



Skilled Nursing Facility Use and Hospitalizations in Heart Failure: A Community Linkage Study

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Abstract

Objectives: To examine the effect of skilled nursing facility (SNF) use on hospitalizations in patients with heart failure (HF) and to examine predictors of hospitalization in patients with HF admitted to a SNF.

Patients and Methods: Olmsted County, Minnesota, residents with first-ever HF from January 1, 2000, through December 31, 2010, were identified, and clinical data were linked to SNF utilization data from the Centers for Medicare and Medicaid Services. Andersen-Gill models were used to determine the association between SNF use and hospitalizations and to determine predictors of hospitalization.

Results: Of 1498 patients with incident HF (mean \pm SD age, 75 ± 14 years; 45% male), 605 (40.4%) were admitted to a SNF after HF diagnosis (median follow-up, 3.6 years; range, 0-13.0 years). Of those with a SNF admission, 225 (37%) had 2 or more admissions. After adjustment for age, sex, ejection fraction, and comorbidities, SNF use was associated with a 50% increased risk of hospitalization compared with no SNF use (adjusted hazard ratio, 1.52; 95% CI, 1.31-1.76). In SNF users, arrhythmia, asthma, chronic kidney disease, and the number of activities of daily living requiring assistance were independently associated with an increased risk of hospitalization.

Conclusion: Approximately 40% of patients with HF were admitted to a SNF at some point after diagnosis. Compared with SNF nonusers, SNF users were more likely to be hospitalized. Characteristics associated with hospitalization in SNF users were mostly noncardiovascular, including reduced ability to perform activities of daily living. These findings underscore the effect of physical functioning on hospitalizations in patients with HF in SNFs and the importance of strategies to improve physical functioning.

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For editorial comment, see page 483; for related articles, see pages 500, 512, and 565

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Heart failure (HF) is a major clinical and public health problem that affects more than 5 million individuals in the United States, and more than 550,000 new cases of HF are diagnosed each year.^{1,2} The number of patients living with HF continues to rise, and it is estimated that more than 8 million Americans will have HF by 2030.³ Heart failure disproportionately affects the elderly and is prevalent in an estimated 20% to 37.4% of the 1.5 to 2 million persons living in a skilled nursing facility (SNF) in the United States.⁴

Although HF is common in persons in SNFs, data on the outcomes for patients with HF in SNFs is sparse. Indeed, a recent scientific statement from the American Heart

Association underscores that “further studies that provide longitudinal data regarding the range of patient experiences after hospital discharge to a SNF are needed.”^{4,p657} Addressing this recognized information gap requires comprehensive knowledge of clinical data that can be linked to SNF data to obtain the requisite complete longitudinal information and reconstruct the patient experience. These steps are conceptually straightforward but operationally complex and, hence, seldom executed. Yet, generating such data sets is important to study hospitalizations, a key indicator of HF management. Indeed, although referrals to SNFs could be envisioned as a way to reduce hospitalizations, a “revolving door” phenomenon after SNF admission has

been hypothesized to drive hospital readmissions,⁵ and there is evidence that mortality and hospital readmissions are increased for hospitalized older adults with HF discharged to SNFs compared with those discharged to other sites.⁶ The urgent need to study the effect of SNF use on hospitalizations in HF was recently emphasized^{6,7} but has yet to be carefully examined.

To address these gaps in knowledge, we assembled a community cohort of patients with validated incident (first-ever) HF who were not in a SNF immediately before diagnosis. We then created a comprehensive linked data set including clinical, medical care use, and SNF information to examine SNF utilization after HF diagnosis, to study the effect of SNF use on hospitalizations, and to examine the predictors of hospitalization in patients admitted to a SNF.

METHODS

Study Setting

This study was conducted among residents in Olmsted County, Minnesota, from January 1, 2000, through December 31, 2010. Olmsted County (2010 population: 144,248) is representative of the state of Minnesota and the Upper Midwest region of the United States⁸ with similar age, sex, and ethnic characteristics. In addition, age- and sex-specific mortality rates are similar for Olmsted County, the state of Minnesota, and the entire United States.⁸

Longitudinal, population-based epidemiologic studies in Olmsted County are possible because only a few providers (Mayo Clinic, Olmsted Medical Center, and a few private providers) deliver nearly all the health care to the local residents.^{9,10} The provider-linked medical records from each institution are indexed through the Rochester Epidemiology Project (REP), resulting in the linkage of all detailed clinical (including medical care use) and demographic information from nearly all sources of care.⁸ Thus, the REP constitutes a unique infrastructure for epidemiologic and outcomes studies because the population of Olmsted County is served by a unified medical system with comprehensive clinical records.⁹ The data architecture consists of diagnostic and procedure codes that enable case finding to direct medical record

review and data collection. Thus, through the REP, HF cases were identified and validated, and clinical data (including hospitalizations) were abstracted from the complete medical record.

Identification of Patients With HF

All Olmsted County inpatients and outpatients with a diagnosis assigned an *International Classification of Diseases, Ninth Revision, Clinical Modification* code 428 from January 1, 2000, to December 31, 2010, were identified.¹¹ A random sample of 50% of the HF diagnoses from 2000 through 2006 and 100% of the HF diagnoses from 2007 through 2010 were manually reviewed. The HF diagnoses were validated by experienced nurse abstractors using the Framingham criteria,¹² which are highly reliable.¹¹ The event was classified as incident if no history of previous HF was found on review of all sources of information.

Patient Characteristics

We selected the 20 conditions recently identified as a public health priority by the US Department of Health and Human Services^{13,14} to classify comorbidities.^{15,16} These conditions were ascertained electronically by retrieving *International Classification of Diseases, Ninth Revision, Clinical Modification* codes from both inpatient and outpatient encounters at all providers indexed in the REP. As described previously,¹⁵ 2 occurrences of a code (either the same code or 2 different codes within the code set for a given disease) separated by more than 30 days and occurring within 5 years before the incident HF date were required for diagnosis. Because all the patients had HF, this condition was not included. Conditions that were absent (autism, human immunodeficiency virus) or infrequent (hepatitis [n=9]) also were not included, leaving 16 chronic conditions: coronary artery disease, arrhythmia, stroke, hypertension, hyperlipidemia, diabetes, arthritis, osteoporosis, asthma, chronic obstructive pulmonary disease, chronic kidney disease, cancer, depression, dementia, schizophrenia, and substance abuse.

Body mass index was calculated using height at the time of HF diagnosis and weight from the last outpatient visit before HF diagnosis. Marital status was ascertained from the medical record.

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