Clin. Cardiol. 24, 56–62 (2001)

Length of Stay and Procedure Utilization Are the Major Determinants of Hospital Charges for Heart Failure

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Summary

Background: Most of the 10 billion dollars spent annually on heart failure (HF) management in this country is attributed to hospital charges. There are widespread efforts to decrease the costs of treating this disorder, both by preventing hospital admissions and reducing lengths of stay (LOS).

Hypothesis: The objective of this study was to identify the major determinants of hospital charges for an acute hospitalization for HF among a large, diverse group of patients.

Methods: Administrative information on all 1995 New York State hospital discharges assigned ICD-9-CM codes indicative of HF in the principal diagnosis position were obtained. Bivariate and multivariate statistical analyses were utilized to determine those patient- and hospital-specific characteristics which had the greatest influence on hospital charges.

Results: In all, 43,157 patients were identified. Mean hospital charges were \$11,507 ± 15,995 and mean hospital LOS was 9.6 ± 14.5 days. With multivariate analyses, the most significant independent predictors of higher hospital charges were longer LOS, admission to a teaching hospital, treatment in an intensive care unit, and the utilization of cardiac surgery, permanent pacemakers, and mechanical ventilation. Age, gender, race, comorbidity score, and medical insurance, as well as treatment by a cardiologist and death during the index hospitalization were not among the most significant predictors.

Conclusions: We conclude that LOS and procedure utilization are the major determinants of hospital charges for an acute episode of inpatient HF care. Reducing LOS and other initiatives to restructure hospital-based HF care may reduce total health care costs for HF.

Key words: congestive heart failure, outcomes, hospital charges, length of stay

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Received: November 23, 1999
Accepted with revision: March 29, 2000

Introduction

Heart failure (HF) is associated with high rates of mortality and morbidity.[1] This syndrome is the leading cause of hospital admission among patients aged > 65 years.[2] Thus, the care of patients with HF poses a significant societal burden and will continue to do so as the population ages.[3] As hospital charges account for most of the extraordinarily high costs of HF care,[3] there have been widespread efforts to decrease the costs of treating this disorder both by preventing hospital admissions and reducing lengths of stay (LOS).[4] Such efforts have proliferated despite limited understanding of the true determinants of hospital charges or costs among patients admitted for evaluation and treatment of HF. Thus, we obtained administrative records on all patients hospitalized for HF in New York State during a single calendar year. The purpose of this study was to identify the major determinants of hospital charges for an acute hospitalization for HF among a large and diverse group of patients.

Methods

Patients

This study was approved by the institutional review board of the Massachusetts General Hospital where all data were stored and all analyses performed. Information on all 1995 New York State hospital discharges assigned International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes indicative of HF in the principal diagnosis position were obtained from the Statewide Planning and Research Cooperative System (SPARCS) database. SPARCS is an agency of the New York Department of Health which incorporates data on patients hospitalized in acute care facilities from, among other sources, the uniform bill and uniform discharge abstract submitted by hospitals. The codes selected were 428.0, 402.91, 404.93, 428.1, 402.11, 398.91, 404.91, 404.13, 402.01, 404.03, 404.11, 404.01, and 428.9. This method of case selection defined a group of patients whose primary diagnosis upon hospital discharge was HF, irrespective of procedures performed or Diagnosis-Related Group (DRG) number assigned. Only the chronologically first hospital discharge for HF during 1995 for each patient was included in this analysis.

To simplify the analyses of potentially complex interactions between race or ethnicity and other variables,[5] only patients whose race was reported as black or white were included in this analysis. Because type of insurance coverage may have a significant influence on hospital charges,[6] we restricted inclusion to patients with the four most common forms of insurance coverage which, in general, have widely understood arrangements with acute care hospitals regarding payment for inpatient care. The groups included were Medicare-fee-for-service (FFS), Medicaid-FFS, health maintenance organization (HMO), and commercial indemnity plans. Thus, patients with other types of payment programs, such as self-pay, Veterans' or CHAMPUS benefits, Medicare-HMO and Medicaid-HMO plans were excluded from this study. When reporting data to SPARCS, the admitting hospital made the distinction of patients' insurance type based on information such as proof of coverage and knowledge of local third-party payer reimbursement contracts.

Hospital LOS was defined as the date of discharge or death minus the date of admission. Heart failure readmission was coded as present or absent for each patient by searching the same data set for subsequent discharges for that patient. Comorbid illness was determined by searching up to 14 secondary diagnosis codes for each patient. Total comorbid disease was quantified according to the method of Charlson. To achieve this, a Charlson Comorbidity Index[7] and its age-modified variant[8] were calculated for each patient. Process of care was determined by searching the principal procedure code and up to 14 secondary procedure codes for each patient. A patient was classified as receiving care from a cardiologist if any of his or her providers was listed as a specialist in cardiovascular diseases. Patients were classified as "urban" if their discharge occurred at a hospital located in a county within a Federal metropolitan statistical area. All other patients were classified as "rural." Patients were classified as "teaching" if their discharge occurred at a hospital listed as a primary or affiliated institution of an accredited internal medicine or family practice residency program according to the American Medical Association's directory of postgraduate medical training programs.[9] All other patients were classified as "nonteaching." The actual hospital records of 3% of the patients were audited manually to confirm the presence of HF based on the documentation of appropriate symptoms, physical findings, laboratory tests, and response to appropriate therapy.

Statistical Analyses

The bivariate relationships between hospital charges and the independent variables were examined using Student's unpaired *t*-test (for categorical independent variables), and Pearson's correlation coefficient and Spearman's rank correlation coefficient (for continuous independent variables). Multiple linear regression analyses were then used to select the most significant determinants of hospital charges from the pool of all potential variables. To do this, the following were entered as independent variables in a linear regression model for charges using forward stepwise selection: patient demographics (age, gender, and race), medical insurance (Medicare, Medicaid, HMO, or indemnity), intensive care unit (ICU) hospitalization (yes or no), coexistent illnesses (ischemic heart disease, hypertension, cardiomyopathy, atrial fibrillation, shock, diabetes, renal disease, previous cardiac surgery, chronic lung disease, pneumonia, cancer, and anemia), Charlson Comorbidity Index, medical and surgical procedures (echocardiography, nuclear ventriculography, exercise testing, cardiac telemetry monitoring, pulmonary artery catheterization, cardiac catheterization, percutaneous transluminal coronary angioplasty, invasive electrophysiology testing, pacemaker placement, renal dialysis, mechanical ventilation, and any cardiac surgery, including coronary bypass surgery, valve surgery, and heart transplantation), treatment by a cardiologist (yes or no), interhospital transfers (transfer from another hospital and transfer to another acute care hospital), discharge disposition status (discharge "against medical advice" and transfer to a skilled nursing facility), clinical outcomes during the index hospitalization (LOS and death), hospital readmission (yes or no), and hospital characteristics (teaching vs. nonteaching and rural vs. urban). Because of the size of the patient cohort, many independent variables could be expected to retain statistical significance in the model, even in the absence of clinical significance. Therefore, in an effort to maximize the explainable variance in hospital charges while restricting the panel of significant determinants to those which were most relevant, we chose to define arbitrarily but prospectively the most parsimonious or "best" model for charges in the following way: The step in the stepwise selection process which was associated with an increase of ≤ 0.003 in the overall r^2 for the model compared with the preceding step was identified. The preceding step was then called the "best" model. In interpreting results, a p value of ≤ 0.01 was considered statistically significant. Results are displayed as mean ± standard deviation (SD).

Results

Patients and Hospitals

A total of 52,021 patients was hospitalized at least once with the chosen ICD-9-CM codes in New York State during 1995. Of these, 3,277 were excluded from the current analysis on the basis of their insurance status (self-pay, 1,942 patients; Medicare-HMO, 528; "Other," 487; Medicaid-HMO, 102; "Other Government," 47; Worker's Compensation, 40; self-insured self-administered plan, 37; CHAMPUS or Veteran's Administration benefits, 29; no charge, 25; Corrections Department, 20; and no-fault insurance, 20). An additional 5,587 patients were excluded because race was either unknown or reported as neither black nor white. A total of 236 unique hospitals contributed at least one patient to the study sample of 43,157. Among these, the median caseload per hospital was 282.

Demographics and Clinical Characteristics

Tables I and II display the clinical features, demographic characteristics, and clinical outcomes of the study cohort. Among the 43,157 patients included in this analysis, the majority were elderly (74.5 ± 13.0 years), female (57.0%), and white (83.4%). Pediatric and adolescent cases were uncommon, as only 0.2% of the sample were younger than 21 years. In contrast, 81.0% of patients were ≥65 years of age. The mean Charlson Comorbidity Index was 2.7 ± 1.7. Of all index hospital admissions, 89.6% occurred at urban hospitals, while 50.7% occurred at teaching institutions. The distribution of charges is shown in Figure 1. Median hospital charge was $7,515 with an interquartile range of $4,575–12,870 (mean ± SD = $11,507 ± 15,995). Mean hospital LOS was 9.6 ± 14.5 days (median = 7, interquartile range = 4–7). The rate of death during the index hospitalization was 7.0%. The HF readmission rate during 1995 among the 22,609 hospital survivors, who were discharged during the first 6 months of the year, was 28.0%. Among the patients whose hospital records were audited manually, HF was found to be both present and a primary cause of hospitalization in 96% of cases.

The most common ICD-9-CM code in the principal diagnosis position was 428.0 (congestive heart failure), which was found in 87.0% of patients. The second most common principal diagnosis was 402.91 (hypertensive heart disease, unspecified, with congestive heart failure), which was found in 7.1% of patients. There were no significant differences in primary diagnosis codes between insurance groups. Diagnosis-Related Group 127 (congestive heart failure and shock) was assigned to 91% of patients. Other DRGs included DRG 124 (3.2%), DRG 121 (1.6%), DRG 120 (1.2%), DRG 115 (1.1%), DRG 123 (0.5%), DRG 478 (0.4%), DRG 112 (0.3%), DRG 110 (0.2%), and DRG 104 (0.1%).

TABLE I Relationship between hospital charges and demographic features, clinical characteristics, and clinical outcomes (dichotomous variables) for 43,157 patients with heart failure

Variable	Subgroup	Frequency (%)	Hospital charges ($, mean ± SD)	Subgroup	Frequency (%)	Hospital charges ($, mean ± SD)	p Value [a]
Sex	Female	57.0	11,730 ± 16,469	Male	43.0	11,212 ± 15,341	0.0008
Race	White	83.4	11,094 ± 15,735	Black	16.6	13,575 ± 17,091	0.0001
Medicare insurance	Yes	77.9	11,351 ± 15,009	No	22.1	12,055 ± 19,055	0.0009
Medicaid insurance	Yes	9.0	13,124 ± 21,461	No	91.0	11,347 ± 15,341	0.0001
HMO insurance	Yes	3.1	10,498 ± 14,145	No	96.9	11,539 ± 16,049	0.0088
Indemnity insurance	Yes	10.1	11,575 ± 17,997	No	89.9	11,499 ± 15,755	0.79
Hospital location	Urban	89.6	11,990 ± 15,564	Rural	10.4	7,324 ± 18,818	0.0001
Hospital type	Teaching	50.7	13,318 ± 17,656	Nonteach	49.3	9,645 ± 13,841	0.0001
Ischemic heart disease	Present	50.2	11,155 ± 15,590	Absent	49.8	11,887 ± 16,412	0.0001
Hypertension	Present	43.4	10,888 ± 13,617	Absent	56.6	11,983 ± 17,591	0.0001
Valvular heart disease	Present	20.5	11,937 ± 13,679	Absent	79.5	11,396 ± 16,537	0.002
Other cardiomyopathies	Present	12.5	13,373 ± 19,517	Absent	87.5	11,241 ± 15,409	0.0001
Prior cardiac surgery	Present	10.4	9,855 ± 10,770	Absent	89.6	11,699 ± 16,483	0.0001
Atrial fibrillation	Present	28.1	12,829 ± 16,038	Absent	71.9	10,990 ± 15,949	0.0001
Ventricular arrhythmia	Present	3.9	16,641 ± 20,723	Absent	96.1	11,297 ± 15,736	0.0001
Shock	Present	0.7	26,408 ± 35,560	Absent	99.3	11,397 ± 15,710	0.0001
Cerebrovascular disease	Present	5.4	14,486 ± 17,476	Absent	94.6	11,337 ± 15,890	0.0001
Renal disease	Present	21.0	15,417 ± 19,610	Absent	79.0	10,465 ± 14,710	0.0001
Chronic lung disease	Present	28.6	12,059 ± 15,325	Absent	71.4	11,286 ± 16,251	0.0001
Pneumonia	Present	6.8	20,468 ± 23,914	Absent	93.2	10,851 ± 15,046	0.0001
Diabetes mellitus	Present	32.3	11,512 ± 14,194	Absent	67.7	11,505 ± 16,789	0.96
Cancer	Present	6.7	11,409 ± 12,099	Absent	93.3	11,514 ± 16,238	0.66
Anemia	Present	16.8	14,860 ± 19,222	Absent	83.2	10,832 ± 15,174	0.0001
Inpatient death [b]	Yes	7.0	18,420 ± 26,509	No	93.0	10,985 ± 14,772	0.0001
Readmission for HF [c]	Yes	28.0	10,960 ± 13,441	No	72	11,256 ± 14,991	0.15

[a] P value for difference in mean charges between patients with and without the given characteristic being present.
[b] Death during the index hospitalization.
[c] Hospital readmission for HF within 6 months of index discharge.
Abbreviations: SD = standard deviation, HMO = health maintenance organization, HF = heart failure.

TABLE II Relationship between hospital charges and patient age, comorbidity scores and hospital length of stay (continuous variables) for 43,157 patients with heart failure

Variable	Mean ± SD (median, interquartile range)	r	p Value
Age (years)	74.5 ± 13.0; (76, 67 – 84)	−0.01	0.006
Total comorbid diagnoses (number)	5.1 ± 2.0; (5, 4 – 6)	0.21	0.0001
Charlson Comorbidity Index	2.7 ± 1.7; (2, 1 – 3)	0.09	0.0001
Age-modified Charlson Comorbidity Index	5.7 ± 2.0; (6, 4 – 7)	0.07	0.0001
Length of stay (days)	9.6 ± 14.5; (7, 4 – 11)	0.76	0.0001

Abbreviations: SD = standard deviation, r = Pearson correlation coefficient for association between variable and hospital charges.

Bivariate Analyses

The bivariate relationships between hospital charges and clinical features, demographic characteristics, and clinical outcomes are shown in Tables I and II. Perhaps because of the large size of the data set, most of the patient- and hospital-specific variables tested in the bivariate analyses proved to have statistical significance in their relationship with hospital charges. Urban and teaching hospitals had higher charges than rural and nonteaching hospitals. Charges were higher among black patients (compared with whites) and those with Medicaid insurance (compared with other insurance groups). In general, the presence of comorbid illnesses was associated with higher charges. Patients who died during the index hospitalization (median charge = $10,340, mean = $18,420 ± 26,509) had higher charges than hospital survivors (median charge = $7,406, mean = 10,985 ± 14,772) (p = 0.0001). However, LOS was also longer among patients who died than those who survived (14.1 ± 22.3 vs. 9.2 ± 13.7 days, p = 0.0001), suggesting that day charges may explain some of the difference in total charges between those who survived and those who did not. Among all individuals, LOS was strongly related to hospital charges (r = 0.76, p = 0.0001). The positive relationship between LOS and charges was significant among patients in all quartiles of LOS, suggesting that the LOS–charges interaction was not restricted to patients with extreme or outlier values of either or both variables. Using the non-parametric Spearman rank correlation coefficient also confirmed a strong positive association between LOS and charges (r = 0.85, p = 0.0001). In addition, the logarithm of LOS had a significant positive relationship with both charges (Pearson r = 0.62, p = 0.0001) and the logarithm of charges (Pearson r = 0.83, p = 0.0001).

As would be expected, the utilization of virtually all technical and invasive procedures was associated with higher hospital charges. For example, compared with those not undergoing

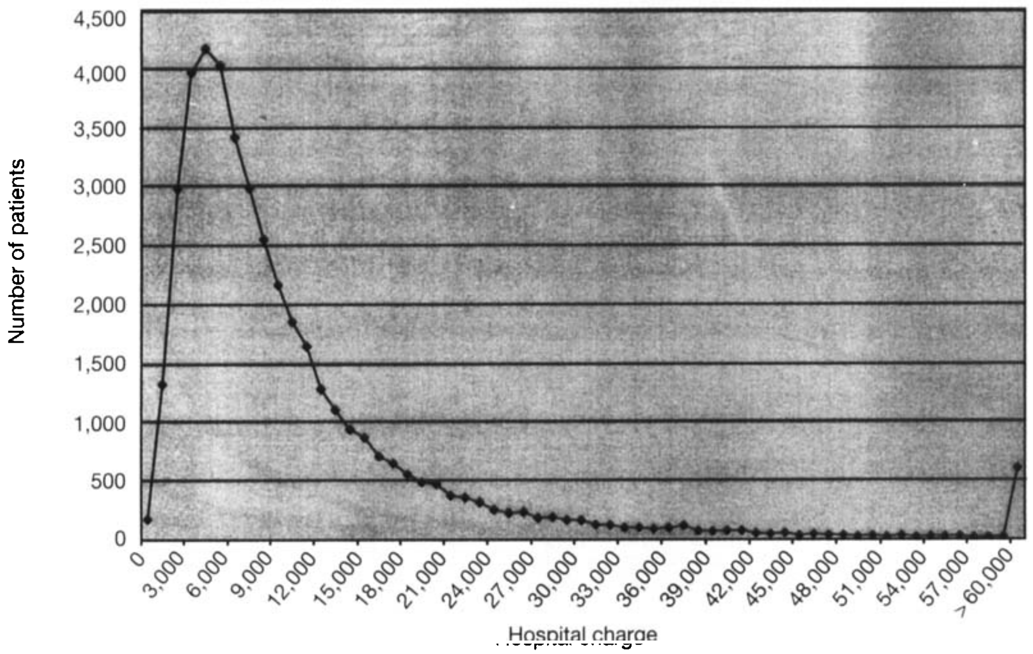

FIG. 1 Frequency distribution of hospital charges for 43,157 patients with heart failure.

TABLE III The best linear regression model for hospital charges [a]

Independent variable	Beta coefficient $	Standard error [b]	Beta coefficient ÷ standard error	F Value	p Value
Intercept	553	78	7	50.3	0.0001
Length of stay [c]	796	3	265	63,802.7	0.0001
Any cardiac surgery	44,506	686	65	4,208.1	0.0001
Teaching hospital	3,317	91	36	1,324.4	0.0001
Mechanical ventilation	7,097	200	35	1,254.5	0.0001
Pacemaker placement	12,389	427	29	841.6	0.0001
Patient treated in ICU	2,871	102	28	784.9	0.0001

[a] r^2 for model = 0.65; F value = 13,564.4; p = 0.0001.
[b] Standard error of the beta coefficient.
[c] Units for length of stay are dollars per additional day.
Abbreviation: ICU = intensive care unit.

such procedures, charges were significantly higher among patients undergoing pulmonary artery catheterization ($31,833 ± 28,115 vs. 11,160 ± 15,478, p = 0.0001), cardiac catheterization ($22,396 ± 29,750 vs. 11,053 ± 14,983, p = 0.0001), and any cardiac surgical procedure ($75,228 ± 60,697 vs. 11,221 ± 14,906, p = 0.0001). Patients who were treated by cardiologists had slightly higher charges than those who were not ($11,921 ± 15,254 vs. 11,400 ± 16,179, p = 0.0001).

Multivariate Analyses

The results of the multivariate analyses are shown in Tables III and IV. The "best" model (Table III) as defined prospectively identified the following significant independent predictors of hospital charges: hospital LOS, the performance of any cardiac surgical procedure (coronary bypass surgery, valve replacement, or heart transplantation), teaching hospital, the use of mechanical ventilation, implantation of a permanent pacemaker, and treatment in an intensive care unit (ICU) ($r^2 = 0.65$, p = 0.0001). Because few (193 of 43,157, or 0.5%) patients actually underwent cardiac surgery, a second model for charges was developed which excluded cardiac surgery as an independent variable. The results of this second regression analysis are shown in Table IV. This alternative "best" model as defined prospectively identified the following significant independent predictors of hospital charges: hospital LOS, teaching hospital, implantation of a permanent pacemaker, the use of mechanical ventilation, the performance of cardiac catheterization, treatment in an ICU, and the performance of pulmonary artery catheterization for continuous hemodynamic monitoring ($r^2 = 0.63$, p = 0.0001).

Discussion

In this study, we examined how hospital charges for an acute episode of HF are influenced by patients' clinical features, demographic characteristics, procedure utilization, and short-term clinical outcomes, as well as hospital-specific factors. The principal findings of this study are as follows: (1)

TABLE IV The best linear regression model for hospital charges with "any cardiac surgery" omitted from the model [a]

Independent variable	Beta coefficient $	Standard error [b]	Beta coefficient ÷ standard error	F Value	p Value
Intercept	302	80	4	14.2	0.0002
Length of stay [c]	804	3	268	61,398.7	0.0001
Teaching hospital	3,264	95	34	1,189.9	0.0001
Pacemaker placement	13,540	439	31	947.9	0.0001
Mechanical ventilation	6,403	211	30	922.9	0.0001
Cardiac catheterization	7,049	241	29	852.1	0.0001
Patient treated in ICU	2,873	106	27	731.7	0.0001
PA catheterization	8,456	377	22	502.4	0.0001

[a] r^2 for model = 0.63; F value = 10,572.1; p = 0.0001.
[b] Standard error of the beta coefficient.
[c] Units for length of stay are dollars per additional day.
Abbreviations: ICU = intensive care unit, PA = pulmonary artery.

With bivariate analyses, higher charges were related to black race, Medicaid insurance, urban and teaching hospitals, higher levels of comorbid illness, death during the hospitalization, longer hospital LOS, and the utilization of technical and invasive procedures; and (2) with multivariate analyses, the most significant independent predictors of higher hospital charges were longer hospital LOS, teaching hospital, treatment in an ICU, and the utilization of cardiac surgery, permanent pacemakers, and mechanical ventilation.

The Importance of Hospital Length of Stay

The results of our study underscore LOS as a critical determinant of charges for hospital-based HF care, perhaps the most important determinant. It is equally probable that LOS is a significant determinant of hospital costs as well. In this regard, our findings are compatible with prior studies of the costs of hospital-based care for cardiac disease.[10] In our study, after accounting for other determinants of charges, each additional hospital day was associated with an increment of approximately $800 in the average total hospital bill. Although our study, being retrospective in nature, offers no proof of such an assertion, one could reasonably speculate that reducing LOS by 1 day per discharge would yield savings approximately equivalent to that dollar value. Thus, the cost of any new HF intervention or treatment which would decrease LOS should be rationally judged in comparison with the potential expense reduction associated with earlier hospital discharge. In 1996, Medicare reimbursed acute care hospitals for 709,714 hospital discharges assigned DRG 127,[11] a value which has been constant or rising for more than a decade.[12] In the current study, DRG 127 was assigned to 91% of those with an ICD-9-CM code for HF in the primary diagnosis position,[13] the remaining 9% with a primary diagnosis of HF were assigned other DRG. Thus, it is likely that there are approximately 781,000 (1.10 × 709,714) primary HF hospital admissions reimbursed annually among Medicare beneficiaries. If LOS was reduced by 1 day per HF-related discharge, we estimate that hospital charges would diminish by 625 million dollars ($800 × 781,000) annually among the Medicare population. This value represents nearly 10% of the current annual cost of inpatient HF care in the United States. Additional savings could be achieved by effecting similar reductions in LOS and charges among non-Medicare patients, who, in our sample, accounted for 22% of all HF admissions. Of course, these estimates do not include increased costs, in any, arising from additional postdischarge medical care made necessary by earlier hospital discharge.

Our speculation assumes that a reduction by 1 hospital day can be achieved without jeopardy to quality of care and without a rise in postdischarge clinical event rates.[14] In retrospective studies, we have previously observed no association between longer LOS and better clinical outcomes, including hospital survival rate, postdischarge survival rate, readmission rate, or postdischarge quality of life.[15, 16] Furthermore, we have also shown that shorter LOS during a preceding HF admission is not a significant predictor of the risk for hospital readmission for HF.[17] In like fashion, the retrospective studies of Brophy *et al.*,[18] Vinson *et al.*,[19] Krumholz *et al.*,[20] and Stearns[21] suggest that shorter LOS is not associated with worse clinical outcomes. More recently, we performed a prospective, randomized, controlled trial utilizing a critical pathway for the purpose of improving quality of care and reducing resource utilization.[22] Compared with patients treated at hospitals assigned to the control group, those treated at hospitals assigned to the treatment limb received better care, had a mean reduction in LOS of 1.0 day, and had equivalent functional status, readmission rates, and mortality after discharge. Thus, in aggregate, the prior evidence suggests that LOS for HF can be reduced without jeopardy to patient safety. The current study suggests that doing so likely incurs substantial savings by virtue of a reduction in hospital charges. Moreover, the point has been made that additional savings would likely accrue from an absolute reduction in the total number of hospital admissions for HF.[4, 23]

The Importance of Severity of Illness

The source of information for this study, an administrative data set, lacks sensitive validated measures of disease-specific illness severity. Nonetheless, a few concepts regarding burden of illness warrant comment. First, it is logical to assume that some of our significant determinants of hospital charges are proxies for severity of HF or overall illness. As mechanical ventilation, pulmonary artery catheterization, and ICU admission are more likely utilized among sicker patients with HF, it is probable that hospital charges are higher among patients who are more severely ill. This assertion is consistent with recent observations that aggressive disease management strategies which emphasize comprehensive treatment and early intervention to prevent HF exacerbations in the outpatient setting reduce health care costs among patients with advanced chronic HF.[24] Second, the relatively minor role played by direct measures of concurrent illness is noteworthy. Although our patients had a mean of 5.1 medical diagnoses (in addition to HF) and a mean Charlson Index of 2.7, none of the individual or composite indicators of comorbid illness were identified as significant predictors of hospital charges. Common as they may be, coexistent medical conditions do not appear to have a strong influence on hospital charges for HF, after adjustment for procedure use.

The Importance of Procedure Utilization

As expected, procedure use was identified as a significant determinant of hospital charges. These findings are consistent with a prior observation that processes of care are more influential on hospital LOS for HF than severity of illness.[25] Thus, it is likely that the performance of expensive but medically indicated procedures will impose a "ceiling" on the savings realized through restructuring hospital-based HF care. However, the performance of some procedures may actually lead to longer-term savings. We have shown that the performance of certain procedures (including echocardiography and cardiac catheterization) during a given hospitalization for HF reduces the risk of subsequent readmission for HF.[17] Moreover, in the current study, a history of cardiac surgery in the past was associated with lower hospital charges during the index admission. Finally, given the low prevalence of most major procedures during any given HF admission (cardiac surgery, 0.5%; permanent pacemaker insertion, 1.1%; and cardiac catheterization, 4.0%), it is unlikely that their performance will have a major global impact on the economic issues pertinent to the 1 million HF admissions which occur annually in this country.

Potential Limitations

This study was based on retrospective analyses of a statewide hospital discharge administrative database. Illness severity is not fully captured in such sources of data because of inadequate clinical information such as disease-specific functional status and well being, physical examination findings, laboratory results, or valid global measures of risk.[26, 27] Thus, lacking perfectly precise measures of HF severity or global health status, we cannot be sure how burden of illness truly relates to hospital charges. Second, we cannot discount the possibility that biases in hospitals' coding practices (between or within certain patient groups) affected the results of this study. Finally, the source of information for this study did not contain accurate estimates of health care costs at the patient or hospital level. As hospital charges may only approximate true costs, the quantitative implications of this study should be interpreted with caution.

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