



Cost comparison across heart failure patients with reduced and preserved ejection fractions: Analyses of inpatient decompensated heart failure admissions

Natalia Olchanski^{a,*}, Amanda R. Vest^b, Joshua T. Cohen^a, Peter J. Neumann^a, David DeNofrio^b

^a Center for the Evaluation of Value and Risk in Health, Institute for Clinical Research and Health Policy Studies at Tufts Medical Center, Boston, MA, United States

^b Division of Cardiology, Cardiovascular Center, Tufts Medical Center, Boston, MA, United States

ARTICLE INFO

Article history:

Received 25 August 2017

Received in revised form 29 January 2018

Accepted 6 March 2018

Keywords:

Heart failure

Hospitalizations

Healthcare costs

Healthcare economics

ABSTRACT

Background: Heart failure (HF) is the leading cause of inpatient admissions in the US for adults aged over 65 years and accounts for more than \$17 billion in Medicare expenditures annually. There are limited published data on factors influencing expenditure and the relationship between cost and hospital length of stay. We sought to describe institutional costs of HF hospitalization, as well as demographic and clinical predictors of higher hospitalization costs in an academic hospital setting.

Methods and results: Demographic and clinical information was collected retrospectively for 564 unique consecutive patients with a decompensated HF admission during 2010–2013. Forty-six percent had a baseline LVEF >40%, categorized as HF with preserved ejection fraction (HFpEF). Forty-three percent were female and the mean age was 71 years. Patients with reduced ejection fraction (HFrEF) were predominantly male, younger and had a lower burden of baseline comorbidities than HFpEF patients. Length of stay was longer for HFrEF (median 4 days) than HFpEF (median 3 days, $p = 0.01$). Mean total hospitalization cost was \$9521. Mean costs trended higher for HFrEF patients than for HFpEF patients (\$10,286 versus \$8858, $p = 0.07$). Room and board contributed more than half of all costs.

Conclusions: In this single-center study, we observed a trend towards higher HF hospitalization costs for patients with HFrEF, compared to HFpEF, even though patients with HFpEF are older and had more comorbid conditions. Costs were largely driven by length of stay, with higher heart rate at admission, lower systolic blood pressure, and higher creatinine associated with higher inpatient costs.

© 2018 Elsevier B.V. All rights reserved.

1. Introduction

Heart failure (HF) is the leading cause of inpatient admissions in the United States for adults aged over 65 years. Over 5 million adults in the United States currently have HF and the total cost for HF treatment is estimated at \$31 billion annually [1]. Approximately 1 million patients in the United States are hospitalized annually with a primary diagnosis of HF, costing Medicare more than \$17 billion a year [2]. As health care costs rise and the population ages, there is a growing focus on the economic burden that HF hospitalizations place on the healthcare system. With more than half of HF patients readmitted within 12 months after discharge [3], hospital admissions represent one of the largest cost drivers in this population. Despite this, factors that predict costly hospital stays are not well understood.

There are limited data on the expenditures, cost drivers, and the relationship between cost and length of hospital stay in HF patients. In addition, there is a paucity of information on how inpatient costs

for patients with reduced ejection fraction (HFrEF) compare to the corresponding costs for HF patients with preserved ejection fraction (HFpEF) [4]. Patients with HFpEF represent approximately half of the HF population and have a higher comorbidity burden and age range than HFrEF patients. Therefore, accurate characterization of the costs of hospitalization specific to decompensated HFpEF is of particular relevance to payers and healthcare systems [5,6].

To this end, we sought to quantify the total, direct and overhead institutional costs of a HF hospitalization for patients with preserved versus reduced ejection fraction. Using data from an academic hospital, we set out to identify demographic and clinical factors that predict greater hospitalization costs, as a prelude to the development of more focused cost-effective inpatient care strategies.

2. Methods

We assembled a retrospective cohort of patients consecutively admitted to Tufts Medical Center, Boston, with acutely decompensated HF and discharged between October 1st 2010 and November 30th 2013. We included all patients coded with HF related diagnosis-related group (DRG) codes 291 (HF and shock with major complication or comorbidity), 292 (HF and shock with a complication or comorbidity), or 293

* Corresponding author.

E-mail address: nolchanski@tuftsmedicalcenter.org (N. Olchanski).

(HF and shock without a complication or comorbidity). Each of the patients included in the study represented one unique hospitalization for HF and subsequent patient hospitalizations were not included. We excluded patients with prior heart transplant or prior left ventricular assist device (LVAD) placement because the costs for these patients cannot be generalized to a typical HF population. The Tufts Medical Center Institutional Review Board approved this study and waived the requirement for written patient consent because of the study's retrospective nature.

Trained data extractors collected retrospective information from electronic medical records. A heart failure cardiologist adjudicated a sample of patients and any queries from the data extractors. Collected data included patient demographics, medical comorbidities, HF etiology, left ventricular ejection fraction (LVEF) within the 12 months preceding admission, vital signs at the time of admission and discharge, key laboratory variables at the time of admission, medications at the time of admission and discharge, length of total hospital admission, length of intensive care unit (ICU) admission if applicable, and mortalities during the index hospitalization. We collected and managed study data using the Research Electronic Data Capture (REDCap) tool hosted at the Tufts Clinic and Translational Science Institute [7]. REDCap is a secure, web-based application designed to support data capture for research studies. The assembled cohort was stratified by LVEF into a HFpEF group (LVEF >40%) and a HFrEF group (LVEF ≤40%) for further analysis. The LVEF threshold of 40% is typically used for HFrEF versus HFpEF designation in the US [8]. However, since HFpEF is sometimes defined as LVEF >50% we also performed a sensitivity analysis using this HFpEF threshold and excluding the 41–49% LVEF subgroup (described by the European Society of Cardiology as HF with mid-range EF).

We extracted cost data for the cohort's index hospitalizations from the Tufts Medical Center cost accounting system. The patient and admission was linked to the electronic medical record information by medical record number and date of admission. Six patients in the clinical data set did not have a corresponding entry in the cost accounting system and were therefore excluded from the cohort. We divided the hospitalization cost drivers by category (see [Technical Appendix Table](#)) and reported the total cost of index HF hospital stays, and the total cost per day for these index HF episodes. We used the medical care services component of the US Consumer Price Index (CPI) to adjust all costs to 2014 US dollars. The cost accounting system did not contain data on payer reimbursement for these hospitalizations. Therefore, we did not include these data in our analysis.

The primary analytic objective aimed to describe the costs associated with an index acute decompensated HF hospitalization for the Tufts Medical Center cohort. The secondary objectives were to: (a) identify patient characteristics associated with higher costs; and (b) determine if HFrEF and HFpEF patients had comparable costs. We summarized patient demographics, clinical and laboratory characteristics and medications for both the total cohort and for the HFrEF and HFpEF subgroups separately. We compared the HFrEF and HFpEF subgroups using the Student's *t*-test for continuous data and the chi-squared test for categorical data. Data for specific measures demonstrating highly skewed distributions were first log-transformed before applying the *t*-test. All tests were two-sided, with the significance level set at 0.05. We reported mean and median values for continuous variables, and displayed hospital costs graphically by category, for the aggregated cohort, and for the HFrEF and HFpEF subgroups separately.

We used multivariable linear regression analysis to estimate the impact of baseline patient characteristics on total HF hospitalization cost. The candidate covariates were selected based on a priori clinical knowledge of variables that would likely affect medical costs, length of hospital stay, or both [1,9]. A step-wise selection algorithm identified final covariates. The model outcome was the log-transformed total cost of the index HF hospitalization (adjusted to 2014 US dollars). We also tested alternative models that replaced continuous covariates with categorical variables. In these models we found no significant non-linear associations between the outcome and the predictors. Hence, these alternative models did not produce substantially different findings. Based on these findings, the remainder of this paper presents results from the continuous covariate model, which had greater statistical power than the categorical covariate versions. We used SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA) to perform all statistical analyses.

3. Results

The cohort totaled 564 patients, with an overall median hospital length of stay of 4.3 days and 13 inpatient mortalities during the index hospitalization. The demographics were typical of a contemporary inpatient acute HF sample, with approximately half of the patients categorized as HFpEF ([Table 1](#)). As expected, patients in the HFrEF subgroup were younger and more predominantly male, as compared to patients in the HFpEF subgroup (mean age 67.5 versus 75 years, $p < 0.0001$ and 30.5% versus 58.3% female, $p = 0.001$, respectively). Also as expected, the mean body mass index (BMI) was lower in the HFrEF subgroup, and the HFrEF patients had a lower prevalence of comorbidities (atrial fibrillation, hypertension, chronic obstructive pulmonary disease). Most patients in the combined cohort had a prior history of HF (68.6%), although HFrEF patients were less likely to be admitted with a new presentation of the HF syndrome than HFpEF patients (24.2% versus 40.9%, $p < 0.0001$). For the combined cohort, the mean LVEF was 39%, while for patients with

HFrEF, the mean LVEF was 23%, and for patients with HFpEF, the mean LVEF was 57% ([Table 1](#)).

The HFrEF subgroup was largely managed as per current guidelines at the time of hospital admission; 55% were receiving an ACE-inhibitor or angiotensin receptor antagonist (not shown in [Table 1](#)), 78% a beta-blocker and 21% a mineralocorticoid receptor antagonist. Cardiac resynchronization therapy (CRT) was noted in 17% of HFrEF admissions, and 41% of patients had an implantable cardioverter defibrillator (ICD) at the time of admission. Compared to HFpEF patients, HFrEF patients had a higher mean heart rate, lower mean blood pressure, and higher mean brain natriuretic peptide (BNP) upon admission ([Table 1](#)). Prescription of standard oral HF therapies were overall stable between hospital admission and discharge; at discharge, 79% were prescribed beta-blockers, 38% an ACE-inhibitor, 13% an angiotensin receptor antagonist, 17% a mineralocorticoid inhibitor, and 81% a diuretic.

The two subgroups also differed in terms of length of stay, with HFrEF patients staying in the hospital longer (median 4 days) than HFpEF patients (median 3 days, p value for comparison = 0.01, [Table 2](#)). There was also a non-significant trend towards greater ICU utilization among HFrEF (14.4%), as compared to HFpEF patients (9.3%) ($p = 0.07$). The mean total cost for the entire HF hospitalization stay was \$9521, with the mean cost per day amounting to \$2226 ([Table 2](#)). Mean total hospital stay costs for the HFrEF patients (\$10,286) exceeded the corresponding costs for the HFpEF patients (\$8858), but the difference did not reach statistical significance ($p = 0.07$). There was a very small number of patients with LVEF 41–49% (7% of the total cohort). Inclusion of this mid-range LVEF subgroup in either HFrEF or HFpEF group did not significantly change the results.

The total cost difference was driven largely by the longer length of stay for HFrEF patients compared to HFpEF patients; LVEF as a continuous variable was not an independent predictor of costs in the multivariable model (parameter estimate 0.00216, $p = 0.28$, [Table 3](#)). Among the cost drivers, room and board was responsible for more than half of all costs ([Fig. 1](#)). Diagnostics and pharmacy costs were the next biggest contributors. [Technical Appendix Fig.](#) focuses on the components of the difference in cost between the HFrEF and HFpEF groups. Room and board was the largest component of these differences.

Several admission markers that are associated with poorer HF prognosis were independent predictors of higher cost, including diabetes (18% higher costs), history of ventricular tachycardia (27% higher costs), higher creatinine (8% higher cost for each one-unit mg/dL increase), lower systolic blood pressure (5% higher cost for each 10 mmHg decrease in admission systolic blood pressure), and heart rate on admission (3% higher cost per beat per minute (BPM) increase), [Table 3](#). The largest demographic predictor of cost was race. Compared to Caucasians ($n = 380$, 67.4%), African American patients ($n = 59$, 10.5%) had 21% lower costs and Asians ($n = 72$, 12.8%) 26% lower costs (p value for each comparison <0.05). Caucasian patients trended towards a longer length of stay compared to other racial groups. The median (quartile range) for length of stay was 4 (2–6) for Caucasians, 3 (2–4) for African Americans, and 3 (2–4) for Asians. Compared to the overall cohort, the patients who died during their hospitalization had a longer length of stay (mean 8 ± 6 days, median 6 days) and a higher total hospitalization cost (mean \$28,371 $\pm$ \$23,475, median \$18,290). There were no differences in hospitalization death rates between racial groups.

4. Discussion

In our single-center study of acute HF patients admitted to an academic medical center, HFpEF patients incurred non-significantly lower hospitalization costs (\$8858 vs \$10,286, $p = 0.07$). This appeared to be related to a shorter length of stay and a trend towards lesser ICU utilization for HFpEF patients. This was an unexpected finding because HFpEF patients tend to be older, with more comorbid disease – almost half of deaths among HFpEF patients are non-cardiac in etiology [5,6,10]. Despite this, the current study suggests that efforts to reduce

Download English Version:

<https://daneshyari.com/en/article/8662063>

Download Persian Version:

<https://daneshyari.com/article/8662063>

[Daneshyari.com](https://daneshyari.com)