57–1.24)	0.37
Dementia	1.16 (0.94–1.43)	0.17	1.02 (0.67–1.55)	0.93
Depression	1.15 (0.94–1.39)	0.17	1.22 (0.83–1.79)	0.31
Diabetes mellitus	0.96 (0.79–1.16)	0.67	1.10 (0.75–1.61)	0.62
Dialysis	0.47 (0.17–1.33)	0.15	1.12 (0.33–3.79)	0.86
GI bleed	1.15 (0.88–1.50)	0.32	1.12 (0.68–1.85)	0.66
Hypertension	1.07 (0.90–1.29)	0.44	0.99 (0.68–1.43)	0.95
Prior MI	1.05 (0.76–1.44)	0.78	1.03 (0.59–1.79)	0.92
Peripheral vascular disease	0.82 (0.68–1.00)	0.04	0.85 (0.58–1.24)	0.40
Chronic kidney disease	1.11 (0.90–1.36)	0.34	1.28 (0.85–1.92)	0.23
<b>Health services use</b>				
Number of physician visits	0.99 (0.98–1.00)	0.09	1.00 (0.99–1.02)	0.77
Number of medications	1.01 (0.99–1.02)	0.24	0.98 (0.96–1.02)	0.20
Number of hospital days	0.99 (0.98–1.00)	0.04	1.00 (0.99–1.01)	0.38
Charlson comorbidity score	1.07 (1.03–1.12)	0.001	1.05 (0.96–1.15)	0.25
Nursing home use	1.14 (0.93–1.40)	0.20	0.69 (0.45–1.05)	0.08
<b>Hospice admission year</b>				
Per subsequent calendar year	0.93 (0.90–0.97)	0.001	0.87 (0.80–0.94)	<0.001
<b>Referral to hospice from (vs. home)</b>				
Emergency department	0.56 (0.29–1.08)	0.08	1.86 (0.73–4.78)	0.20
Acute care hospital	0.71 (0.58–0.88)	0.001	1.46 (1.01–2.11)	0.04
Nursing home	0.65 (0.45–0.93)	0.02	0.57 (0.22–1.46)	0.24

CHF = congestive heart failure; GI = gastrointestinal; MI = myocardial infarction.

20% of heart failure patients were ever referred to hospice compared with more than 50% of cancer patients.<sup>8</sup> Similarly, fewer patients with heart failure than with cancer were adequately supported with prescription opioids in the months preceding death.<sup>8</sup> Consistent with these findings, our current analyses revealed that patients in the heart failure cohort were generally admitted to hospice late (seven days or less before death). We also found that heart failure patients were more likely to visit emergency departments and get hospitalized as well as die in acute care settings than patients in the cancer group.

Several factors may explain the potentially different patterns of hospice use in heart failure patients. First, physicians may be less able to recognize the prognosis of end-stage heart failure because the trajectory of the condition is unpredictable and outcomes may be more

variable than cancer.<sup>10,11</sup> Supporting this hypothesis are studies indicating that many physicians are unable to reliably predict six-month mortality in heart failure and that most tend to overestimate survival in these patients.<sup>17</sup> Second, both physicians and patients may be reluctant to discuss limited life expectancy. Physicians may fear that conversations about palliative care and hospice referral would elicit negative responses from patients, whereas patients and their families might not be receptive to hearing information about end-of-life preferences.<sup>18,19</sup> The acceptance of palliative care and hospice use in cardiology has not been studied, and may be less than that of oncology, in part the result of less formal training and exposure to palliative care. In contrast, oncology has traditionally placed a significant emphasis on symptom palliation as a routine part of comprehensive care.<sup>20</sup>

Third, heart failure-specific hospice services may not be as readily available as cancer-related hospice services, thus making it difficult to facilitate prompt referrals.<sup>21</sup> Finally, there could be inherent differences between heart failure patients and cancer patients, specifically in terms of their preferences for treatment aggressiveness at the end of life as well as their needs for intravenous or mechanical therapies to treat symptoms and maintain well-being.<sup>22,23</sup>

One of the distinguishing features of this study is its characterization of hospice referral patterns as well as acute care use after hospice enrollment, which to date have not been described or compared between heart failure and cancer patients. The observation that most heart failure referrals to hospice were generated in acute care hospitals and nursing home facilities suggests that these referrals were likely prompted by health care providers rather than patients themselves. This contrasts with cancer patients where most referrals originated from noninstitutional settings such as personal homes, possibly reflecting patient- or family-initiated referrals. Reasons for this difference are unclear but may reflect the lack of coordination among outpatient palliative care services for heart failure patients. There has been a growing body of evidence as well as general acceptance within the oncology community that early introduction of palliative care for metastatic cancer patients is associated with both better psychosocial adjustments and improved quality of death.<sup>24,25</sup> Increasing recognition among oncologists toward the value of timely end-of-life care may be another potential reason for the difference in enrollment patterns. Future work should evaluate whether educational interventions that emphasize the importance of hospice and supportive care programs can improve the rate of patient-initiated referrals for heart failure. Similarly, it would be important to assess if better access to outpatient palliative care services for heart failure patients can optimize end-of-life outcomes by minimizing the frequency of acute care use and the number of deaths in acute care settings after hospice enrollment.

There were several limitations to this study. First, our analyses only included elderly fee-for-service Medicare beneficiaries who participated

in the PACE program in Pennsylvania. Thus, the study findings may not be completely representative of younger or high-income patients and cannot be generalized to other jurisdictions. Second, it is possible that acute care and emergent procedures may be justified in certain circumstances even after hospice enrollment. Inherent to administrative claims data; however, we could not reliably provide information on the reasons for acute care services use and, therefore, we assumed that all acute care was inappropriate. Third, we selected narrow definitions of acute care and late enrollment to hospice based solely on claims data. Reassuringly, sensitivity analyses using different definitions for these various outcomes yielded very consistent results. Fourth, we did not evaluate other palliative care interventions, such as receipt of supportive care and pain medications, in our analyses. Finally, unlike some prior studies, we retrospectively identified the end-of-life period and only included patients who died during the study period,<sup>12</sup> primarily because of limitations of the data source. Therefore, the results may not reflect those who had prolonged survival after hospice enrollment.

In summary, we found that among those who received hospice care before death, heart failure patients were more likely to enter hospice closer to end of life and more likely to use and die in acute care settings than cancer patients. Heart failure patients were most frequently referred to hospice from acute hospitals and long-term facilities. Further research is needed to elucidate the physician, patient, and system factors for the low hospice use among heart failure patients. Interventions are needed to help stakeholders recognize the importance of palliative and hospice care so that improvements can be made to the end-of-life phase of both heart failure patients and cancer patients.

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