

Longer Hospital Length of Stay is Not Related to Better Clinical Outcomes in Congestive Heart Failure

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Abstract

Efforts to reduce hospital lengths of stay (LOS) are prevalent, despite limited understanding of the clinical impact of duration of hospitalization. Thus, we sought to evaluate the clinical relevance of LOS in congestive heart failure (CHF) by studying its relationship to inpatient and post-discharge outcomes among individuals with this disorder. Ten acute care community hospitals in New York State participated in this investigation. The study population consisted of 1,402 consecutive patients, predominantly elderly, who were hospitalized for evaluation and treatment of moderately severe or severe CHF. The patients' medical records were abstracted by trained personnel immediately after hospital discharge. Patients were followed forward for six months time to track death and readmission rates, as well as functional status, quality of life, and satisfaction. Mean LOS for the group was 7.9 ± 9.2 days. Longer LOS had a neutral or negative association with patient outcomes. Specifically, longer LOS was linked to a higher adjusted mortality rate during the index hospitalization, as well as a greater adjusted risk of death during the post-discharge period. Moreover, longer LOS was associated with worse post-discharge functional class and a trend for less patient satisfaction with their physicians' care. We conclude that death becomes more prevalent and functional measures decline in association with prolonged hospital stays for heart failure. Although these findings may be of use in planning management strategies, they offer no proof that reducing the costs of care will improve clinical outcomes in CHF.

(*Am J Man Care* 1997;3:1285-1291)

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This work was supported in part by grants from the New York State Department of Health (Grant numbers C 011191, C 011696, and C 013333).

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Because the costs of inpatient management of cardiovascular disease are directly related to the duration of hospitalization,¹ length of stay (LOS) can be viewed as a surrogate for expense. Current trends, predominantly economic in origin, are exerting pressure to reduce interhospital variation in LOS for many common and expensive medical and surgical diagnoses.^{2,3} Congestive heart failure (CHF) is the major cause for hospital admission among patients over the age of 65 years in the United States.^{4,5} Because the bulk of costs of heart failure care are derived from hospital admissions, many believe that reducing hospital days will yield significant savings.⁴

Efforts to reduce LOS have been met with a mixed response from physicians.⁶ Shortening hospital stays affects physicians in a mixed way. From the clinical perspective, physicians have traditionally viewed the hospital environment as one which, by virtue of its monitoring, diagnostic, and therapeutic capabilities, affords patients their greatest protection from harm. In medically marginal cases, some physicians opt to hospitalize patients in order to afford themselves greater protection from legal liabilities. The economic impact is variable, being a function of who (provider or insurer) bears the financial risk.

We reasoned that compliance with initiatives to shorten LOS in CHF could be enhanced by better understanding of the relationship between duration of hospitalization and measurable patient outcomes. Thus, we sought to learn more about the clinical implications of LOS by studying its associations with endpoints such as death and readmission. Using aggregate data for each institution, we found that mean LOS is not related to inpatient mortality rates.⁷ However, there are few published, large, multicenter studies of the relationship between patients' LOS and their outcomes among individuals with this disorder.⁸⁻¹⁰ We hypothesized that longer LOS would have a neutral or negative association with clinical outcomes.

... METHODS ...

Patients

The database of the Management to Improve Survival in Congestive Heart Failure (MISCHF) Study was utilized. The design of the MISCHF Study has been reported.¹¹ In brief, this ongoing project involves the collaboration of 10 acute care community hospitals in the study of improvement of the quality of care for heart failure patients. Between April 1 and December 31, 1995, all patients assigned diagnosis-related group (DRG) 127 (CHF and shock) were enrolled. In addition, patients assigned DRG 124 (cardiac catheterization with complex diagnosis), whose principal diagnosis was one of the ICD-9 codes required for assignment of DRG 127, were also included. By current coding standards, this latter group includes patients whose principal diagnosis was compatible with CHF, but by virtue of having undergone diagnostic cardiac catheterization, were assigned DRG 124 instead of DRG 127.^{12,13} By the definition of DRG assignment, patients with a secondary diagnosis of CHF and those undergoing invasive treatment strategies such as cardiac surgery were excluded from the study. The MISCHF Study was approved by the institutional review boards of all of the participating centers.

Chart Review and Patient Follow-up

The medical records of all eligible patients were thoroughly abstracted by trained personnel immediately after hospital discharge. Hospital LOS was defined as the date of discharge or death minus the date of admission. In cases where the date of discharge or death was the same as the date of admission, a LOS value of one day was designated. The presence of CHF was confirmed by the investigators based on the presence of appropriate medical history, physical findings, laboratory results, and response to appropriate therapy. Comorbid illness was quantified using the Charlson Index.¹⁴ Hospital charges were obtained from the institutions' computer databases. For patients with more than one eligible hospitalization during the study period, the first was chosen as the index admission for this analysis.

Survivors were followed for six months after hospital discharge, being contacted by telephone three times during this period to track rates of death and hospital readmission. The first telephone contact occurred 2 to 6 weeks after discharge, the second 3 to 4 months after discharge, and the third 6 to 7 months after discharge. The causes of rehospitalization and death were determined by discussion with the patient

(where appropriate), the family, and the attending physician, and by review of the patient's hospital records and death certificate. Quality of life, measured with the Ladder of Life questionnaire,¹⁵ and New York Heart Association functional class were assessed during each telephone interview. Patients were queried regarding their perception of how successful their cardiac care had been, in terms of improving their quality of life. Responses to this question, called the "Perceived Clinical Effectiveness Score" were graded on a Likert scale from 1 to 5. A score of 1 on "Perceived Clinical Effectiveness" indicated a perception of very successful therapy, while 5 reflected the perception of failed management. During each telephone call, patients indicated their compliance with dietary recommendations on a scale from 1 to 5, with 1 indicating high compliance and 5 indicating poor compliance. Also pharmacologic compliance was ranked on a scale from 0 to 100, a value proportional to the reported percentage of daily prescribed medications actually consumed. During the first post-discharge telephone interview only, patients expressed their satisfaction with institutional services and with their doctor's care during their recent hospitalization. Responses to both questions were graded on a Likert scale from 1 to 5, with a score of 1 indicating high satisfaction and a score of 5 indicating low satisfaction.

Data Management and Statistical Analyses

Raw data obtained by chart review were double-entered by experienced clerks on a personal computer at a core laboratory using commercially available software (Q&A, Symantec Corporation, Cupertino, CA). Data were later transferred to a VAX-3190 computer using SAS software (SAS Institute, Cary, NC)¹⁶ for statistical analyses.

To determine the relationship between duration of hospitalization and dichotomous outcomes among individual patients, mean LOS was compared between those experiencing the endpoint of interest and those not, using Student's *t* test. For continuous outcomes, the relationship between LOS and the endpoint of interest was assessed using two-variable linear regression. To account for severity of illness, all of the patient-specific historical features and laboratory results identifiable on admission to the hospital (exclusive of processes of care) were entered into a multiple logistic regression model for death using forward stepwise selection. Those clinical variables remaining in this model ($P < 0.15$) were then entered as independent variables, together with LOS, into multiple regression models for the outcomes of interest. To do this, logistic regression was used for dichotomous out-

come variables and linear regression was used for continuous outcome variables. In interpreting results, a *P* value of < 0.05 was considered statistically significant. In this article, results are given as mean ± standard deviation.

... RESULTS ...

The mean acute care bed capacity of the hospitals participating in the MISCHF Study was 206 (median of 220). Eight of the institutions had fully equipped and staffed intensive care unit services. Four of the hospitals had cardiac catheterization laboratories actively performing procedures; adult cardiac surgical services were offered at only one. None of the institutions offered programs of tertiary-level care for patients with CHF such as cardiac transplantation. Freestanding or affiliated residency training programs in internal medicine and/or family practice existed at two. Two of the ten hospitals had strong official affiliations with at least one United States medical school, although neither was considered the primary or "university" teaching hospital of its affiliated institution.

A total of 1,402 patients were enrolled in the MISCHF trial during the study period. The clinical characteristics of these subjects are displayed in Table 1. The majority of patients had severe or moderately severe CHF, with 88% recorded as New York Heart Association functional class III or IV at the time of hospital admission. The principal discharge ICD-9 diagnosis code listed on the discharge abstract was "Congestive Heart Failure" (428, 428.0 or 428.1) in 90% of cases. Only one patient was noted to have a principal discharge ICD-9 diagnosis code compatible with cardiogenic shock (785.51). Clinical CHF was determined by the investigators to be the primary medical problem in 96% of cases. Among those whose primary cause of CHF was documented, chronic ischemic heart disease/previous myocardial infarction was the most common etiology (44%).

Mean hospital LOS for the 1,402 subjects was 7.9 ± 9.2 days. Figure 1 shows the frequency distribution of admissions and discharges by day of the week. Admission was most frequent on Tuesday (18.1% of admissions) and least frequent on Saturday (9.9%). Discharge was most frequent on Friday (21.1% of discharges) and least frequent on Sunday (7.3%). However, LOS was equivalent among patients admitted (*P* = 0.38) and discharged (*P* = 0.48) on each of these seven days of the week.

Seventy-nine patients (5.6%) died during the index hospitalization, with the majority of the deaths attributed to cardiovascular causes. Among survivors, 45.7% were readmitted to a hospital for any cause at least

once within 6 months of initial discharge, while 25.3% were readmitted at least once for CHF. Among those surviving their index hospitalization, 17.9% died within 6 months of discharge. The cumulative 6-month mortality for the study group was 22.4%.

Mean hospital charges for the group was \$7,507 ± \$6,658. LOS was strongly and positively related to total hospital charges (*r* = 0.817, *P* < 0.000001). A regression formula for prediction of total hospital charges from LOS was developed: Charges = \$2,876 plus (\$589 times LOS in days).

Table 1. Demographic Characteristics, Medical History, and Laboratory Test Results of Patients Hospitalized with Congestive Heart Failure (N = 1,402)

Clinical Feature*	
Female	57%
Age (y)	75.2 ± 11.6
White	94%
Medicaid insurance	6%
Etiology of congestive heart failure	
Acute ischemia or infarction	6.2%
Chronic ischemic/previous infarction	30.6%
Hypertensive heart disease	10.1%
Valvular heart disease	10.2%
Alcohol-related	0.6%
Idiopathic	1.3%
Cor pulmonale	1.2%
Congenital	0.2%
Other	9.7%
Unknown or not documented	29.8%
NYHA functional class at admission	3.4 ± 0.9
Duration of congestive heart failure, months	33.9 ± 42.8
Sinus cardiac rhythm present on admission ECG	65%
Cardiomegaly noted on any chest roentgenogram	80%
Left ventricular ejection fraction	0.37 ± 0.15
Serum sodium at admission, mmol/dL	139 ± 5
Serum creatinine at admission, mg/dL	1.6 ± 1.5

NYHA = New York Heart Association; ECG = electrocardiogram; mmol/dL = millimoles per deciliter; mg/dL = milligrams per deciliter
*Categorical variables are reported as percentage of group; continuous variables are reported as mean with standard deviation.

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The relationships between LOS and crude dichotomous patient outcomes are displayed in Table 2. As a general trend, LOS during the index hospitalization

was longer among patients experiencing a study endpoint than it was for those who did not have such an event. These differences achieved statistical significance when

LOS was stratified by the occurrence of the following endpoints: all-cause mortality during the index hospitalization, all-cause mortality during the post-discharge period, cumulative all-cause mortality, CHF mortality during the post-discharge period, and cumulative CHF mortality. In no case was the occurrence of a crude study endpoint associated with a significantly shorter mean LOS.

Together, sudden cardiac death and progressive CHF were cited as the primary cause of death during the index hospitalization in 65 of the 79 cases (82%). Mean LOS was equivalent among those with sudden cardiac death and those dying of intractable CHF ($P = 0.26$).

The relationships between LOS and crude continuous patient outcomes are displayed in Table 3. As a general trend, longer LOS during the index hospitalization was associated with measures of worse functioning, poorer outcome, and less patient satisfaction. Statistical significance was achieved for the relationship between LOS and New York Heart Association functional class assessed one month after discharge. Trends of borderline significance were observed for the relationships between longer LOS and less satisfaction with physicians' care ($P = 0.10$), and lower average Ladder of Life score ($P = 0.11$). In no case was longer LOS associated with a significantly better crude functional, outcome, or satisfaction measure.

The regression model for death derived to identify severity covariables retained the following independent predictors: the presence of ventricular arrhythmia, admission from a nursing home, New York Heart Association class IV at admission, lower serum sodium,

Figure 1. Frequency Distribution of Admissions and Discharges by Day of the Week

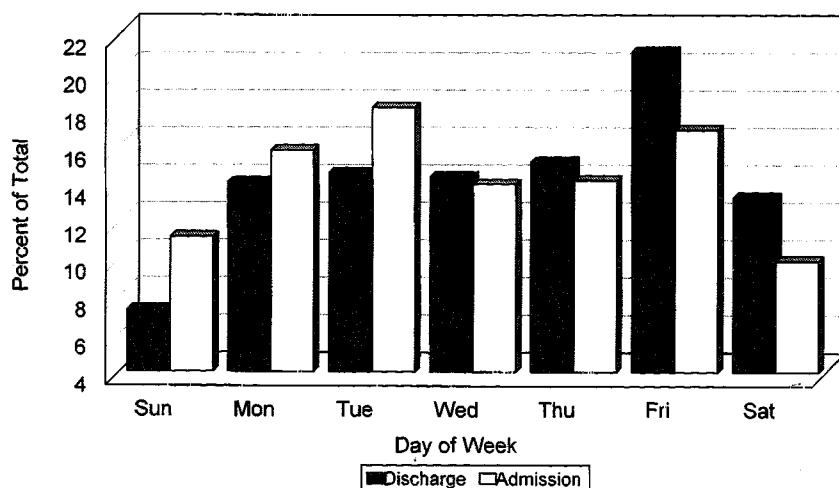


Table 2. Differences in Crude Mean Length of Stay (LOS) Between Patients Experiencing Study Endpoints and Those Not Experiencing the Same Endpoints

Clinical Event	LOS of Patients (+) Event	LOS of Patients (-) Event	P
Inpatient Outcome			
All-cause mortality*	11.7 ± 14.9	7.7 ± 8.7	0.02
Outcomes Following Discharge			
All-cause readmission	7.6 ± 7.9	8.1 ± 9.8	0.36
Readmission for CHF	8.4 ± 9.7	7.8 ± 9.1	0.32
All-cause mortality*	9.5 ± 8.5	7.7 ± 9.3	0.01
CHF mortality*	10.5 ± 9.5	7.7 ± 9.1	0.005
Non-CHF mortality	8.6 ± 7.4	7.9 ± 9.3	0.33
Readmission or death	7.7 ± 7.8	8.1 ± 10.0	0.46
Cumulative Outcomes			
All-cause mortality*	10.1 ± 10.7	7.4 ± 8.7	0.0001
CHF mortality*	11.0 ± 11.9	7.6 ± 8.7	0.0007
Non-CHF mortality	9.1 ± 9.0	7.8 ± 9.2	0.13
Readmission or death	8.2 ± 9.1	7.7 ± 9.3	0.30

*Indicates that LOS remained significant after adjustment for patient severity (see text).

lower creatinine clearance, and higher Charlson Index. The c-statistic for this model was 0.80. When entered into logistic and linear regression models for the clinical outcomes shown in Tables 2 and 3, together with these other six covariables, longer LOS retained independent predictive value for all-cause mortality during the index hospitalization (odds ratio (OR) = 1.034, $P < 0.0001$); all-cause mortality during the post-discharge period (OR = 1.017, $P = 0.03$); CHF mortality during the post-discharge period (OR = 1.021, $P = 0.01$); cumulative all-cause mortality (OR = 1.028, $P = 0.0005$); cumulative CHF mortality (OR = 1.034, $P < 0.0001$); and higher New York Heart Association functional class at the first post-discharge follow-up ($\beta = 0.014$, $P = 0.04$). In no case was longer LOS associated with a significantly improved severity-adjusted clinical outcome.

... DISCUSSION ...

Hospitalization allows the patient concentrated and sustained exposure to the healthcare delivery system where more monitoring, diagnostic, and therapeutic services can be provided per unit time than in the home. Because these services are intended to improve patients' quality of life and/or reduce their risk for death or readmission, one could speculate that shorter hospital stays are associated with worse patient outcomes. Conversely, prolonged contact with the hospital environment increases the patient's cumulative exposure to potential threats, which range from nosocomial infections to iatrogenic injury. Thus, it would be equally sensible to postulate that longer hospital stays contribute to poorer outcomes. Finally, an association between these entities could be indirect. Specifically, LOS might be a marker for severity of illness, without incremental independent predictive value of its own. Despite the range of potential and unknown interactions between LOS and outcomes, many institutions have committed zealously to reducing the preferred "dose" of hospital days in CHF without a firm understanding of its impact on the natural history of this syndrome.

Thus, we sought to improve understanding of the clinical implications of LOS by examining its relationship with patient outcomes. Our

results suggest that longer hospital stays are not associated with better patient outcomes. Specifically, longer LOS was linked to a higher adjusted mortality rate during that hospitalization, as well as a greater adjusted risk of death during the post-discharge period. Moreover, longer LOS was associated with significantly worse post-discharge functional class and a trend for less patient satisfaction with their physicians' care. Thus, patients with CHF who have shorter LOS appear to have outcomes equivalent or superior to those with longer hospital stays.

Being based on observational and retrospective data, these conclusions do not serve as proof that a reduction in LOS would cause an improvement in quality of life or survival. In fact, it is probable that severity of illness and processes of care are the important determinants of outcome, upon which duration of hospitalization has minimal additional independent effect. However, in the absence of large prospective, randomized studies, our preliminary finding that shorter hospital stays are not associated with inferior outcomes may offer some guidance and reassurance to investigators and clinicians who are grappling with issues of resource utilization in heart failure. Furthermore, these results are evidence against two common notions. First, these data suggest that extended hospital stays are not protective of future

Table 3. The Relationship Between Length of Stay (LOS) and Crude Continuous Patient Outcomes Using Two-Variable Linear Regression

Clinical Outcome	Beta Coefficient	P	r ²
Outcomes 1 month following discharge			
Ladder of Life score	-0.12	0.22	0.0023
New York Heart Association functional class *	0.47	0.03	0.007
"Perceived Clinical Effectiveness" score	0.24	0.21	0.002
"Satisfaction With Hospital Care" score	0.31	0.19	0.003
"Satisfaction With Physician's Care" score	0.38	0.10	0.004
Medical compliance score	0.06	0.43	0.0009
Dietary compliance score	-0.26	0.17	0.003
Outcomes over 6 months following discharge			
Mean Ladder of Life score	-0.27	0.11	0.007
Mean New York Heart Association functional class	0.53	0.13	0.006
Time to first any-cause readmission, days	-0.005	0.43	0.001
Time to first CHF readmission, days	-0.004	0.67	0.0007
Time to death, days	-0.003	0.85	0.0004

*Indicates that LOS remained significant after adjustment for patient severity (see text).

untoward events. For example, longer hospital stays afforded no protection against hospital readmission. Second, these results are evidence against the notion that elderly patients will express less satisfaction with physicians who discharge them from the hospital earlier. Perhaps, these data suggest that functional status and other social and biologic factors are greater determinants of satisfaction than is duration of hospitalization.

These findings are consistent with the results of other studies. We have examined aggregate hospital data that demonstrate no relationship between mean LOS and hospital mortality rate among 3,912 patients admitted to 15 community hospitals during 1992.⁷ In addition, we have observed that LOS is more closely related to the processes and systems of care than markers of CHF severity.¹⁷ Stearns⁸ concluded that longer LOS was not related to a lower risk for postadmission mortality among patients hospitalized with CHF during 1982 and 1983. Vinson and colleagues⁹ observed no difference in median LOS during the index hospitalization between 66 patients readmitted and 74 not, in a small study of elderly subjects with CHF. Brophy and coworkers¹⁰ showed that hospital LOS was not related to the combined endpoints of death and hospital readmission among 153 subjects. Rich and colleagues¹⁸ demonstrated that a nurse-directed CHF care management program reduced LOS while reducing hospital readmission rate. Finally, our observation of a bias toward Friday discharges is consistent with the theory of Miller et al. regarding the discretionary use of hospital days.¹⁹

CHF is a common disorder associated with high rates of morbidity and mortality. It has been estimated that the care of patients with CHF comprises 5.4% of the entire annual expenditure for healthcare in this country.²⁰ A pattern of medical practice that delivers care that is less effective and/or more costly than possible with available techniques²¹ may pose a risk to patients and society, in terms of both clinical and economic impact. Because we found outcomes to be inversely related to resource utilization, we speculate that cautious and well-focused cost-savings initiatives could be executed without great risk of worsening patient morbidity and mortality rates. In the wake of these findings, our consortium has begun a multicenter clinical trial of quality improvement and cost-reduction measures in CHF management, using a randomized, controlled design.¹¹ To reduce inefficiencies in practice patterns, an evidence-based clinical care pathway is the cornerstone of this program. We propose that additional studies are necessary to document practice patterns on a

more widespread basis, and to devise, implement, and test methods of quality improvement and cost-reduction in heart failure.

Acknowledgment

We wish to gratefully acknowledge the skill and dedication of those who audited medical records for the purpose of this study.

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