



# PREHOSPITAL DELAY, PRECIPITANTS OF ADMISSION, AND LENGTH OF STAY IN PATIENTS WITH EXACERBATION OF HEART FAILURE

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**Background** Factors that precipitate hospitalization for exacerbation of heart failure provide targets for intervention to prevent hospitalizations.

**Objectives** To describe demographic, clinical, behavioral, and psychosocial factors that precipitate admission for exacerbation of heart failure and assess the relationships between precipitating factors and delay before hospitalization, and between delay time and length of hospital stay.

**Methods** All admissions in 12 full months to a tertiary medical center were reviewed if the patient had a discharge code related to heart failure. Data on confirmed admissions for exacerbation of heart failure were included in the study. Electronic and paper medical records were reviewed to identify how long it took patients to seek care after they became aware of signs and symptoms, factors that precipitated exacerbation, and discharge details.

**Results** Exacerbation of heart failure was confirmed in 482 patients. Dyspnea was the most common symptom (92.5% of patients), and 20.3% of patients waited until they were severely dyspneic before seeking treatment. The most common precipitating factor was poor medication adherence. Delay times from symptom awareness to seeking treatment were shorter in patients who had a recent change in medicine for heart failure, renal failure, or poor medication adherence and longer in patients with depressive symptoms and hypertension.

**Conclusions** Depressive symptoms, recent change in heart failure medicine, renal failure, poor medication adherence, and hypertension are risk factors for hospitalizations for exacerbation of heart failure. (*American Journal of Critical Care*. 2017;26:62-69)

The clinical course of heart failure is characterized by frequent exacerbations that lead to visits to an emergency department, hospitalizations, or even death.<sup>1,2</sup> Because of the high cost and public health impact of this complication, identification of factors that precipitate hospitalization for exacerbation of heart failure could provide targets for interventions to decrease high hospitalization rates.<sup>3-6</sup> Demographic (eg, old age),<sup>7,8</sup> clinical (eg, previous hospitalizations, comorbid conditions),<sup>3-10</sup> psychosocial (eg, poor social support),<sup>8</sup> and behavioral (eg, poor adherence to medication or to a low-sodium diet)<sup>4,6,8,9</sup> factors have been identified as precipitating factors of readmission for exacerbation of heart failure. In none of these studies, however, have demographic, clinical, behavioral, and psychosocial factors been analyzed together, thus limiting the ability to define independent predictors of readmission.

Many patients with worsening heart failure and escalating signs and symptoms delay seeking medical advice or treatment that could prevent rehospitalization or a prolonged stay in the emergency department.<sup>11</sup> Shorter delay in seeking early medical advice or treatment is associated with fewer or less intense signs and symptoms, shorter treatment time in the emergency department, shorter stays in intensive care units, shorter hospital stays, lower mortality, and better quality of life.<sup>11-15</sup> Few studies<sup>16-18</sup> have been done on factors associated with delay in seeking care for escalating signs and symptoms in patients with heart failure. Similarly, few investigators<sup>19,20</sup> have examined the relationship between prehospital delay and length of hospital stay. Accordingly, the purposes of our study were to describe demographic, clinical, behavioral, and psychosocial factors that precipitate admission for exacerbation of heart failure among patients who delay seeking care; determine the relationship between the precipitating factors and delay time from symptom awareness to seeking medical care; and determine

the relationship between prehospital delay time and length of hospital stay.

## Methods

### Design and Sample

The study was a retrospective chart review of data on patients admitted during 1 year (January 1 through December 31, 2009) to a tertiary referral medical center consisting of 2 separate hospitals. Data were screened for inclusion if they had a *International Classification of Diseases, Ninth Revision*<sup>21</sup> discharge code related to heart failure (428.0-428.4, 428.9, 429.3, 425.0-425.9). The appropriate institutional review board approved an exemption from obtaining informed consent from patients whose data were reviewed.

In addition to data with the appropriate *ICD-9* codes, admission data were included in the study if an exacerbation of heart failure was the primary or secondary cause of admission that either met the Framingham criteria for exacerbation of heart failure<sup>22</sup> or resulted in the patient receiving treatment for exacerbation of heart failure. Adjudication by heart failure experts was done when necessary. Only data on patients with a history of heart failure were included.

### Measurement

Electronic and paper medical records were reviewed to identify signs and symptoms experienced before the patients sought treatment, responses to worsening signs and symptoms by patients and caregivers, factors that precipitated hospital admission for exacerbation of heart failure, medication regimen before admission, and discharge details. The

Shorter delay in seeking early medical advice or treatment for worsening heart failure is associated with better outcomes.

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**Table 1**  
Characteristics of 482 patients in the sample

Characteristic	Value <sup>a</sup>
Age, mean (SD), y	62 (15)
Age ≥ 65 years	203 (42)
Male	272 (56)
Living at home alone	87 (18)
Unmarried	250 (52)
White	375 (78)
Body mass index, <sup>b</sup> mean (SD)	31.5 (9.2)
Charlson Comorbidity Index, mean (SD)	6.0 (7.9)
Left ventricular ejection fraction, mean (SD), %	43.7 (27.0)
Left ventricular ejection fraction ≥ 40%	221 (46)
Use of angiotensin-converting enzyme inhibitor (before admission)	223 (46)
β-Blocker use (before admission)	306 (63)
Delay time, mean (SD), days	15.7 (51.6)
Length of hospital stay, mean (SD), days	7.2 (13.0)
Number of signs or symptoms before seeking treatment, mean (SD)	5.1 (2.2)
Number of precipitating factors, mean (SD)	2.1 (1.3)

<sup>a</sup> Values are number (percentage) of patients unless otherwise specified in the first column.

<sup>b</sup> Calculated as weight in kilograms divided by height in meters squared.

precipitating factors were demographic (eg, age, sex), clinical (eg, infection, myocardial infarction, comorbid conditions), psychosocial (eg, documented history of depressive symptoms, anxiety), and behavioral (eg, adherence to prescribed medications or a low-sodium diet). A form to collect all information was developed for the study. Precipitating factors were based on previous publications, clinical insight, and patients' perspectives. All data on precipitating factors were based on whether or not the factor was documented in the electronic or paper medical records. For example, whether or not patients had medication nonadherence was based on whether or not any documented data from the medical record (eg, no insurance, no money, no transportation, no support) indicated that the patients did not refill their prescriptions, skipped taking medications, or did not take medications regularly as prescribed.

Patients could have more than one factor precipitating admission. All data were abstracted from medical records by registered nurses who were cardiac care specialists and extensively trained in data collection. Before data collection, all team members independently collected data from the same 3 charts. We compared the data collected on the same forms during this reliability testing process and resolved

disagreements to ensure 100% agreement. Data collectors met weekly throughout the chart review period to discuss records that were difficult to interpret or had conflicting data.

Delay time was defined as the time from first awareness of a sign or symptom of heart failure (eg, shortness of breath) to seeking treatment (patients reached hospital for seeking medical care)<sup>11</sup> and was calculated from symptom awareness to emergency department arrival time as documented in the history and physical examination. Length of stay during the index hospitalization was calculated as the time from emergency department arrival to hospital discharge.

### Data Analysis

SPSS, version 23.0, software (IBM) was used for data analysis; *P* less than .05 was considered significant. Patient characteristics, time from symptom awareness to emergency department arrival, length of stay during the index hospitalization, signs and symptoms of exacerbation of heart failure before the index hospitalization, and factors that precipitated exacerbation of heart failure were summarized by using means and standard deviations or frequencies with percentages. We used  $\chi^2$  analysis, *t* tests, and Spearman correlations to examine the bivariate relationships among signs and symptoms of exacerbation of heart failure before the index hospitalization, precipitating factors of hospitalization for exacerbation of heart failure, time from symptom awareness to hospital admission, and length of stay during the index hospitalization. All potential precipitating factors were entered in a stepwise or forward linear regression to determine which precipitating factors contributed to longer times that patients had signs or symptoms before being admitted. Because delay time and length of stay were skewed, a logarithmic transformation was used to obtain a normal distribution for these variables. A normal distribution was confirmed by using histograms, skewness, and kurtosis ( $-1 < \text{skewness}$  and  $\text{kurtosis} < 1$ ). All correlation or regression analyses were done with the transformed value. We assessed variance inflation factors to test for multicollinearity in the multiple regression models.

## Results

### Sample Characteristics

A total of 482 patients were admitted for a confirmed exacerbation of chronic heart failure and had complete information on precipitating factors of exacerbation and length of hospital stay; 346 patients had data on delay time. The mean age of patients in the sample was 62 years (SD, 15 years), and about half were male (Table 1). More than half of the patients

had systolic dysfunction with a left ventricular ejection fraction of 40% or less. A total of 26 patients (5.4%) died before discharge. The majority of the patients were white. About one-fifth of the patients lived alone at home.

### Signs and Symptoms Experienced and Management Before Seeking Care

Patients experienced about 5 signs or symptoms before admission. Dyspnea was the most common (93%). Next, in order, were edema (64%), exertional dyspnea (42%), orthopnea (36%), angina (34%), cough (33%), paroxysmal nocturnal dyspnea (23%), nausea (22%), weight gain (18%), and excessive tiredness (17%). More than one-third of the patients (36.3%) did not do anything (ie, no action taken was documented in the medical record) when they had signs or symptoms. A few patients called their physicians or nurses (4%) or took a diuretic (3%) before seeking care. Approximately one-fifth of the patients (20.3%) waited until they were severely dyspneic before seeking treatment. Less than half of the patients came to the hospital by ambulance (45%); others were transported by family (12%), other mode of transport (4%), and even by self (2%).

### Precipitating Factors of Hospital Admission

The most common precipitating factor was poor medication adherence; slightly more than one-fifth of patients had documentation in their chart that they did not adhere to their prescribed medication before admission. The other top precipitating factors included infection (19%), renal insufficiency (17%), renal failure (15%), hypertension (14%), and dysrhythmias (13%; Table 2).

### Delay Time and Other Data

The mean delay time from symptom awareness to seeking treatment was 16 days (SD, 52 days; median, 3 days). Mean length of stay during the index hospitalization was 7 days (median, 4 days). We detected a significant correlation between delay time and number of signs and symptoms before admission ( $\rho = 0.203$ ;  $P < .001$ ). No significant relationship was detected between delay time and length of stay during the index hospitalization ( $\rho = 0.09$ ;  $P = .12$ ) or between delay time and number of precipitants of hospital admission for exacerbation of heart failure ( $\rho = -0.073$ ;  $P = .18$ ).

Depressive symptoms, recent change in heart failure medicine, renal failure, poor medication adherence, and hypertension were significantly associated with delay in time from symptom awareness to

**Table 2**  
Most common precipitating factors of hospital admission for 482 patients with exacerbation of heart failure

Rank	Precipitating factor	No. (%) of patients
1	Poor medication adherence	99 (21)
2	Infection	93 (19)
3	Renal insufficiency	84 (17)
4	Renal failure	73 (15)
5	Hypertension	68 (14)
6	Dysrhythmias	64 (13)
7	Excessive fluid intake	53 (11)
8	Myocardial infarction	50 (10)
9	Excessive sodium	41 (9)
9	Exacerbation of chronic obstructive pulmonary disease	45 (9)

**Table 3**  
Precipitating factors of hospital admission for exacerbation of heart failure and delay time from symptom awareness to seeking treatment in 346 patients<sup>a</sup>

Precipitating factor	t	$\beta$	95% CI	P
Depression or depressive symptoms	3.114	0.176	0.29 to 1.28	.002
Recent change in heart failure medicine	-2.873	-0.163	-0.63 to -0.12	.004
Renal failure	-3.046	-0.173	-0.50 to -0.11	.003
Poor medication adherence	-2.771	-0.161	-0.39 to -0.07	.006
Hypertension	2.154	0.126	0.02 to 0.39	.03

<sup>a</sup>  $F = 6.65$ ,  $P < .001$ .

seeking treatment. Patients who had recent changes in their heart failure medications, renal failure, and poor medication adherence had shorter delay times from symptom awareness to seeking treatment. Those who had depressive symptoms and hypertension experienced longer delay times from symptom awareness to seeking treatment (Table 3). In each regression model, all variance inflation factors were 1.1 or less, suggesting no parameter distortion due to multicollinearity.

### Discussion

The Centers for Medicare and Medicaid Services recently initiated the Readmissions Reduction Program based on the Affordable Care Act. Hospitals are financially penalized for heart failure readmissions within 30 days. Therefore, identifying factors that precipitate acute decompensated heart failure is timely and important in order to intervene and decrease the likelihood of rehospitalization.<sup>3-6</sup> We

Psychological states play an important role in patients' decisions to seek care.

found several important clinical (infection, renal insufficiency, renal failure, hypertension, dysrhythmias), behavioral (poor adherence to medications), and psychosocial (depressive symptoms) factors that precipitated exacerbations of heart failure. The majority of patients with heart failure have multiple comorbid conditions.<sup>23,24</sup> Our findings suggest that increased attention to these comorbid conditions (including psychological conditions such as depressive symptoms) is warranted.

We found that more than one-fifth of cases of acute decompensated heart failure were due to poor adherence to the recommended regimen; poor medication adherence was independently associated with

delay in seeking treatment. Our finding of poor medication adherence as a precipitating factor to signs and symptoms and treatment is consistent with the results of previous studies.<sup>3,4,6,9,23,25-31</sup> In our study, poor medication adherence was the leading precipitant of acute decompensated heart failure among all demographic, clinical, behavioral,

and psychosocial factors. Thus, development of effective interventions to address medication nonadherence before discharge is needed. Because of the lack of effectiveness of usual discharge instructions, most likely emphasis on discharge should be directed toward this common problem associated with rehospitalization.

Using multiple regression, we found 5 factors either positively or negatively associated with delays to seeking treatment: depression or depressive symptoms, recent change in heart failure medicine, renal failure, poor medication adherence, and hypertension. As is well-known, heart failure patients with poorer medication adherence have worse health outcomes than do patients with better adherence.<sup>32</sup> We hypothesized that patients with poor medication adherence would have a longer delay time in seeking medical attention. However, contrary to our hypothesis, patients with poor medication adherence had shorter delay times. Information on relationships between medication adherence and delay in time between symptom onset and accessing treatment has not been reported. In 2 studies<sup>33,34</sup> on chronic obstructive pulmonary disease, patients with higher adherence to a written action plan (initiate standing prescriptions for both antibiotics and prednisone within 3 days of onset of exacerbation) had a greater reduction in exacerbation recovery time than did patients with poor adherence.<sup>33</sup> A longer delay time in treatment of exacerbation significantly extended

recovery time, with 0.42 days per additional day of delay.<sup>34</sup> However, patients with poor medication adherence might delay less because they realize their nonadherence might place them at risk, although the potential mechanism needs further study.

We found that a recent change in heart failure medications, as documented by health care providers in a patient's history and physical examination, was associated with shorter time to seek care. To our knowledge, no studies have indicated the relationship between recent changes in heart failure medications and delay in seeking care. Patients who had a recent change in medications may have had a recent encounter with their health care provider and so might be more alert to signs and symptoms of heart failure and thus shorten their delay time. Our findings emphasize the need to teach patients about the effects and side effects they may experience with changes in medication or dosage. Patients with heart failure should pay careful attention to changes in signs and symptoms during this period, a step that might result in shorter delay in seeking treatment.

In our study, patients with a history of renal failure had shorter delays in seeking treatment. The experiences of this cohort of signs and symptoms and treatment of comorbid conditions may have influenced the patients' decision to seek care. Multiple factors such as older age, living alone, and low socioeconomic status have been linked to greater delays in seeking treatment among patients experiencing acute coronary syndromes.<sup>35</sup> However, more acute symptoms and knowledge about the source of symptoms were associated with shorter treatment delays in this population of patients.<sup>35</sup> An increase in body weight due to fluid retention, pulmonary edema, and anasarca are comparable consequences of fluid volume overload in patients with renal disease or heart failure. Additional mutual symptoms for these comorbid conditions include severe fatigue and cognitive changes.<sup>36,37</sup> Plausibly, patients with combined renal and heart failure have exaggerated symptom experiences because of common symptoms associated with the dual pathological changes and, consequently, seek treatment earlier than do patients without this pattern of comorbid conditions. Furthermore, patients with renal failure often require recurring medical procedures to remove excess fluids and waste,<sup>37</sup> a situation that may increase their proficiency with accessing the health care system for management of signs and symptoms or disease. Last, patients with renal failure may have received instructions on symptom management for the renal disease that also applies to heart failure and acted on that

knowledge by accessing professional medical treatment more expeditiously.

Psychological states play an important role when patients make decisions to seek care. In our study, patients with heart failure who had a history of depression or any depressive symptoms had longer delays in time from symptom awareness to seeking treatment. This finding is similar to the results of a study by Johansson et al<sup>38</sup> in which patients with depressive symptoms had an almost 1.5 times higher risk than did patients without depressive symptoms for a treatment delay greater than 3 days after adjustments were made for clinical variables. Patients with heart failure with depressive symptoms postpone seeking treatment, a decision that may lead to more severe complications and in-hospital procedures.<sup>38,39</sup> Therefore, for patients with heart failure and depressive symptoms, depression screening and treatment may be important strategies for improving delays in seeking care.

In our study, patients with a history of hypertension also had longer delays in seeking treatment. The finding is in line with the results of previous research.<sup>3,4,6,28,40,41</sup> Most patients with hypertension do not have obvious signs and symptoms that prompt them to seek medical treatment. However, uncontrolled hypertension may complicate the acute episode of exacerbation of heart failure and lead to a worse prognosis for hypertension.<sup>42</sup> Therefore, good control of blood pressure is essential in the management of patients who have both heart failure and hypertension.

In addition, we found no association between delay time from symptom awareness to seeking treatment and length of stay during the index hospitalization. This result differs from that of Johansson et al,<sup>19</sup> who found that patients who delayed less than 1 day had a shorter length of stay than did patients who delayed more than 1 day. The lack of association between delay time and length of stay in our study has several potential explanations. Because of the positive correlation between delay time and number of prehospital signs or symptoms in our study, possibly the patients who delayed the longest were the most severely ill and thus received medical treatment more quickly. Previous research has suggested that patients who have a longer delay time are more severely ill than patients with a shorter delay time,<sup>43</sup> have more signs and symptoms,<sup>44</sup> and are more likely to be classified as New York Heart Association functional class IV.<sup>36</sup> Possibly those patients who experienced symptom relief shortly after receiving treatment had a shorter hospital length

of stay.<sup>45</sup> Although we did not assess dyspnea relief in this study, Mebazaa et al<sup>46</sup> reported that approximately 75% of patients with acute heart failure experienced less dyspnea 6 hours after receiving standard treatment. Data<sup>43</sup> also suggest that patients with acute decompensated heart failure receive intravenous therapy about 5 hours after being admitted to the emergency department and that delayed treatment is associated with a longer stay. Other factors not included in our study might have influenced the relationship between treatment time delays and length of stay. For example, a longer stay has been associated with the presence of respiratory comorbid conditions and in-hospital complications.<sup>47</sup> Patients' living arrangements might also have influenced length of stay among our sample. Living alone at home has also been associated with a longer stay<sup>47</sup>; only 18% of our patients reported living alone at home.

## Limitations

Our study has some limitations. First, the study was retrospective, and we had to depend on information documented in the chart by clinicians and retrieved from medical records. Thus, precipitating factors might not have been recorded in some instances. Most likely, more hospital admissions than we detected were associated with poor medication adherence or other psychosocial or behavioral factors. Second, the study sample was limited to a single southeastern state, and the experiences in this state may not be generalizable to other locations. Third, this study took place after the Joint Commission instituted the Heart Failure Core Measures (to which our hospitals had nearly 100% compliance in our chart review) but before the Centers for Medicare and Medicaid Services stopped reimbursing for heart failure readmissions within 30 days of discharge. Therefore, our findings need to be verified in the current climate of nonreimbursement for early readmissions of patients with heart failure.

Among a wide variety of demographic, clinical, behavioral, and psychosocial factors that precipitate admission for exacerbation of heart failure, poor adherence to the recommended medication was the most common factor. Patients with depressive symptoms, recent changes in heart failure medicine, renal failure, poor medication adherence, and hypertension require more diligence with care

**Patients with a history of hypertension also had longer delays in seeking treatment.**

delivery and disease management by clinicians to decrease high rehospitalization rates for exacerbation of heart failure.

#### FINANCIAL DISCLOSURES

This study was supported by funding from the National Institute of Nursing Research awards K23NR014489 (Jia-Rong Wu, principal investigator) and K23NR013480 (Rebecca L. Dekker, coinvestigator) and by a National Institute of Nursing Research center grant 1P20NR010679 (Debra Moser, principal investigator) to the University of Kentucky, College of Nursing.

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## **Prehospital Delay, Precipitants of Admission, and Length of Stay in Patients With Exacerbation of Heart Failure**

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Am J Crit Care 2017;26 62-69 10.4037/ajcc2017750  
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