Care in the Last Year of Life for Community Patients With Heart Failure

Shannon M. Dunlay, MD, MS; Margaret M. Redfield, MD; Ruoxiang Jiang, BS; Susan A. Weston, MS; Véronique L. Roger, MD, MPH

Background—Healthcare utilization peaks at the end of life (EOL) in patients with heart failure. However, it is unclear what factors affect end of life utilization in patients with heart failure and if utilization has changed over time.

Methods and Results—Southeastern Minnesota residents with heart failure were prospectively enrolled into a longitudinal cohort study from 2003 to 2011. Patients who died before December 31, 2012, were included in the analysis. Information on hospitalizations and outpatient visits in the last year of life was obtained using administrative sources. Negative binomial regression was used to assess the association between patient characteristics and utilization. The 698 decedents (47.3% men; 53.4% preserved ejection fraction) experienced 1528 hospitalizations (median 2 per person; range, 0–12; 37.6% because of cardiovascular causes) and 12927 outpatient visits (median 14 per person; range, 0–119) in their last year of life. Most patients (81.5%) were hospitalized at least once and 28.4% died in the hospital. Patients who were older and those with dementia had lower utilization. Patients who were married, resided in a skilled nursing facility, and had more comorbidities had higher utilization. Patients with preserved ejection fraction had higher rates of noncardiovascular hospitalizations although other utilization was similar. Over time, rates of hospitalizations and outpatient visits decreased, whereas palliative care consults and enrollment in hospice increased.

Conclusions—Although patient factors remain associated with differential healthcare utilization at the end of life, utilization declined over time and use of palliative care services increased. These results are encouraging given the high resource use in patients with heart failure. (Circ Heart Fail. 2015;8:489-496. DOI: 10.1161/CIRCHEARTFAILURE.114.001826.)

Key Words: death ■ heart failure ■ hospitalization ■ residence characteristics ■ skilled nursing facilities

Each year in the United States, 275,000 patients die with heart failure (HF).¹ In 2009, 1 in 9 of all deaths listed HF as a contributing cause.¹ By 2030, the number of patients with HF is projected to increase by 25% and the total annual costs of care to rise by 120% to $70 billion.² Although the care of patients with HF is costly and burdensome throughout the disease trajectory,³ utilization including hospitalizations peaks at the end of life (EOL).⁴,⁵ The tremendous burden that EOL care places on patients, caregivers, and the healthcare system has been well recognized,⁶ and there has been an impetus to improve EOL care through many mechanisms, including through the involvement of palliative care specialists in the management of patients with HF.⁷

Clinical Perspective on p 496

However, to develop efficient, patient-centric care pathways, we must first gain a better understanding of the current distribution and predictors of hospitalizations and other healthcare utilization at the EOL and identify whether utilization has changed over time. Recent work has suggested that hospitalization rates for HF have declined,⁸,⁹ but these data fail to capture what happens to patients living with HF as they develop advanced disease and approach EOL. In elderly Medicare beneficiaries from 2000 to 2007, 80% were hospitalized in the past 6 months of life, and costs to Medicare were higher in patients who were younger, had chronic obstructive pulmonary disease, and renal disease.¹⁰ However, it is unknown how utilization may differ in patients with preserved compared with reduced ejection fraction (EF) and how it may be affected by factors such as marital status and palliative care consultation services, which cannot be captured using claims data. Furthermore, contemporary data are needed to delineate whether utilization has changed in recent years.

To fill these knowledge gaps, the primary aim of the study was to systematically examine the factors that predict hospitalizations and outpatient visits in the last year of life in community decedents with HF.

Methods

Study Design

This study was a cohort study conducted in Southeastern Minnesota. This area is relatively isolated from other urban centers, and few providers, the largest of which is Mayo Clinic, deliver the vast majority of medical care to local residents. The Rochester Epidemiology

Downloaded from http://circheartfailure.ahajournals.org by guest on November 10, 2017

Received October 2, 2014; accepted March 19, 2015.
From the Division of Cardiovascular Diseases, Department of Medicine (S.M.D., M.M.R., V.L.R.) and Department of Health Sciences Research (S.M.D., R.J., S.A.W., V.L.R.), Mayo Clinic, Rochester, MN.
Correspondence to Shannon M. Dunlay, MD, MS, Mayo Clinic, 200 First St SW, Rochester, MN 55905. E-mail dunlay.shannon@mayo.edu
© 2015 American Heart Association, Inc.
Circ Heart Fail is available at http://circheartfailure.ahajournals.org
DOI: 10.1161/CIRCHEARTFAILURE.114.001826

489
Project, a medical record linkage system, allows the indexing of medical care for residents, thus enabling the comprehensive capture of health-related events for the community’s residents. The population in this area is representative of the state of Minnesota and the upper Midwest region of the United States. In addition, age- and sex-specific mortality rates were similar for Olmsted County (the largest county in Southeastern Minnesota), the state of Minnesota and the entire United States. Finally, broad disease trends are commensurate to national trends.

Patient Population
Natural language processing of the electronic medical record text was used to identify potential patients with HF. After a clinical visit, documentation is transcribed and appears in the record within 24 hours, making prompt identification of patients with HF possible. The search was restricted to patients who were residents of Olmsted, Dodge, and Fillmore Counties in Minnesota and aged at least 20 years. Experienced research nurses then reviewed the medical record to determine whether patients had active HF meeting Framingham criteria.

Data Collection
Potential Predictors of Healthcare Utilization
Baseline characteristics at the time of study enrollment were collected from the medical record. Resting left ventricular EF was collected from transthoracic echocardiograms performed within 6 months before 2 months after study enrollment. Preserved EF was defined by an EF ≥50%. The Charlson Comorbidity Index was used to assess comorbidity. It is calculated based on the presence or absence of each of the following: myocardial infarction, HF, peripheral vascular disease, cerebrovascular disease, dementia, chronic obstructive pulmonary disease, connective tissue disease, peptic ulcer disease, liver disease, diabetes mellitus, hemiplegia, moderate or severe renal disease, tumor (without metastasis versus metastatic), leukemia, lymphoma, and AIDS. All patients had HF. Diabetes mellitus was defined by American Diabetes Association Criteria or use of diabetic medications. History of myocardial infarction was defined using standard epidemiological criteria. Estimated glomerular filtration rate was calculated based on creatinine measured closest to the time of study enrollment using the modification of diet in renal disease equation, and moderate to severe renal disease was defined as an estimated glomerular filtration rate <60 mL/min per 1.73 m². The remaining comorbidities were defined using physician diagnosis and billing codes. Body mass index was calculated using the last outpatient weight and the earliest adult height, and overweight/obese was defined as body mass index ≥25 kg/m². We determined whether a patient was cared for in a skilled nursing facility (SNF) in their last year of life using administrative billing codes and confirmed using manual chart review. The duration of stay in a SNF was not available. Patients were classified as married if they were married or living with a partner. Age at death was divided into quartiles (<75, 75–83, 84–89, and ≥90 years). Year of death was categorized as 2003–2006, 2007–2009, and 2010–2012. Hospice enrollment and palliative care were identified using manual chart review.

Healthcare Utilization
We examined healthcare utilization at the EOL, which was defined as hospitalizations and outpatient visits in the year before death or from the time from HF diagnosis until death if ≤1 year. The date of death was determined using death certificates filed in Olmsted County, obituary notices, and electronic files of death certificates obtained from the State of Minnesota Department of Vital and Health Statistics. Cause of death was obtained from death certificates; cardiovascular cause of death was defined by the International Classification of Diseases (ICD)-Tenth revision codes 101–199. Information on hospitalizations and outpatient visits in Olmsted County was obtained from the Olmsted County Healthcare Expenditure and Utilization Database. Transfers between hospitals were considered a single hospitalization. The primary reason for admission was categorized as cardiovascular (ICD-9 codes 390–459) or noncardiovascular (all other codes) based on principal ICD-9 code. Outpatient visits were categorized by provider type (cardiologist versus noncardiologist). As we were unable to identify provider type for some visits in the county after July 1, 2010, this analysis was restricted to patients who died prior to that date. Tests, imaging, and outpatient procedures were not counted as outpatient visits and were not quantified.

Statistical Analysis
Baseline patient characteristics by SNF status were compared using t tests for normally distributed continuous variables, Wilcoxon rank-sum tests for non-normally distributed continuous variables, and χ² tests for categorical variables. Negative binomial regression was used to examine the relationship between patient baseline characteristics and the rate of hospitalizations and outpatient visits per person-year of follow-up. Variables with no significant association with healthcare utilization in unadjusted analyses (malignancy, cerebrovascular disease, glomerular filtration rate) were not included in the multivariable models. All models were adjusted for incident versus prevalent status at study enrollment. Patients were divided into quartiles by Charlson Comorbidity Index in the analysis. Predictors of cardiologist visits in the outpatient setting in the last year of life were analyzed using negative binomial regression. Given that the number of cardiologist visits was fewer than other outcomes we examined, only variables that demonstrated a significant relationship with cardiologist visits on bivariate analysis were included in the multivariable model. A 2-sided P value <0.05 was used as the level of significance for all analyses. Analyses were performed using Stata/SE Version 13.0 (College Station, Texas) and SAS version 9.3.

Results
In total, 1369 patients were enrolled in the study (Figure 1). Some patients were excluded from the analysis as they lacked research authorization to examine utilization data or they died...
in the hospital at enrollment. Of the remaining 1243, 698 patients died before December 31, 2012, and are included in the analysis. There were only 2 patients who had an left ventricular assist device implanted before death, and they were retained in the analysis. The median (25th–75th percentile) follow-up time from HF diagnosis until death was 365 (237–365) days. Most decedents (n=486; 69.6%) had a full year of follow-up from HF diagnosis until death. The characteristics of the study population are shown in Table 1. Patients were elderly (mean age, 82 years at death; range, 36–105 years; 8% [n=56] <65-year old at death), 47.3% were men, and 53.4% had preserved EF. Approximately half (n=357; 52.7%) of patients died of a cardiovascular cause, which was more common in patients with reduced EF (57.4% versus 48.9% in preserved EF; P=0.029). In the final year of life, 350 (50.7%) patients were cared for in a SNF. Patients residing in a SNF were older (85 versus 79 years; P<0.001), more often women (63% versus 43%; P<0.001), and more likely to have preserved EF (62% versus 44%; P<0.001).

Table 1. Patient Characteristics

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Missing</th>
<th>Overall (n=698)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at death, mean (SD), y</td>
<td>0</td>
<td>82.2 (10.8)</td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>330 (47.3)</td>
</tr>
<tr>
<td>Ejection fraction, mean (SD), %</td>
<td>18</td>
<td>48.3 (16.2)</td>
</tr>
<tr>
<td>Preserved ejection fraction (≥50%)</td>
<td>18</td>
<td>363 (53.4)</td>
</tr>
<tr>
<td>Comorbidities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>0</td>
<td>622 (89.1)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>0</td>
<td>262 (37.5)</td>
</tr>
<tr>
<td>COPD</td>
<td>0</td>
<td>256 (36.7)</td>
</tr>
<tr>
<td>Prior myocardial infarction</td>
<td>1</td>
<td>214 (30.4)</td>
</tr>
<tr>
<td>Malignancy</td>
<td>0</td>
<td>257 (36.8)</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>0</td>
<td>240 (34.4)</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>0</td>
<td>249 (35.7)</td>
</tr>
<tr>
<td>Dementia</td>
<td>0</td>
<td>50 (7.2)</td>
</tr>
<tr>
<td>eGFR &lt;60 mL/min per 1.73 m²</td>
<td>0</td>
<td>526 (75.4)</td>
</tr>
<tr>
<td>Charlson Comorbidity Index</td>
<td>1</td>
<td>149 (21.4)</td>
</tr>
<tr>
<td>1–2</td>
<td>...</td>
<td>149 (21.4)</td>
</tr>
<tr>
<td>3–4</td>
<td>...</td>
<td>209 (30.0)</td>
</tr>
<tr>
<td>5–6</td>
<td>...</td>
<td>181 (26.0)</td>
</tr>
<tr>
<td>&gt;6</td>
<td>...</td>
<td>158 (22.7)</td>
</tr>
<tr>
<td>Overweight/obese (BMI ≥25 kg/m²)</td>
<td>0</td>
<td>417 (59.7)</td>
</tr>
<tr>
<td>Year of death</td>
<td>0</td>
<td>189 (27.1)</td>
</tr>
<tr>
<td>2003–2006</td>
<td>...</td>
<td>189 (27.1)</td>
</tr>
<tr>
<td>2007–2009</td>
<td>...</td>
<td>268 (38.4)</td>
</tr>
<tr>
<td>2010–2012</td>
<td>...</td>
<td>241 (34.5)</td>
</tr>
<tr>
<td>Married/living with a partner</td>
<td>12</td>
<td>311 (45.3)</td>
</tr>
<tr>
<td>Resided in skilled nursing facility last year of life</td>
<td>7</td>
<td>350 (50.7)</td>
</tr>
</tbody>
</table>

All numbers reported are n (%) unless otherwise noted. BMI indicates body mass index; COPD, chronic obstructive pulmonary disease; and eGFR, estimated glomerular filtration rate.

Healthcare Utilization

At the EOL, 1528 hospitalizations (median 2 per person; range, 0–12) and 12 927 outpatient visits (median 14 per person; range, 0–119) occurred. Hospitalizations and days hospitalized increased in the months before death (Figure 2). In total, 569 (81.5%) patients were hospitalized at least once in their final year of life, and 198 (28.4%) died in the hospital. The median total days hospitalized in the last year was 9 (25th–75th percentile, 3–21; range, 0–160) per person. Of the hospitalizations, 575 (37.6%) were for cardiovascular causes, whereas the remainder were for noncardiovascular causes. The most common reasons for hospitalization were HF (n=322; 21.1% of hospitalizations), pneumonia (n=80; 5.2% of hospitalizations), sepsis (n=66; 4.3% of hospitalizations), and arrhythmia (n=58; 3.8% of hospitalizations).

Predictors of Healthcare Utilization

Several factors were associated with differential EOL utilization; the incidence rate ratios (IRR) predicting hospitalizations and outpatient visits are shown in Table 2 (unadjusted results) and Figure 3 (multivariable results). Lower utilization was seen in patients who were older. Patients who had a greater comorbidity burden, lived in a SNF in the final year of life, and were married had higher utilization.

Hospitalizations

The independent predictors of increased rate of hospitalization included younger age (IRR, 0.52; 95% confidence interval [CI], 0.41–0.65 for those aged ≥90 years compared with <75 years at death), residing in a SNF (IRR, 1.35; 95% CI, 1.16–1.58), being married (IRR, 1.20; 95% CI, 1.02–1.42), and more comorbidities (Charlson Comorbidity Index >6 versus 0–2: IRR, 1.71; 95% CI, 1.36–2.14; Figure 2). When individual comorbidities were included in the models rather than the Charlson Comorbidity Index, chronic obstructive pulmonary disease (IRR, 1.20; 95% CI, 1.03–1.41) and peripheral vascular disease (IRR, 1.29; 95% CI, 1.10–1.51) were associated with increased
hospitalizations and dementia (IRR, 0.64; 95% CI, 0.45–0.91) with decreased hospitalizations (data not shown).

Although younger age and more comorbidities predicted increased rates of cardiovascular and noncardiovascular hospitalizations (Figure 3), being cared for in a SNF at the EOL (IRR, 1.66; 95% CI, 1.37–2.01), being married (IRR, 1.25; 95% CI, 1.03–1.53), and having preserved EF (IRR, 1.20; 95% CI, 1.00–1.43) were only associated with increased noncardiovascular hospitalizations. When examining individual comorbidities, peripheral vascular disease was associated with increased cardiovascular hospitalizations (IRR, 1.66; 95% CI, 1.29–2.14), and dementia with decreased cardiovascular hospitalizations (IRR, 0.45; 95% CI, 0.24–0.84). In contrast, only chronic obstructive pulmonary disease was associated with increased noncardiovascular hospitalizations (IRR, 1.23; 95% CI, 1.02–1.48). Sex, diabetes mellitus, renal dysfunction, malignancy, cerebrovascular disease, body mass index, and prior myocardial infarction were not significant predictors of hospitalization rate.

Although patients who were cared for at a SNF at the EOL had higher rates of hospitalizations, this excess risk was magnified in those who were younger (P value for interaction of age×SNF<0.001 for all-cause, cardiovascular, and noncardiovascular hospitalizations). For example, the IRR for hospitalization among those aged <75 years who were in a SNF compared with those not in a SNF at the EOL was 1.66 (95% CI, 1.18–2.34) versus 1.26 (95% CI, 0.86–1.83) in the oldest SNF residents (aged ≥90 years).

Outpatient Visits

Living in a SNF (IRR, 1.48; 95% CI, 1.29–1.70) and being married (IRR, 1.22; 95% CI, 1.05–1.41) were associated with increased outpatient visits, whereas older individuals had fewer outpatient visits (Figure 3). Neither number of comorbidities (Charlson Comorbidity Index, P for trend=0.061) nor individual comorbidities were associated with differences in rates of outpatient visits. There was a trend toward more outpatient visits in patients with preserved EF (IRR, 1.13; 95% CI, 0.99–1.28).

### Table 2. Unadjusted Predictors of Hospitalizations and Outpatient Visits

<table>
<thead>
<tr>
<th>Variable</th>
<th>All-Cause Hospitalizations</th>
<th>Cardiovascular Hospitalizations</th>
<th>Noncardiovascular Hospitalizations</th>
<th>Outpatient Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.08 (0.92–1.27)</td>
<td>1.29 (1.02–1.64)*</td>
<td>0.97 (0.80–1.18)</td>
<td>1.09 (0.95–1.26)</td>
</tr>
<tr>
<td><strong>Age at death, y</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75–83</td>
<td>1.05 (0.85–1.31)</td>
<td>0.98 (0.71–1.37)</td>
<td>1.10 (0.85–1.42)</td>
<td>1.04 (0.86–1.25)</td>
</tr>
<tr>
<td>84–89</td>
<td>0.73 (0.59–0.91)</td>
<td>0.83 (0.59–1.16)</td>
<td>0.68 (0.52–0.89)</td>
<td>0.75 (0.62–0.91)</td>
</tr>
<tr>
<td>≥90</td>
<td>0.53 (0.42–0.67)†</td>
<td>0.53 (0.37–0.76)†</td>
<td>0.53 (0.40–0.71)†</td>
<td>0.63 (0.53–0.78)†</td>
</tr>
<tr>
<td><strong>Married</strong></td>
<td>1.29 (1.10–1.52)‡</td>
<td>1.30 (1.03–1.65)*</td>
<td>1.29 (1.06–1.56)*</td>
<td>1.27 (1.11–1.45)‡</td>
</tr>
<tr>
<td><strong>Preserved ejection fraction</strong></td>
<td>1.08 (0.92–1.27)</td>
<td>0.84 (0.66–1.07)</td>
<td>1.25 (1.03–1.52)*</td>
<td>1.09 (0.95–1.24)</td>
</tr>
<tr>
<td><strong>Lived in a skilled nursing facility</strong></td>
<td>1.22 (1.04–1.43)*</td>
<td>0.88 (0.70–1.12)</td>
<td>1.49 (1.24–1.81)†</td>
<td>1.25 (1.09–1.42)‡</td>
</tr>
<tr>
<td><strong>Charlson comorbidity quartiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3–4</td>
<td>1.24 (0.99–1.56)</td>
<td>1.08 (0.77–1.52)</td>
<td>1.35 (1.02–1.78)</td>
<td>1.04 (0.86–1.26)</td>
</tr>
<tr>
<td>5–6</td>
<td>1.36 (1.08–1.72)</td>
<td>1.34 (0.95–1.91)</td>
<td>1.36 (1.02–1.81)</td>
<td>1.15 (0.95–1.39)</td>
</tr>
<tr>
<td>&gt;6</td>
<td>1.98 (1.56–2.50)†</td>
<td>2.07 (1.45–2.95)†</td>
<td>1.89 (1.42–2.52)†</td>
<td>1.33 (1.09–1.63)‡</td>
</tr>
<tr>
<td><strong>Individual comorbidities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.22 (1.04–1.43)*</td>
<td>1.21 (0.95–1.54)</td>
<td>1.23 (1.01–1.49)*</td>
<td>1.15 (1.00–1.32)</td>
</tr>
<tr>
<td>COPD</td>
<td>1.33 (1.13–1.57)†</td>
<td>1.27 (0.99–1.63)</td>
<td>1.34 (1.10–1.64)‡</td>
<td>1.11 (0.97–1.27)</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>1.38 (1.17–1.63)†</td>
<td>1.80 (1.41–2.30)†</td>
<td>1.15 (0.94–1.41)</td>
<td>1.09 (0.95–1.25)</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>1.03 (0.87–1.21)</td>
<td>1.12 (0.87–1.43)</td>
<td>0.98 (0.80–1.19)</td>
<td>1.05 (0.92–1.21)</td>
</tr>
<tr>
<td>eGFR &lt;60 mL/min per 1.73 m²</td>
<td>1.00 (0.83–1.20)</td>
<td>0.96 (0.73–1.26)</td>
<td>1.02 (0.82–1.28)</td>
<td>1.07 (0.92–1.25)</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1.09 (0.93–1.29)</td>
<td>0.98 (0.77–1.26)</td>
<td>1.16 (0.95–1.42)</td>
<td>1.07 (0.93–1.22)</td>
</tr>
<tr>
<td>Dementia</td>
<td>0.55 (0.38–0.80)‡</td>
<td>0.42 (0.22–0.78)‡</td>
<td>0.63 (0.41–0.98)*</td>
<td>0.77 (0.59–1.01)</td>
</tr>
<tr>
<td>Prior myocardial infarction</td>
<td>1.12 (0.95–1.34)</td>
<td>1.32 (1.02–1.70)*</td>
<td>1.00 (0.81–1.24)</td>
<td>1.03 (0.89–1.19)</td>
</tr>
<tr>
<td>Overweight or obese</td>
<td>1.15 (0.98–1.36)</td>
<td>1.21 (0.95–1.55)</td>
<td>1.12 (0.92–1.37)</td>
<td>1.01 (0.88–1.15)</td>
</tr>
<tr>
<td><strong>Year of death</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003–2006</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007–2009</td>
<td>0.71 (0.58–0.87)</td>
<td>0.62 (0.46–0.84)</td>
<td>0.78 (0.61–1.00)</td>
<td>0.91 (0.77–1.07)</td>
</tr>
<tr>
<td>2010–2012</td>
<td>0.52 (0.42–0.64)†</td>
<td>0.51 (0.37–0.69)†</td>
<td>0.54 (0.42–0.70)†</td>
<td>0.67 (0.56–0.79)†</td>
</tr>
</tbody>
</table>

For Charlson Comorbidity Index quartiles, age at death, and year of death, P values are for trend across categories. COPD indicates chronic obstructive pulmonary disease; and eGFR, estimated glomerular filtration rate.

*P<0.05.

†P<0.001.

‡P<0.01.
We also evaluated the predictors of the combined end point of hospitalizations and outpatient visits at the EOL. The findings were similar to the predictors of hospitalizations, with higher rates of care utilization seen in patients who were younger at death, married, cared for in a SNF, had more comorbidities, and died in an earlier year (data not shown). There was a trend toward higher rates of hospitalization and outpatient visits in patients with preserved EF (IRR, 1.13; 95% CI, 0.99–1.28; \( P = 0.065 \)).

In total, 40.5% of patients (201 of 496 who died before July 1, 2010) had an outpatient visit with a cardiologist in the last year of life. Cardiologist visits comprised 9.9% of all outpatient visits. There was no change in the proportion of visits that were to cardiologists (rather than other types of providers) in the months preceding death. Cardiology visits occurred at a higher rate in patients who were younger, men, had reduced EF, were married, did not have dementia, and were not cared for in a SNF in the last year of life (\( P < 0.05 \) for each on bivariate analysis). Adjusting for other factors, cardiologist visits in the last year of life were more common in patients who were married and lower in those who were older, had dementia, and were cared for in a SNF (Table 3).

### Time Trends in Healthcare Utilization

All utilization decreased over time. The proportion of patients who died in the hospital decreased over time from 32.8% in 2003–2006 to 22.4% in 2010 to 2012 (\( P \) trend=0.019). The rate of hospitalizations was 46% less for patients who died from 2010 to 2012 and 31% less for those who died from 2007 to 2009 when compared with the rate of hospitalizations for patients who died from 2003 to 2006 (IRR, 0.54 and 0.69, respectively, \( P \) for trend <0.001; Figure 3). Similarly, the rate of outpatient visits was 32% less for those who died in 2010 to 2012 when compared with the rate of outpatient visits for those who died in 2003 to 2006. Trends were similar in patients with preserved and reduced EF.

### Time Trends in Palliative and Hospice Care

In total, 242 (35.4%) patients enrolled in hospice a median (25th–75th percentile) of 21 (4–64) days before death. The use of hospice services increased over time from 28.7% in 2003 to 2006 to 42.2% in 2010 to 2012 (\( P \)<0.001; Figure 4). Palliative care consultations were obtained in 182 (26.5%) patients at a median (25th–75th percentile) of 27 (5–149) days before death and also increased over time. There was no change in the proportion of patients residing in a SNF at the EOL (51.3% in 2003–2006; 50.2% in 2007–2009; and 50.6% in 2010–2012).

### Discussion

There were several important findings from this analysis of a community cohort of decedents with HF. First, patients who were older and had dementia had lower utilization at the EOL, whereas patients who were married, had more comorbidities, and were cared for at a SNF had higher utilization. Second, we saw a dramatic decline in healthcare utilization at the EOL over time, concordant with increases in palliative care consultations and hospice enrollment. Third, healthcare utilization

---

**Table 3. Predictors of Cardiology Visits in the Last Year of Life**

<table>
<thead>
<tr>
<th>Patient Characteristics*</th>
<th>Incidence Rate Ratio (95% CI)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at death (per 1 y increase)</td>
<td>0.96 (0.94–0.98)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male</td>
<td>1.21 (0.81–1.82)</td>
<td>0.35</td>
</tr>
<tr>
<td>Preserved ejection fraction (≥50%)</td>
<td>0.83 (0.57–1.22)</td>
<td>0.34</td>
</tr>
<tr>
<td>Dementia</td>
<td>0.22 (0.09–0.54)</td>
<td>0.001</td>
</tr>
<tr>
<td>Married/living with a partner</td>
<td>2.43 (1.64–3.61)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Resided in skilled nursing facility last year of life</td>
<td>0.39 (0.26–0.57)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* CI indicates confidence interval.

*Variables that were significant (\( P < 0.05 \)) with cardiology visits in univariate analysis were included in the multivariable model.
Impact of Patient Characteristics on Utilization

Most patients were hospitalized at least once in the last year of life, many were hospitalized multiple times and one-fourth spent >3 weeks hospitalized. Although we expected to see lower utilization in those who were older, consistent with findings in Medicare beneficiaries, we also saw lower utilization in those with dementia. In contrast, previous studies have suggested that elderly Medicare beneficiaries with newly diagnosed dementia are at higher risk for hospitalization than people without dementia. The lower utilization in patients with dementia at EOL seen herein may reflect a conscious choice to adopt a palliative approach to care given recognition of adverse prognosis associated with HF and is worthy of additional analysis in future studies.

Conversely, utilization was higher in patients with more comorbidities. The comorbidity burden of patients with cardiovascular diseases such as HF has risen over time and portends adverse prognosis. Herein, we found that utilization at the EOL rose with increasing comorbidity burden. Therefore, patients with HF and multimorbidity are high utilizers of services at the EOL, and care pathways that are not HF specific, but rather encompass the growing population of patients with multimorbidity, need to be developed. Although hospitalizations increased with greater comorbidity burden, we saw no difference in the rate of outpatient visits. Further data are needed to understand this pattern and to explore whether increased outpatient care could decrease use of emergency services.

We were surprised to find higher utilization in those who were married. Marriage has historically been considered protective against adverse outcomes in patients with cardiovascular disease, readmissions, and hospitalizations for some conditions such as pneumonia. However, we found that married individuals had higher rates of hospitalization and outpatient visits at the EOL. These findings require further exploration in future studies.

We also saw higher utilization in patients who were cared for at a SNF. One potential explanation is that SNF care may be more frequently used in patients with more complex disease or less psychosocial support, thereby predisposing them to readmissions and higher healthcare use. Similarly, Allen et al found a higher risk of 30-day readmission in patients with HF who were discharged to a SNF compared with those who were not.

We found few differences in EOL utilization in patients with preserved compared with reduced EF. Although patients with preserved EF had a slightly higher risk of noncardiovascular hospitalizations, there was no difference in overall risk of hospitalization, and the risk of outpatient visits was similar. This finding is in alignment with prior work demonstrating no difference in hospitalization risk or 5-year costs in patients with EF.

Patient characteristics also had an impact on the type of provider seen at the EOL. Patients who were older, not married, had dementia, and were cared for in a SNF were less likely to see a cardiologist in the outpatient setting in the last year of life. This finding is in alignment with other data suggesting that older and more infirm patients are less likely to receive subspecialist care.

Changes in Utilization Over Time

From 2003 to 2012, we saw a marked decline in hospitalizations and outpatient visits at the EOL. Patients were less likely to die in the hospital and more often enrolled in hospice in recent years, which parallels national trends reported by the Centers for Disease Control and in Medicare beneficiaries. We also saw a dramatic increase in palliative care consultations. Although no specific incentives or systems were in place to prompt these consultations, this may reflect increased recognition by clinicians of the importance of palliative care in patients with HF approaching the EOL. Although we were not poised to directly examine whether increased use of palliative care consultations and hospice care led to decreased utilization, both have been shown to decrease hospitalizations and the odds of in-hospital death. Although our data do not inform us whether these shifting patterns of care are in alignment with patient preferences and resulted in improved quality of life, it has been established that most Americans prefer to die at home and hospice improves caregiver satisfaction with care. Although we found that palliative care consultations increased markedly during the study period, other healthcare systems without access to this resource may not see the same temporal trends.

Limitations and Strengths

Several factors should be considered when interpreting these data. We do not have information on the duration patients resided in a SNF at the EOL, which would be of interest to examine in future studies. Although commonly used in health services research, administrative data have limitations. For example, reliance on billing codes to identify the primary reason for hospitalization may result in misclassification. Healthcare utilization outside of the county was not captured. However, comparison with Medicare data would suggest that only 5% of all hospitalizations for elderly residents of Olmsted County occur outside of the county. Participants in the study were, on average, younger than nonparticipants, which should be considered when interpreting study results. As we thoroughly investigated the association between multiple characteristics and outcomes, the possibility that multiple
testing could contribute to finding an association that does not exist cannot be excluded. However, this study has several notable strengths. We captured hospitalizations and outpatient visits at the EOL in a well-characterized group of decedents with HF. We were able to capture data such as marital status and EF that are generally not available in large insurance claims databases. This cohort includes patients with a wide range of age, EF, and comorbidity burden, thus providing a comprehensive depiction of the range of those dying with HF in the community.

Clinical Implications

The population of patients with HF continues to evolve, and a growing number of patients have multimorbidity. Multiple comorbid conditions in addition to HF can make it challenging to provide comprehensive patient care throughout the HF trajectory, but also at the EOL. These data underscore the high utilization in this population and highlight the need for EOL care pathways that encompass patients with a high comorbidity burden. Care directed only at the patient’s HF may not decrease utilization. The concurrent trends of increased utilization of palliative and hospice services and decreased overall healthcare utilization at the EOL are notable. It will be critical to continue to identify appropriate triggers and barriers to palliative care involvement in the care of patients with advanced HF and to equip clinicians with the knowledge and tools that they need to practice primary palliative care themselves.41

Conclusions

Care at the EOL has changed over time in community patients with HF. We saw increased consultations with palliative care specialists, increased enrollment in hospice, and decreased utilization at the EOL. Although these are important changes that deserve acknowledgment, healthcare utilization at the EOL remains high in patients in certain patient subgroups, including those who have multimorbidity and those cared for in SNF, and further work is needed to define and achieve optimal EOL care in these populations.

Sources of Funding

This work was supported by grants from the National Institutes of Health (R01 HL72435 [Dr Roger] and K23 HL116643 [Dr Dunlay]).

Disclosures

None.

References


classifying prognostic comorbidity in longitudinal studies: development

J, Knowler WC, Lebovitz H, Lerman B, Nathan D, Palmer J, Rizza R,
Saudek C, Shaw J, Steffes M, Stern M, Tuomilehto J, Zinman B, Expert
Committee on the Diagnosis and Classification of Diabetes Mellitus.
2003;26:3160–3167.

18. Roger VL, Killian J, Henkel M, Weston SA, Goraya Y, Yawn BP,
Kotke TE, Frye RL, Jacobsen SJ. Coronary disease surveillance in
Olmsted County objectives and methodology. *J Clin Epidemiol.*

S, Kusek JW, Van Lente F. Chronic Kidney Disease Epidemiology
Collaboration. Using standardized serum creatinine values in the modi-
fication of diet in renal disease study equation for estimating glomerular

20. Leibson CL, Katris SC, Barbaresi WJ, Ransoms J, O’Brien PC. Use and
costs of medical care for children and adolescents with and without

21. Phelan EA, Borsorn S, Grothauss L, Balch S, Larson EB. Association of

associated hospitalizations in the United States. *J Am Coll Cardiol.*

23. Glynn LG, Buckley B, Reddan D, Newell J, Hinde D, Dinneen SF,
Murphy AW. Multimorbidity and risk among patients with established
Cardiovascular disease: a cohort study. *Br J Gen Pract.* 2008;58:488–
494. doi: 10.3399/bjgp08x0194599.

24. Chandra V, Sokol M, Goldberg R, Tonascia J. The impact of marital sta-
tus on survival after an acute myocardial infarction: a population-based

25. King KB, Reis HT. Marriage and long-term survival after coronary

26. Garrison GM, Mansukhani MP, Bohn B. Predictors of thirty-day read-
mission among hospitalized family medicine patients. *J Am Board Fam

27. Mor A, Ulrichsen SP, Svensson E, Berencins K, Thomsen RW. Does marriage
protect against hospitalization with pneumonia? A population-based case-

28. Allen LA, Hernandez AF, Peterson ED, Curtis LH, Dui D, Masoudi FA,
Bhatt DL, Heidenreich PA, Fonarow GC. Discharge to a skilled nurs-
ing facility and subsequent clinical outcomes among older patients
hospitalized for heart failure. *Circ Heart Fail*. 2011;4:293–300. doi:
10.1161/CIRCHEARTFAILURE.110.959171.

29. Smith GL, Masoudi FA, Vaccarino V, Radford MF, Krumholz HM.
Outcomes in heart failure patients with preserved ejection fraction:
readmission, and functional decline. *J Am Coll Cardiol.*
2003;41:1510–1518.

30. Liao L, Jollis JG, Anstrom KJ, Whellan DJ, Kitzman DW, Aurigemma
GP, Mark DB, Schulman KA, Gottlieber JS. Costs for heart failure with
normal vs reduced ejection fraction. *Arch Intern Med*. 2006;166:112–
118. doi: 10.1001/archinte.166.1.112.

Radford MF, Krumholz HM. Predictors of cardiologist care for older pa-

variation in referral from primary to secondary care: cohort study. *BMJ.*
2010;341:c6267.

33. U.S. Department of Health and Human Services. *Health, United States,

34. Teno JM, Gozalo PL, Byrum JP, Leland NE, Miller SC, Morden NE, Scupp
T, Goodeman DC, Mor V. Change in end-of-life care for Medicare beneficia-
ries: site of death, place of care, and health care transitions in 2000, 2005, and

35. Back AL, Li YF, Sales AE. Impact of palliative care case management
on resource use by patients dying of cancer at a Veterans Affairs medical

36. Kelley AS, Deb P, Du Q, Aldridge Carlson MD, Morrison RS. Hospice
enrollment saves money for Medicare and improves care quality across a
number of different lengths-of-stay. *Health Aff (Millwood)*.

37. Higginson IJ, Sen-Gupta GJ. Place of care in advanced cancer: a qualita-

2014.


40. Teno JM, Claridge BR, Casey V, Welch LC, Wite L, Shield R, Mor V.
Family perspectives on end-of-life care at the last place of care. *JAMA.*

41. Quill TE, Abernethy AP. Generalist plus specialist palliative care–creat-

**CLINICAL PERSPECTIVE**

Healthcare utilization peaks at the end of life in patients with heart failure. Patients are often repeatedly hospitalized before death and this occurs despite the fact that most Americans say that they would want to avoid hospitalization at the end of life. In a community cohort of decedents with heart failure, we found that healthcare utilization was higher in patients who were younger, had multiple comorbid conditions, were married, and were cared for in a skilled nursing facility, whereas utilization was lower in those who had dementia. However, rates of hospitalization and outpatient visits in the last year of life decreased dramatically from 2003 to 2012, whereas use of palliative care consultations and enrollment in hospice increased during the same period. These findings are encouraging as they demonstrate clear trends toward increased use of pal-
liative care services at the end of life in this community, which parallel decreased healthcare utilization among decedents. However, several patient groups, including those with multimorbidity and those cared for in skilled settings, have particularly high rates of healthcare utilization in the last year of life and may benefit from further evaluation and intervention to optimize end-of-life care.
Care in the Last Year of Life for Community Patients With Heart Failure
Shannon M. Dunlay, Margaret M. Redfield, Ruoxiang Jiang, Susan A. Weston and Véronique L. Roger

Circ Heart Fail. 2015;8:489-496; originally published online April 1, 2015; doi: 10.1161/CIRCHEARTFAILURE.114.001826

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circheartfailure.ahajournals.org/content/8/3/489

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation: Heart Failure can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation: Heart Failure is online at:
http://circheartfailure.ahajournals.org//subscriptions/