Day of Admission and Clinical Outcomes for Patients Hospitalized for Heart Failure

Findings From the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF)

Gregg C. Fonarow, MD; William T. Abraham, MD; Nancy M. Albert, RN, PhD; Wendy Gattis Stough, PharmD; Mihai Gheorghiade, MD; Barry H. Greenberg, MD; Christopher M. O’Connor, MD; Eduardo Nunez, MD; Clyde W. Yancy, MD; James B. Young, MD

Background—Differences in hospital staffing may influence outcomes for patients with acute conditions, including heart failure (HF), depending on which day of the week the patients are admitted. This study examined the relationship between the day of the week patients are hospitalized for HF and death rate, length of stay (LOS), and rehospitalization rate.

Methods and Results—A total of 259 US hospitals participating in the Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF) submitted data on 48,612 patients with HF. Sixty- to 90-day postdischarge follow-up data were collected prospectively in a prespecified 10% sample. We analyzed day of admission and discharge, demographic, medical history, medication use, laboratory, and in-hospital procedure data for their association with hospital LOS and death rate. Patient characteristics were similar for weekday and weekend presentation. LOS was a median of 4.0 days and a mean of 5.7±0.7 days; in-hospital death rate was 3.8%. In-hospital and postdischarge risk of death were similar for each day of the week in the hospital and follow-up cohorts, respectively. LOS, however, was significantly influenced by day of admission, even after adjustment for other LOS risk factors. The shortest LOS by admission day of the week was Tuesday (5.39 days), and the longest was Friday (5.88 days; P<0.001).

Conclusions—No differences in death rate by day of admission or discharge for HF hospitalizations were evident. Hospitalizations for HF on Thursday and Friday were associated with prolonged LOS. Understanding the factors responsible for the increased LOS and potential adjustments in staffing to facilitate weekend discharges may improve the efficiency of HF hospital care. (*Circ Heart Fail*. 2008;1:50-57.)

Key Words: heart failure ■ length of stay ■ registries ■ mortality ■ hospitalization

Heart failure (HF) is among the leading cause of hospitalizations, and these hospitalizations contribute substantially to the high costs of the disease. There are at least 3.6 million hospitalizations with HF as the primary or a secondary cause each year in the United States.1,2 The estimated annual cost of HF is $33.2 billion, with much of this attributable to the costs of hospitalization.1 HF hospitalizations are also associated with substantial morbidity and mortality.3,4 Understanding factors that influence care and clinical outcomes for patients hospitalized with HF, particularly those that are modifiable, is important and may identify strategies to improve HF outcomes.

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Most acute-care hospitals provide routine care with full staff on the weekdays and work on a more limited or reduced staff complement on weekends.5 Furthermore, there are differences in physician coverage of patients on weekdays compared with weekends. Recent studies suggest admission on the weekends is associated with a higher death rate than...
weekday admissions for acute myocardial infarctions and other serious medical conditions.6,7 Admission and discharge day of the week may also influence hospital length of stay (LOS).8 These studies underscore potential adverse consequences of reduced hospital and physician staffing on weekends. Little is known, however, as to whether the day of the week on which patients are hospitalized for HF is associated with differences in clinical outcomes.

The Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure (OPTIMIZE-HF) is a registry and performance-improvement program for patients hospitalized with HF.9 The objectives of the present analysis of OPTIMIZE-HF data are to determine the relationship between the day of the week patients are hospitalized with HF and clinical outcomes, including hospital LOS, in-hospital death, and early postdischarge death and death/rehospitalization. We also assessed the relationship of day of hospital discharge with postdischarge clinical outcomes.

Methods

OPTIMIZE-HF is a comprehensive, hospital-based registry and process-of-care improvement program designed to provide optimal medical care and education to patients hospitalized for HF. The OPTIMIZE-HF program has been described in detail previously9–12 and will be summarized briefly here. Patients qualified for enrollment if they were hospitalized for episodes of new or worsening HF as the primary cause of admission or if significant HF symptoms developed during hospitalization for another primary diagnosis, with HF being the primary discharge diagnosis.9–12 Consecutive patients were enrolled irrespective of their ventricular function, including systolic dysfunction documented by a left ventricular ejection fraction <40%, HF symptoms in the setting of preserved left ventricular systolic function (diastolic dysfunction HF), or HF without left ventricular function measurement.9–12 Hospital teams used HF case-ascertainment methods similar to those of the Joint Commission on Accreditation of Healthcare Organizations.13

From March 1, 2003, to December 31, 2004, 48 612 patients hospitalized at 259 centers in the United States were enrolled in the OPTIMIZE-HF registry. All regions of the United States were represented, and institutions from community hospitals to large tertiary medical centers participated.9–11 A prespecified patient representation, including serum sodium and serum creatinine; left ventricular systolic dysfunction status. The generalized estimating equation logistic model for postdischarge death or rehospitalization included the following variables: LOS; prior history of chronic obstructive pulmonary disease and diabetes mellitus; procedures, including coronary angiography, mechanical ventilation, and cardiac resynchronization therapy placement; discharge medications, including angiotensin-converting enzyme inhibitor, angiotensin receptor blocker, hydralazine, and lipid-lowering agent; discharge vital signs, including heart rate and systolic blood pressure; admission laboratory values, including elevated troponin I, sodium, hemoglobin, and creatinine; and left ventricular systolic dysfunction status. The generalizability of the results to other settings was assessed using a combination of average annualized rates of hospitalization and postdischarge death and rehospitalization across days of the week. The authors had full access to the data and take full responsibility for the integrity of the data. All authors have read and agreed to the manuscript as written.

Results

Clinical Characteristics of Patients Hospitalized for HF

OPTIMIZE-HF enrolled a total of 48 612 patients hospitalized for HF at 259 academic and community hospitals of
various sizes from all regions of the United States. The patient characteristics and institutional demographics of hospitals participating in the hospital and follow-up cohorts have been published previously and were similar.10–12 Mean patient age was 73.1 years; 52% of patients were female, and 74% were white (Table 1). Comorbidities were frequent, including hypertension in 71%, diabetes mellitus in 42%, and chronic obstructive pulmonary disease in 28%. HF origin was ischemic in 46% of enrolled patients, and the mean left ventricular ejection fraction was 39%. Of those patients assessed, 48.8% had documented left ventricular systolic dysfunction, and 51.2% had HF with preserved systolic function. The follow-up cohort included 5791 patients, whose characteristics were similar to those of the overall registry. Patient characteristics were similar for those admitted by day of the week (Table 1). Patient characteristics were also similar when patients admitted on weekdays were compared with those admitted on weekdays (data not shown).

The distributions of hospitalizations by the admission and discharge day of the week are shown in Figure 1. The frequency of admission and discharge varied significantly by day of the week (both \( P<0.0001 \)). Monday was the most frequent day of admission for heart failure (17.8%) and Saturday the least frequent day (10.8%). The majority of patients were admitted to the hospital from the emergency department (74.4%), which ranged from 69.9% on Thursday to 89.5% on Sunday (Table 1). Friday was the most frequent day of discharge (19.4%), and Sunday was the least frequent (7.1%). There were 37,866 (77.9%) of 48,612 patients admitted to the hospital on a weekday, and 10,746 (22.1%) of 48,612 hospitalized on a weekend. Hospital discharges on weekends were modestly less frequent than admissions (absolute difference 4.1%, \( P<0.001 \)), with 37,293 (82.0%) of 45,469 of patients discharged from the hospital on a weekday and 8176 (18.0%) of 45,469 discharged during the weekend.

**In-Hospital Deaths**

There were 1834 in-hospital deaths reported among 48,612 enrolled patients (3.8%). In-hospital death rates did not substantially differ by admission day of the week, ranging from 3.4% to 4.1% (\( P=0.19 \)) as shown in Table 2. On multivariable analysis, admission day of the week was not predictive of in-hospital death (Table 2). When analyzed by admission on a weekend versus weekday, the in-hospital death rates did not significantly differ. Weekend admission was not associated with an increase in in-hospital death rate on multivariable analysis compared with weekday admission (OR 0.99, 95% CI 0.84 to 1.17).

**Hospital LOS**

The median hospital LOS was 4.0 days (25th to 75th percentile interquartile range 3.0 to 7.0), and mean LOS was 5.7±5.7 days. Hospital LOS varied significantly by the day of admission. Hospitalizations for HF on Sunday, Monday, and Tuesday resulted in the shortest hospital LOS, whereas hospitalizations on Thursday and Friday were associated with the longest LOS (Table 2). The shortest LOS by admission day of the week was Tuesday (5.59 days), and the longest was Friday (5.88 days; \( P<0.001 \)). On adjusted analyses, admission days Thursday and Friday were independent predictors of longer LOS. No other admission day was associated with shorter or longer LOS (Figure 2). When analyzed for weekend versus weekday admission day, no significant differences were found for LOS on unadjusted or adjusted analyses.

**Sixty- to 90-Day Postdischarge Outcomes**

During the 60- to 90-day period after hospital discharge, there were 481 deaths in the follow-up cohort (6.7%), which occurred a median of 42 days (25th to 75th percentile interquartile range 24 to 66 days) after discharge. Rehospitalization during the follow-up period occurred in 1715 patients (29.6%). The combined end point of death/rehospitalization was met in 1909 (34.9% of patients). Postdischarge death, death/rehospitalization, and rehospitalization rates did not differ by admission day of the week (Table 3). On adjusted analyses, admission day of the week was also not predictive of postdischarge death, death/rehospitalization, or rehospitalization (Table 3). When analyzed by admission on a weekend versus weekday, postdischarge death, death/rehospitalization, and rehospitalization rates did not differ significantly. Weekend admission was not associated with a significant increase in postdischarge death, death/rehospitalization, or rehospitalization rates on multivariable analysis (HR 1.16, 95% CI 0.87 to 1.55; OR 1.03, 95% CI 0.91 to 1.18, and OR 1.07, 95% CI 0.91 to 1.26, respectively).

Discharge day of the week was not associated with significantly different postdischarge death, death/rehospitalization, or rehospitalization rates on unadjusted or adjusted analyses (Table 4). Weekend versus weekday discharge was also not associated with a significant increase in postdischarge death, death/rehospitalization, or rehospitalization rates on multivariable analysis (HR 1.21, 95% CI 0.88 to 1.67; OR 1.05, 95% CI 0.88 to 1.24 and OR 1.10, 95% CI 0.92 to 1.31, respectively).

**Discussion**

OPTIMIZE-HF has demonstrated that among a large, representative population of patients admitted to the hospital for HF, no differences in in-hospital or early postdischarge death rates by the day of admission were evident. The risk of postdischarge death/rehospitalization or rehospitalization also did not differ by day of admission. Furthermore, the day of the week in which hospital discharge occurred did not appear to influence postdischarge clinical outcomes. The day of the week patients were hospitalized for HF did, however, significantly influence hospital LOS. Hospitalizations for HF on Thursday and Friday were associated with prolonged LOS. These findings provide important insights into factors that may or may not influence the quality and efficiency of hospital care and outcomes for HF patients.

Hospital staffing is reduced on Saturdays and Sundays in both the number of staff and level of experience.5,14 Also, fewer supervisors are present in the hospital on weekends.14 In addition, the level of physician coverage for patients also differs on weekends in most hospital settings, and the weekend physician staff frequently provide coverage for other health professionals and thus may be less familiar with the patients under their care.15,16 These differences in hospital...
<table>
<thead>
<tr>
<th>Variables</th>
<th>Hospital Cohort (n=49612)</th>
<th>Sunday (n=5528)</th>
<th>Monday (n=5528)</th>
<th>Tuesday (n=7706)</th>
<th>Wednesday (n=7707)</th>
<th>Thursday (n=7715)</th>
<th>Friday (n=5210)</th>
<th>Saturday (n=5210)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>72±14</td>
<td>73±14</td>
<td>73±14</td>
<td>73±14</td>
<td>73±14</td>
<td>72±14</td>
<td>72±14</td>
<td>74±14</td>
</tr>
<tr>
<td>Female, %</td>
<td>51.6</td>
<td>51.1</td>
<td>50.6</td>
<td>51.0</td>
<td>50.9</td>
<td>51.1</td>
<td>53.0</td>
<td>54.3</td>
</tr>
<tr>
<td>White, %</td>
<td>76.4</td>
<td>75.4</td>
<td>75.9</td>
<td>76.4</td>
<td>76.4</td>
<td>76.4</td>
<td>77.4</td>
<td>76.7</td>
</tr>
<tr>
<td>Black, %</td>
<td>18.2</td>
<td>18.5</td>
<td>19.0</td>
<td>18.1</td>
<td>17.8</td>
<td>18.7</td>
<td>17.3</td>
<td>18.0</td>
</tr>
<tr>
<td>Admission from the emergency department, n (%)</td>
<td>36 188 (74.4)</td>
<td>49 486 (89.5)</td>
<td>60 070 (70.1)</td>
<td>54 737 (70.2)</td>
<td>51 285 (70.5)</td>
<td>50 000 (89.9)</td>
<td>49 893 (71.3)</td>
<td>45 086 (87.9)</td>
</tr>
<tr>
<td>Admission from the outpatient setting, n (%)</td>
<td>91 444 (18.8)</td>
<td>214 (2.3)</td>
<td>2041 (23.6)</td>
<td>1836 (23.6)</td>
<td>16 35 (22.5)</td>
<td>16 52 (23.1)</td>
<td>1478 (21.2)</td>
<td>288 (5.5)</td>
</tr>
<tr>
<td>Transfer from skilled nursing facility, hospital or other source, n (%)</td>
<td>3280 (6.8)</td>
<td>366 (6.6)</td>
<td>549 (6.3)</td>
<td>487 (6.3)</td>
<td>514 (7.1)</td>
<td>499 (7.0)</td>
<td>521 (7.5)</td>
<td>344 (6.6)</td>
</tr>
<tr>
<td>Ischemic cause of HF, %</td>
<td>45.7</td>
<td>47.1</td>
<td>45.6</td>
<td>45.8</td>
<td>46.4</td>
<td>45.6</td>
<td>44.9</td>
<td>44.7</td>
</tr>
<tr>
<td>Gastroesophageal reflux, %</td>
<td>11.5</td>
<td>11.7</td>
<td>12.0</td>
<td>11.8</td>
<td>12.0</td>
<td>11.0</td>
<td>11.5</td>
<td>11.6</td>
</tr>
<tr>
<td>Left atrial systolic dysfunction, %</td>
<td>48.8</td>
<td>48.0</td>
<td>48.7</td>
<td>50.1</td>
<td>49.3</td>
<td>48.5</td>
<td>48.1</td>
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</tr>
<tr>
<td>Left ventricular ejection fraction, mean±SD, %</td>
<td>39±18</td>
<td>39±17</td>
<td>39±18</td>
<td>38±18</td>
<td>39±18</td>
<td>39±18</td>
<td>39±18</td>
<td>40±18</td>
</tr>
<tr>
<td>Weight, mean±SD, kg</td>
<td>83±26</td>
<td>81±25</td>
<td>83±26</td>
<td>83±26</td>
<td>83±26</td>
<td>83±27</td>
<td>82±26</td>
<td>81±26</td>
</tr>
<tr>
<td>Systolic blood pressure, mean±SD, mm Hg</td>
<td>143±33</td>
<td>145±34</td>
<td>142±33</td>
<td>142±32</td>
<td>142±32</td>
<td>141±33</td>
<td>145±34</td>
<td>145±34</td>
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<tr>
<td>Diastolic blood pressure, mean±SD, mm Hg</td>
<td>76±19</td>
<td>77±20</td>
<td>76±19</td>
<td>77±19</td>
<td>76±19</td>
<td>76±19</td>
<td>77±19</td>
<td>77±19</td>
</tr>
<tr>
<td>Sodium, mean±SD, mEq/L</td>
<td>138±5</td>
<td>138±5</td>
<td>138±5</td>
<td>138±5</td>
<td>138±5</td>
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<td>138±5</td>
</tr>
<tr>
<td>Serum creatinine, mean±SD, mg/dL [SI units (μmol/L)]</td>
<td>1.77±1.55</td>
<td>1.91±1.84</td>
<td>1.87±1.77</td>
<td>1.79±1.65</td>
<td>1.71±1.44</td>
<td>1.68±1.3</td>
<td>1.67±1.24</td>
<td>1.73±1.48</td>
</tr>
<tr>
<td>Hemoglobin, mean±SD, g/dL [SI units (mmol/L)]</td>
<td>12.1±2.04</td>
<td>12.1±2.06</td>
<td>12.2±2.06</td>
<td>12.1±2.05</td>
<td>12.1±2.07</td>
<td>12.1±2.07</td>
<td>12.1±2.04</td>
<td>12.1±1.99</td>
</tr>
<tr>
<td>Lactate dehydrogenase, mean±SD, U/L</td>
<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
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<tr>
<td>Lactate dehydrogenase, mean±SD, U/L</td>
<td>258±131</td>
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<tr>
<td>Lactate dehydrogenase, mean±SD, U/L</td>
<td>258±131</td>
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<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
<td>258±131</td>
</tr>
</tbody>
</table>
Dromes may vary according to the day of the week, but rate of admission and the severity of acute coronary syn-
physicians hospitalized. Prior studies have suggested that the week could reflect differences in the characteristics of
large number of patients hospitalized with HF each year. Hospitalizations for this patient population because of the
translate into substantial numbers of deaths and recurrent
weekday and weekend admission of patients with HF could
result in patients admitted on the weekend who were sicker
than those admitted during the week. In the present study,
result in patients admitted on the weekend who were sicker
than those admitted during the week. In the present study,

Evidence is inconsistent with regard to the relationships between weekend hospitalization, treatment decisions, quality of care, and clinical outcomes. One study of close
to 4 million hospitalizations in Ontario, Canada, from 1988 to
1997 found that for certain medical conditions, patients
admitted on the weekend were >15% more likely to die in the hospital than were patients admitted during the week. Another study observed that there was a 9% increase in risk-adjusted death rate among patients admitted to intensive care units on weekends compared with weekdays. The Myocardial Infarction Data Acquisition System (MIDAS) study reported an increase of in-hospital risk of death that persisted up to 1 year for patients admitted during weekends. A large analysis of hospitals participating in the National Registry of Myocardial Infarction (NRMI) also suggested that off-hours presentation for acute myocardial infarction was associated with a higher in-hospital death rate. For patients hospitalized with HF, admission on weekends compared with weekdays has not been associated with an increase in deaths in prior studies. Among the 141,687 HF hospitalizations included in the Canadian study, the in-hospital death rate did not differ by weekday compared with weekends (10.8% versus 11.0%, adjusted HR 1.00, 95% CI 0.96 to 1.04). An unadjusted analysis of administrative records for patients hospitalized in California in 1998 revealed that for patients with HF (n=55,835), there was no difference in death rate for weekend admission (OR 1.03, 95% CI 0.96 to 1.12). In the present study, we did not find that risk of death among patients hospitalized with HF varied by admission day of the week or by weekday/weekend admission. These findings suggest that for HF patients, there may be adequate

**Table 2. In-Hospital LOS and Death Rate by Hospital Admission Day of the Week**

<table>
<thead>
<tr>
<th>Day</th>
<th>No. of Patients</th>
<th>LOS, d Mean±SD</th>
<th>Median (25th–75th Percentile)</th>
<th>Death Rate, %</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>5528</td>
<td>5.41±5.60</td>
<td>4 (3–6)</td>
<td>3.69</td>
<td>1.0</td>
</tr>
<tr>
<td>Monday</td>
<td>8660</td>
<td>5.49±5.70</td>
<td>4 (3–7)</td>
<td>3.43</td>
<td>1.11 (0.86–1.43)</td>
</tr>
<tr>
<td>Tuesday</td>
<td>7796</td>
<td>5.39±4.93</td>
<td>4 (2–7)</td>
<td>3.49</td>
<td>0.98 (0.76–1.28)</td>
</tr>
<tr>
<td>Wednesday</td>
<td>7277</td>
<td>5.54±5.25</td>
<td>4 (2–7)</td>
<td>3.77</td>
<td>0.99 (0.76–1.29)</td>
</tr>
<tr>
<td>Thursday</td>
<td>7151</td>
<td>5.75±5.17</td>
<td>5 (3–7)</td>
<td>3.79</td>
<td>1.02 (0.78–1.34)</td>
</tr>
<tr>
<td>Friday</td>
<td>6982</td>
<td>5.88±5.75</td>
<td>5 (3–7)</td>
<td>4.24</td>
<td>1.17 (0.90–1.52)</td>
</tr>
<tr>
<td>Saturday</td>
<td>5218</td>
<td>5.61±5.25</td>
<td>4 (3–6)</td>
<td>3.95</td>
<td>1.16 (0.88–1.53)</td>
</tr>
</tbody>
</table>

LOS, Kruskal-Wallis test P<0.0001; mortality omnibus P value unadjusted P=0.26, adjusted P=0.65 (adjusted for variables listed in Methods).

**Figure 1.** Frequency of hospitalizations by admission and discharge days of the week. Distribution of hospitalizations by admission day of the week and discharge day of the week are shown. The 95% CIs are show as bars.

**Figure 2.** Admission day of the week and risk-adjusted hospital LOS. Risk-adjusted incident rate ratio for hospital LOS and 95% CIs by admission day of the week are shown.
Table 3. Admission Day of the Week and 60- to 90-Day Multivariable Risk-Adjusted Postdischarge Outcomes

<table>
<thead>
<tr>
<th>Factor</th>
<th>Rate, %</th>
<th>Adjusted HR (95% CI)</th>
<th>P</th>
<th>Rate, %</th>
<th>Adjusted OR (95% CI)</th>
<th>P</th>
<th>Rate, %</th>
<th>Adjusted OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>7.32</td>
<td>1.0</td>
<td></td>
<td>33.7</td>
<td>1.0</td>
<td></td>
<td>28.4</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>6.66</td>
<td>0.90 (0.57–1.41)</td>
<td>0.64</td>
<td>35.0</td>
<td>1.12 (0.84–1.49)</td>
<td>0.45</td>
<td>29.9</td>
<td>1.08 (0.84–1.40)</td>
<td>0.54</td>
</tr>
<tr>
<td>Tuesday</td>
<td>7.03</td>
<td>0.76 (0.48–1.22)</td>
<td>0.26</td>
<td>33.3</td>
<td>0.96 (0.72–1.28)</td>
<td>0.79</td>
<td>27.5</td>
<td>0.89 (0.69–1.16)</td>
<td>0.40</td>
</tr>
<tr>
<td>Wednesday</td>
<td>6.33</td>
<td>0.91 (0.56–1.46)</td>
<td>0.69</td>
<td>35.2</td>
<td>1.27 (0.95–1.69)</td>
<td>0.10</td>
<td>30.0</td>
<td>1.13 (0.87–1.48)</td>
<td>0.37</td>
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<tr>
<td>Thursday</td>
<td>6.16</td>
<td>0.72 (0.44–1.18)</td>
<td>0.20</td>
<td>36.2</td>
<td>1.10 (0.83–1.46)</td>
<td>0.52</td>
<td>31.5</td>
<td>1.09 (0.83–1.42)</td>
<td>0.55</td>
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<tr>
<td>Friday</td>
<td>6.52</td>
<td>0.72 (0.44–1.20)</td>
<td>0.21</td>
<td>33.6</td>
<td>0.99 (0.78–1.24)</td>
<td>0.90</td>
<td>28.3</td>
<td>0.91 (0.69–1.20)</td>
<td>0.51</td>
</tr>
<tr>
<td>Saturday</td>
<td>7.09</td>
<td>0.88 (0.52–1.49)</td>
<td>0.63</td>
<td>38.6</td>
<td>1.26 (0.88–1.81)</td>
<td>0.20</td>
<td>32.5</td>
<td>1.20 (0.84–1.59)</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Omnibus P value death-adjusted P=0.79, death/rehospitalization-adjusted P=0.38, rehospitalization-adjusted P=0.20. Adjusted for variables listed in Methods.

The strengths of the present study include that it was performed by use of a systematic approach to data collection and was conducted in 259 US hospitals from all regions of the country using a well-defined cohort of HF patients. Another important feature of the present study is that it is the first that assessed the relationship between day of admission and clinical outcomes independent of other prognostic variables. The knowledge provided by the present study may help guide clinicians and hospital administrators in implementing more effective staffing and management strategies for hospitalized HF patients. Although day of the week for admission or discharge did not influence death or rehospitalization risk, there was a significant and independent influence on efficiency of care. The present study demonstrates that LOS was significantly influenced by day of admission, even after adjustment for other LOS risk factors. Approximately $360 million in direct costs could be eliminated each year without patients being exposed to higher risk of early death or rehospitalization. For a hospital with 1000 HF hospitalizations annually, this could translate into $330 000 or more a year in reduced costs. Future studies should be designed to prospectively test whether different weekend staffing models and other interventions to facilitate weekend hospital discharges can favorably impact hospital LOS without exposing patients to lower quality of care or higher risk of postdischarge death/rehospitalization.

Study Limitations

The present analysis of OPTIMIZE-HF may be influenced by several limitations. Follow-up data were obtained in a subset of patients being discharged on weekends. The possibility that a portion of HF patients discharged on Fridays could be leaving the hospital before they are fully stabilized. In addition, home health and other support services for Fri or weekend discharges would most often be initiated until the following Monday. However, we found no evidence that different days of the week for admission or discharge were associated with differences in postdischarge clinical outcomes.

Table 4. Discharge Day of the Week and 60- to 90-Day Multivariable Risk-Adjusted Postdischarge Outcomes

<table>
<thead>
<tr>
<th>Factor</th>
<th>Rate, %</th>
<th>Adjusted HR (95% CI)</th>
<th>P</th>
<th>Rate, %</th>
<th>Adjusted OR (95% CI)</th>
<th>P</th>
<th>Rate, %</th>
<th>Adjusted OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>5.26</td>
<td>1.0</td>
<td></td>
<td>34.4</td>
<td>1.0</td>
<td></td>
<td>30.4</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>6.49</td>
<td>1.27 (0.66–2.41)</td>
<td>0.48</td>
<td>34.7</td>
<td>0.82 (0.58–1.17)</td>
<td>0.28</td>
<td>29.1</td>
<td>0.83 (0.60–1.15)</td>
<td>0.25</td>
</tr>
<tr>
<td>Tuesday</td>
<td>6.41</td>
<td>1.02 (0.53–1.96)</td>
<td>0.96</td>
<td>34.4</td>
<td>0.80 (0.53–1.21)</td>
<td>0.29</td>
<td>29.3</td>
<td>0.80 (0.58–1.10)</td>
<td>0.17</td>
</tr>
<tr>
<td>Wednesday</td>
<td>6.93</td>
<td>1.27 (0.68–2.38)</td>
<td>0.46</td>
<td>36.8</td>
<td>0.92 (0.65–1.30)</td>
<td>0.62</td>
<td>31.2</td>
<td>0.91 (0.67–1.25)</td>
<td>0.57</td>
</tr>
<tr>
<td>Thursday</td>
<td>8.51</td>
<td>1.53 (0.83–2.83)</td>
<td>0.18</td>
<td>35.7</td>
<td>0.94 (0.71–1.25)</td>
<td>0.68</td>
<td>30.2</td>
<td>0.89 (0.65–1.22)</td>
<td>0.48</td>
</tr>
<tr>
<td>Friday</td>
<td>5.79</td>
<td>0.89 (0.47–1.71)</td>
<td>0.74</td>
<td>34.0</td>
<td>0.76 (0.54–1.06)</td>
<td>0.10</td>
<td>29.1</td>
<td>0.81 (0.59–1.10)</td>
<td>0.17</td>
</tr>
<tr>
<td>Saturday</td>
<td>6.77</td>
<td>1.72 (0.93–3.3)</td>
<td>0.10</td>
<td>34.2</td>
<td>0.82 (0.58–1.16)</td>
<td>0.26</td>
<td>30.8</td>
<td>0.89 (0.64–1.25)</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Omnibus P value death-adjusted P=0.08, death/rehospitalization-adjusted P=0.23, rehospitalization-adjusted P=0.73. Adjusted for variables listed in Methods.
of patients and were limited to 60 to 90 days. We do not have data on patients who may have died before reaching the hospital or who presented to the emergency department with HF but were released without admission. These findings may not apply to hospitals that differ in patient characteristics or care patterns from OPTIMIZE-HF hospitals, although a recent study suggests patients enrolled in OPTIMIZE-HF are nationally representative. The patient data on no prior history of HF were collected in OPTIMIZE-HF in a different format than in other studies and are likely an underestimate of the proportion of patients with a new diagnosis of HF. Given the overall large number of patients observed, some differences, although statistically significant, may not be clinically relevant. Also, despite multivariable analyses, we cannot exclude that residual measured and unmeasured confounding account for some of these observations. Despite these limitations, the present analysis provides new insights into the relationship between day of admission and discharge for HF hospitalization and clinical outcomes from a large, representative data set of patients hospitalized with HF from all regions of the country, including patients with preserved systolic function and multiple comorbidities.

Conclusions
No differences in either in-hospital or postdischarge death rate for patients hospitalized with HF by day of admission were evident. Postdischarge clinical outcomes also did not significantly vary by day of hospital discharge. In contrast to studies of patients hospitalized with acute myocardial infarction, these findings suggest that that the level of access to care on weekends does not appear to adversely affect risk of death for patients hospitalized with HF. However, day of the week for hospital admission does significantly influence hospital LOS. Hospitalizations for HF on Sunday, Monday, and Tuesday are associated with the shortest hospital LOS, whereas hospitalizations on Thursday and Friday are associated with the longest LOS. Patients hospitalized with HF are most frequently discharged on Friday and least frequently discharged on Sunday. Understanding the factors responsible for the increased LOS and making potential adjustments in staffing to facilitate weekend discharges may improve the efficiency of HF hospital care.

Source of Funding
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Disclosures
Drs Fonarow, Abraham, Gheorghiade, Greenberg, O'Connor, Yancy, and Young and W. Gattis Stough have received research grants and honoraria from and have served as consultants and/or speakers for GlaxoSmithKline. Dr Albert is a consultant for GlaxoSmithKline. Dr Nunez was an employee of GlaxoSmithKline.

References
19. Magid DJ, Wang Y, Herrin J, McNamara RL, Bradley EH, Curtis JP, Pollack CV Jr, French WJ, Blaney ME, Krumholz HM. Relationship between time of day, day of week, timeliness of reperfusion, and
Heart failure is among the leading causes of hospitalizations, and these hospitalizations contribute to the morbidity, mortality, and high costs of the disease. Most acute care hospitals provide routine care with full staff on the weekdays and work on a more limited or reduced staff complement on weekends. There are also differences in physician coverage of patients on weekdays compared with weekends. Recent studies suggest admission on the weekends is associated with higher risk of death than weekday admissions for acute myocardial infarctions and other serious medical conditions. This study examined the relationship between the day of the week patients are hospitalized for heart failure and death rate, length of stay, and readmission rate. Patient characteristics were similar for weekday and weekend presentation. In-hospital and postdischarge risks of death were similar for each day of the week. Length of stay, however, was significantly influenced by day of admission, even after adjustment for other length of stay risk factors. The shortest length of stay by admission day of the week was Tuesday (5.39 days), and the longest was Friday (5.88 days). Patients hospitalized with heart failure were most frequently discharged on Friday and least frequently discharged on Sunday. In contrast to studies of patients hospitalized with acute myocardial infarction, these findings suggest that the level of access to care on weekends does not appear to adversely affect risk of death for patients hospitalized with heart failure. Understanding the factors responsible for the increased length of stay and potential adjustments in staffing to facilitate weekend discharges may improve the efficiency of hospital care for patients with heart failure.
Day of Admission and Clinical Outcomes for Patients Hospitalized for Heart Failure:
Findings From the Organized Program to Initiate Lifesaving Treatment in Hospitalized
Patients With Heart Failure (OPTIMIZE-HF)

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