Characteristics and Outcomes of Very Elderly Patients After First Hospitalization for Heart Failure

Rashmee U. Shah, MD; Vivian Tsai, MD; Liviu Klein, MD, MS; Paul A. Heidenreich, MD, MS

**Background**—The very elderly (age 80 years and older) with heart failure (HF) is a growing population that is rarely included in clinical trials. The aim of this investigation was to describe the characteristics and outcomes of very elderly patients after a first HF hospitalization.

**Methods and Results**—We identified very elderly patients (age 80 years and older) discharged with HF from the Veteran’s Administration National Patient Care Database from 1999 to 2008. Outcomes of interest were death during index admission, 30-day and 1-year mortality, and 30-day all-cause and HF readmissions. We used generalized estimating equations to evaluate outcome differences between age groups within the very elderly cohort (ages 80 to 84, 85 to 89, and 90 and older), adjusting for comorbidities, demographics, and clustering by treatment facility. We identified 21,397 very elderly veterans with a first HF hospitalization during the study period. Thirty-day mortality decreased from 14% to 7% (both P<0.001) and 1-year mortality decreased from 49% to 27% (P<0.001). Although these improvements were most notable for patients age 90 and older (1-year mortality improved by 25.9%), the adjusted odds of death within 1 year were highest for the oldest veterans (odds ratio, 1.85; 95% confidence interval, 1.64 to 2.09, using the 80- to 85-year age group as reference). For all patients, 30-day all-cause readmissions remained largely unchanged and did not differ between age groups.

**Conclusions**—Mortality for very elderly HF patients has improved over time, but 30-day readmissions remain frequent. Future studies should identify interventions to reduce cardiac and noncardiac rehospitalization of very elderly HF patients. *(Circ Heart Fail. 2011;4:301-307.)*

**Key Words:** heart failure ■ aging ■ epidemiology ■ outcomes

An aging population and advances in treatments for ischemic heart disease, stroke, and hypertension has led to a heart failure (HF) epidemic over the last 2 decades. More patients are aging with HF, but data for patients ages 80 years and older are limited. Prior investigations define elderly HF patients as age 65 years and older, whereas in reality the mean age at diagnosis is above 75 years old and approaches 80 in the Medicare population. Furthermore, randomized, controlled trials rarely enroll very elderly patients. These factors have led to limited understanding of prognosis and treatment for the oldest HF patients.

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Studies focusing on very elderly HF patients are limited to European cohorts. The Euro Heart Failure Survey, for example, showed important clinical differences among octogenarians with HF compared with younger patients. In addition, the older age group had different mortality and rehospitalization rates. Similar studies in the US populations are lacking, and, given the different structure of our healthcare system and composition of our population, it is plausible that outcomes differ from European cohorts.

The proportion of very elderly HF patients will increase as the population ages, highlighting the need for investigations focusing on the oldest patients. The aim of this study was to describe the characteristics of very elderly patients, defined as age 80 years and older, with a first HF hospitalization. We also evaluated outcome differences within the very elderly population and temporal trends after first HF hospitalizations.

**Methods**

We used data from the Veteran’s Administration (VA) National Patient Care Database. Patients were included if they were 80 years of age or older and had at least 1 hospitalization with a primary discharge diagnosis of HF between 1999 and 2008 (International Classification of Diseases [ICD9] 428, 429.3, 402.01, 402.11, 402.91, 425.xx). Hospitalizations at non-VA facilities, but paid for by the VA, were included. The first admission was used as the index date for those with more than 1 admission during this time period. Patients were categorized into age groups (80 to 84 years old, 85 to 89 years old, and 90 years and older) to allow for comparisons within the very elderly cohort.

Prior comorbidities were included if they appeared as primary or secondary ICD9 codes during a hospitalization or in at least 2 outpatient encounters during the year before index admission. Comorbid conditions were identified using ICD-9-CM diagnostic codes.
coding of the Charlson comorbidity index. Additional comorbidities evaluated but not included in the index were atrial fibrillation or flutter (ICD 427.3), hypertension (ICD 401 to 405), ischemic heart disease (ICD 410 to 414), and depression (ICD 300.4, 301.12, 309, 311).

We calculated the incident HF rate by dividing the number of unique HF admissions by the total number of patients receiving care in the VA for each age group and year. Outcomes of interest were death during the index admission, all-cause mortality within 30 days, 90 days, and 1 year of the index admission, all-cause and HF readmissions within 30 days of the index admission, and discharge location from index admission. We examined changes in these outcomes according to age group and year of index hospitalization. In addition, we analyzed outcomes for black veterans compared with the full cohort to assess differences by race/ethnicity. Readmissions were counted from the date of discharge of the index admission, and 1-year mortality data for 2008 because of incomplete follow-up. Possible discharge locations were nursing homes, other hospitals, boarding houses, hospice, or home. The VA’s Beneficiary Identification Records Locator Subsystem death file and the Social Security Death Index were used to determine survival.

We determined adjusted odds ratios for mortality and readmission for different age groups using generalized estimating equations that controlled for demographics, prior diagnosis, comorbidities present during admission according to the Charlson index, and clustering of patients within facilities.

Statistical analysis was performed using SAS 9.2 software. We used ANOVA (continuous variables) and \( \chi^2 \) tests (categorical variables) to compare baseline characteristics and outcomes between age groups. A test for trend was used to evaluate changes in outcomes according to year of index hospitalization. Given that we made 13 univariate comparisons, a stricter 2-sided probability value of \( P<0.004 \) was considered statistically significant for the univariate analysis.

**Results**

Between 1999 and 2008, 21,397 veterans age 80 years and older had at least 1 admission for HF in the VA system. Patients 80 to 84 years old comprised 62.9% of the very elderly cohort, whereas those older than 90 years comprised 8.1% of the cohort. Admission rates peaked in 2005 and 2006 for 80- to 89-year-olds, whereas rates for those 90 years and older appear to be increasing (Figure 1). The oldest age group had lower burden of comorbid conditions compared with the youngest group (Charlson comorbidity index, 1.53 versus 1.83; \( P<0.001 \)). We observed a stepwise decrease in the prevalence of ischemic heart disease, diabetes, and chronic pulmonary disease with increasing age group. In contrast, renal disease and atrial fibrillation/flutter were more common among those older than 90 years (Table 1).

Mortality rates during the index admission, at 30 days, and at 1 year were highest for veterans ages 90 years and over (Table 2). In this oldest age group, 8.5% died during the index admission, 14.0% died within 30 days, and 45.9% died within 1 year. One-year mortality rate for black veterans (n=2612) was slightly better than 1-year mortality for the full cohort: 35.0% compared with 37.1%.

Thirty-day mortality decreased significantly over time for the entire cohort, from 14.4% in 1999 to 7.3% in 2008 (\( P<0.001 \)). The decrease was greatest for veterans ages 90 years and older, from 21% in 1999 to 10% in 2008 (Figure 2). Thirty-day mortality declined by 6.7% for patients ages 80 to 84 years and 7.2% for patients ages 85 to 89 years. The overall 1-year mortality rate decreased significantly over the study period, from 48.8% in 1999 to 27.2% in 2007 (\( P<0.001 \)). The mortality rate declined by 26% for patients ages 90 years and older, 23.2% for those ages 80 to 84 years, and 19.2% for those age 85 to 89 years (Figure 3).

All-cause and HF readmissions within 30 and 90 days were common, ranging from 16% to 25% for the different age groups (Table 2). HF readmissions within 30 days declined slightly but insignificantly during the study period and were highly variable (Figure 4). In 2008, 16.7% of all patients were readmitted within 30 days for any cause. All-cause readmissions within 30 days were similar across age groups and were not significantly different for different time periods (Figure 5).

After adjustment for patient demographics, prior diagnoses, and comorbidities during admission, the 1-year mortality rate was higher for those ages 90 years and older (odds ratio [OR], 1.85; 95% confidence interval [CI], 1.64 to 2.09) and those ages 85 to 89 years (OR, 1.35; 95% CI, 1.26 to 1.46) compared with 80- to 84-year-olds. There was no significant age difference in adjusted 30-day all-cause readmission according to age group (OR, 0.91; 95% CI, 0.76 to 1.09 for veterans ages 90 years and older; OR, 1.04; 95% CI, 0.95 to 1.14 for 85- to 89-year-olds, compared with 80- to 84-year-olds). We also found no difference in the odds of being readmitted with a primary HF diagnosis according to age group (OR, 1.06; 95% CI, 0.82 to 1.36 for veterans ages 90.
and older; OR, 1.09; 95% CI, 0.96 to 1.25 for 85- to 89-year-olds, compared with 80- to 85-year-olds).

For the entire study period, 80% to 90% of patients were discharged to the community rather than nursing homes or home-based primary care. The proportion of community discharges remained stable, ranging from 85.9% and 89.3% during the study period (P = 0.72). The oldest patients, 90 years and older, were less likely to be discharged to the community compared with patients ages 80 to 84 years old (84.0% versus 88.9%, P = 0.001) over the entire study period.

Discussion

This investigation is the first to describe long-term outcomes in a large cohort of very elderly HF patients in the United States. We found that mortality rates improved during the study period. HF readmissions have also improved, but all-cause readmission rates remained high, with no particular trend over time. After controlling for demographics and comorbidities, 1-year mortality was higher in the older age groups, but readmissions did not differ between age groups.

Thirty-day mortality decreased during the study period for all age groups, consistent with trends seen in younger veterans as well as Medicare beneficiaries.10,11 The degree of improvement for our very elderly VA cohort, however, was greater than for Medicare patients. Bueno et al11 reported a 1.1% decrease in 30-day mortality from 1999 to 2006 among Medicare beneficiaries ages 65 and older; we found a 7.1% decrease in 30-day mortality for all very elderly patients during the study period and a 10% decrease in 30-day mortality for patients ages 90 and older. One-year mortality among our very elderly cohort was also comparable to Medicare patients; however, we observed greater improvement over time.12

Table 1. Baseline Characteristics of Very Elderly Heart Failure Patients According to Age Group

<table>
<thead>
<tr>
<th>All (n=21,397)</th>
<th>80 to 84 Years (n=13,457)</th>
<th>85 to 89 Years (n=6,215)</th>
<th>≥90 Years (n=1,725)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, %</td>
<td>100</td>
<td>62.9</td>
<td>29.0</td>
<td>8.1</td>
</tr>
<tr>
<td>Age, y</td>
<td>84.0±3.5</td>
<td>81.8±1.4</td>
<td>86.52±1.4</td>
<td>92.03±2.3</td>
</tr>
<tr>
<td>Race/Ethnicity, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>13,173 (80.2)</td>
<td>8,399 (79.8)</td>
<td>3,776 (81.9)</td>
<td>997 (76.4)</td>
</tr>
<tr>
<td>Black</td>
<td>2,612 (15.9)</td>
<td>1,690 (16.1)</td>
<td>673 (14.6)</td>
<td>249 (19.1)</td>
</tr>
<tr>
<td>Other</td>
<td>647 (3.9)</td>
<td>431 (4.1)</td>
<td>157 (3.4)</td>
<td>69 (4.5)</td>
</tr>
<tr>
<td>Male sex, n (%)</td>
<td>20,843 (97.4)</td>
<td>13,125 (97.5)</td>
<td>6,047 (97.3)</td>
<td>1,671 (96.9)</td>
</tr>
</tbody>
</table>

Table 2. Clinical Outcomes of Very Elderly Heart Failure Patients According to Age Group

<table>
<thead>
<tr>
<th>All (n=21,397)</th>
<th>80 to 84 Years (n=13,457)</th>
<th>85 to 89 Years (n=6,215)</th>
<th>≥90 Years (n=1,725)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During hospitalization</td>
<td>1385 (6.5)</td>
<td>807 (6.0)</td>
<td>41 (6.9)</td>
<td>147 (8.5)</td>
</tr>
<tr>
<td>30 Days after discharge</td>
<td>2184 (10.2)</td>
<td>1251 (9.3)</td>
<td>692 (11.1)</td>
<td>241 (14.0)</td>
</tr>
<tr>
<td>1 Year after discharge</td>
<td>7937 (37.1)</td>
<td>4710 (35.0)</td>
<td>2435 (39.2)</td>
<td>792 (45.9)</td>
</tr>
<tr>
<td>All-cause readmission, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 Days after discharge</td>
<td>3458 (17.3)</td>
<td>2197 (17.4)</td>
<td>1010 (17.5)</td>
<td>251 (15.9)</td>
</tr>
<tr>
<td>90 Days after discharge</td>
<td>4972 (24.9)</td>
<td>3145 (24.9)</td>
<td>1459 (25.2)</td>
<td>368 (23.3)</td>
</tr>
<tr>
<td>Heart failure admission, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 Days after discharge</td>
<td>1202 (6.0)</td>
<td>745 (5.9)</td>
<td>358 (6.2)</td>
<td>99 (6.3)</td>
</tr>
<tr>
<td>90 Days after discharge</td>
<td>2341 (11.7)</td>
<td>1462 (11.6)</td>
<td>680 (11.8)</td>
<td>199 (12.6)</td>
</tr>
</tbody>
</table>
Survivor bias may account for the improved outcomes we found in our patients compared with younger Medicare populations. Our patients appear healthier than HF registry patients, such as Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients with Heart Failure (OPTIMIZE-HF) and Acute Decompensated Heart Failure National Registry (ADHERE). Patients who have their first HF admission at very elderly ages may be healthier, with more benign HF etiologies, and are likely to have better outcomes.

Changes in HF management patterns may have contributed to the favorable mortality improvement observed in this analysis. An emphasis on performance measures has led to increased use of evidence-based therapies for systolic HF across many provider settings. In the late 1990s, marked underutilization of these therapies for patients over age 80 years, compared with younger patients, created a larger opportunity for improvement in the 2000s for this very elderly age group.

In the late 1990s, the VA restructured its delivery system to provide care under veterans integrated service networks, or VISNs, which promoted efficient use of pooled resources and continuity of care. This structure also encouraged vertical integration of care over the entire acute care episode, not just the in-hospital encounter. During the same time period, the VA undertook major quality improvement efforts that included electronic medical records, new infrastructure including cardiac catheterization facilities, quality assurance programs, and systematic audits of medical records. For cardiac diseases, these efforts resulted in decreased mortality rates after acute myocardial infarction as well as improved compliance with effective therapies. HF patients appear to have benefitted from these quality and delivery system initiatives as well.

Ideally, one would like to compare our results with other studies of very elderly patients. Whereas studies of very elderly HF patients are limited for a US population, the Euro HF Survey provides a similar age group for comparison. In the European cohort, in-hospital mortality was 10.7% (compared with our rate of 6.7%) and 1-year mortality was 28.4% (compared with our rate of 37.1%). One could attribute these small differences to more aggressive use of critical care services in the United States or a larger proportion of women, with longer life expectancies, in the European cohort.

The ADHERE and OPTIMIZE registries allow for comparison with other age groups admitted for HF, including those younger than 65 years of age. Mortality rate during index admission in ADHERE was 3.2% in 2004 (compared with 6.5% in our analysis); postdischarge 60- to 90-day mortality in OPTIMIZE was 8.6% (compared with 10.2% for

![Figure 2. Thirty-day mortality rates after hospitalization according to year and age group.](http://circheartfailure.ahajournals.org/)

![Figure 3. One-year mortality rates after hospitalization according to year and age group.](http://circheartfailure.ahajournals.org/)
30-day mortality in our analysis). Better outcomes in these cohorts are expected, given the younger age distributions and larger proportion of female patients.

All-cause 30-day readmission rates remained stable during the study period for all very elderly age groups; these rates are comparable to all-cause readmissions for veterans age 65 years and older. Medicare patients, for comparison, have also had stagnant 30-day all-cause readmissions in recent years, with slight increases in the past decade.

Stagnant all-cause readmission rates highlight the need to focus on noncardiac conditions during HF hospitalizations among the elderly. Curtis et al found that non-HF causes for readmission included pneumonia, renal failure, and chronic obstructive pulmonary disease, conditions that may be preventable. For example, evidence suggests that suggests non-selective β-receptor antagonists can worsen chronic obstructive pulmonary disease and that elderly patients may be more prone to side effects after initiation of systolic HF therapies. Health care providers may be able to prevent certain noncardiac readmissions by careful drug selection and close monitoring. In addition, elderly patients are at increased risk for hospital-acquired infections; simple hygiene measures and aspiration precautions may decrease readmissions caused by pneumonia.

We found that >80% of patients were discharged to home, whereas about only 50% of Medicare HF patients were discharged home. Our very elderly patients have fewer comorbid conditions than younger populations, which may explain the discrepancy. Additionally, the VA payment system uses the same funds to pay for acute and postacute care, creating an incentive to send patients home. On the other hand, Medicare payments for acute and postacute care are not linked, and health care providers may be more inclined to send patients to skilled nursing facilities. The recently passed health care reform bill may change this dynamic by using bundled payment systems that could encourage Medicare providers to discharge patients to home. Finally, one cannot exclude the possibility that veterans have different health care preferences and decline nursing home care.

Limitations
Our study has several methodological limitations. The high proportion of men in the VA population limits the applicability of our findings to women. Also, we used hospitalizations to identify incident HF events, and outcome trends for patients treated entirely in the outpatient setting may differ. Administrative data have limitations, as it does not allow for determination of disease severity and symptom status such as New York Heart Association class. Race/ethnicity was miss-
ing for 4966 veterans, which limits conclusions from the race/ethnicity-stratified analysis.

Over the study period, the mean number of incident HF events for the oldest group (ages 90 years and older) was 325 per year, compared with 1948 for the younger age groups (ages 80 to 89 years). Although we observed changes in incidence and outcomes between 1999 and 2008 in the oldest patients, these estimates are uncertain because of the small number of cases.

Elderly veterans are also eligible for Medicare and thus could have been admitted for HF outside of the VA. It is more likely that dual care has decreased over time rather than increased, given the economic recession. If this is the case, our study undercounts events in the early years and is more accurate in the later years, which suggests that the improvement trends may be stronger than reported here. Finally, information about left ventricular function was unavailable, so we were unable to characterize the population in this regard.

Conclusions

In the coming years, we can expect increasing HF admissions in an aging population. Our investigation provides new information about characteristics and outcomes for the oldest HF patients in the United States and points out areas for future research. According to United States census projection, by 2050 over 15% of the population will be age 65 and over and 5% of the population will be age 85 years and older; in absolute numbers, over 20 million Americans will be older than 85 years. Although HF survival is improving, readmission rates are stagnant and remain high regardless of age. This finding highlights the challenge of identifying interventions to reduce readmissions that are often due to noncardiac conditions, particularly in light of the pending changes to Medicare reimbursement for 30-day readmissions.

Future investigations into delineating outcome predictors and identifying effective treatment of very elderly HF patients are warranted.

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Disclosures

None.

References


Heart failure is the most common reason for hospitalization among older patients. With the aging population, the number of older patients hospitalized for heart failure will grow severalfold in the coming years. Currently, the very elderly—individuals 80 years and older—represent the fastest-growing segment of the older population. Their numbers are expected to grow to 21 million over the next 40 years. Data on survival and readmission rates after a first heart failure hospitalization are limited in this segment of the population. We examined trends in mortality rates and heart failure readmissions rates of a national population of veterans 80 years and older from 1999 to 2008 and found substantial improvement in 30-day and 1-year mortality rates, with the most impressive decreases observed among those 90 years and older. Although older patients had significantly fewer readmissions for heart failure over time, they continued to be readmitted frequently for other conditions after their index hospitalization for heart failure. Identifying predictors for readmissions among the very elderly population will be crucial to more effectively treat this rapidly growing segment of heart failure patients.
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