

# Frequent Utilization of the Emergency Department for Acute Heart Failure Syndrome

## A Population-Based Study

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**Background**—Although most research on patients with acute heart failure syndrome (AHFS) has focused on readmissions, this may provide an incomplete picture of health-care utilization. We examined the proportion and characteristics of patients with frequent emergency department (ED) visits for AHFS and associated health-care utilization.

**Methods and Results**—A retrospective cohort study of adults with at least 1 ED visit for AHFS between 2010 and 2011 was performed, derived from population-based multipayer data of state ED and inpatient databases for 2 large and diverse states, California and Florida. The analytic sample comprised 113 033 patients with 175 491 ED visits for AHFS. During the 1-year follow-up period, 30.8% of patients had  $\geq 2$  (frequent) visits, accounting for 55.4% (95% confidence interval, 55.2–55.5%) of all ED visits for AHFS. In the multivariable model, significant predictors of frequent ED visits were non-Hispanic black race, Hispanic ethnicity, Medicaid insurance, and lower median household income (all  $P < 0.001$ ). At the visit level, patients with frequent ED visits accounted for 55.0% (95% confidence interval, 54.8–55.3%) of all AHFS hospitalizations via ED. Total charges for AHFS were \$3.08 billion (95% confidence interval, \$3.03–\$3.14 billion) in Florida alone; patients with frequent ED visits accounted for 53.3% of total charges (95% confidence interval, 53.2–53.3%).

**Conclusions**—In this large cohort study, we found that one third (31%) of ED patients with AHFS had frequent ED visits for this condition and that minority race/ethnicity and lower socioeconomic status were associated with frequent ED visits. Individuals with frequent ED visits accounted for the majority of ED visits, hospitalizations, and hospital charges. (*Circ Cardiovasc Qual Outcomes*. 2014;7:735–742.)

**Key Words:** emergency service, hospital ■ epidemiology ■ heart failure ■ recurrence

Heart failure is an important public health problem in the United States.<sup>1,2</sup> Approximately 5.1 million Americans have clinically manifest heart failure, and the prevalence continues to rise.<sup>3</sup> Recent national estimates indicate that there were  $\approx 676\,000$  emergency department (ED) visits for acute heart failure syndrome (AHFS), and 1 million hospitalizations, with an estimated direct cost of \$31 billion annually.<sup>3</sup> In this context, the federal government identified the reduction of hospitalizations for AHFS as one of the objectives of Healthy People 2020 through better prevention and treatment.<sup>4</sup> To develop and implement preventive measures effectively, identifying patients at risk for future deteriorations is critical.

To date, most research on patients with AHFS focused on examining readmissions<sup>5–7</sup>; however, focusing solely on hospital admissions may provide an incomplete picture of the health-care utilization and discount the importance of upstream ED visits.<sup>1,8,9</sup> Indeed,  $\leq 80\%$  of patients hospitalized with AHFS initially present to the ED.<sup>10,11</sup> Furthermore, ED visits are increasingly interpreted by policy makers as an

important measure in monitoring and evaluating the integration of health-care delivery programs.<sup>12</sup> Although a few studies evaluated ED visits for AHFS in the early 2000s,<sup>9,13</sup> little is known about individuals at greatest risk, that is, patients with frequent ED visits for AHFS.

To address these knowledge gaps, we used large, population-based, multipayer databases from 2 large and diverse states (California and Florida) to examine the proportion and characteristics of patients with frequent ED visits for AHFS. We also sought to investigate hospitalization rates, near-fatal event rates, and hospital charges associated with frequent ED visits.

## Methods

### Study Design and Setting

This is a retrospective cohort study using data from the Healthcare Cost and Utilization Project State Emergency Department Databases (SEDD) and State Inpatient Databases. The SEDD includes all treat-and-release and transfer ED visits from short-term, acute-care,

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## WHAT IS KNOWN

- Most emergency department (ED) visits for acute heart failure syndrome (AHFS) are considered preventable through evidence-based management. Patients with frequent ED visits for AHFS are at greatest risk.

## WHAT THE STUDY ADDS

- This population-based study of patients with AHFS demonstrated that approximately one third of patients had frequent ED visits for AHFS during a 1-year follow-up period. Moreover, non-Hispanic black race, Hispanic ethnicity, and lower socioeconomic status were associated with frequent ED visits for AHFS.
- This population accounted for the majority of all ED visits. The high proportion of patients with frequent ED visits was associated with increased hospitalizations, near-fatal events, and hospital charges.

nonfederal community hospitals in participating states. The State Inpatient Databases include all inpatient discharges from short-term, acute-care, nonfederal, general, and other specialty hospitals in participating states, including those admitted from the ED. Taken together, we identified all ED visits regardless of disposition. Additionally, these databases contained information on short-term outcomes for patients admitted through the ED. Additional details of the SEDD and State Inpatient Databases can be found elsewhere.<sup>14,15</sup>

In this study, we used the data from California and Florida SEDD and State Inpatient Databases in 2010 and 2011. These 2 states were selected for their geographic distribution, high data quality, and importantly because their databases included unique encrypted patient-level identifiers that enable follow-up of specific patients across years. The institutional review board of Massachusetts General Hospital waived review of this study.

## Study Population

We identified all adults aged  $\geq 18$  years with at least 1 ED visit for AHFS in 2010, by using *International Classification of Diseases, Ninth Revision, Clinical Modification* codes for heart failure (402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, and 428.0) in the primary diagnosis field.<sup>16</sup> We excluded out-of-state residents and patients who died at the first ED visit or hospitalization during the study period.

## Explanatory Variables

The databases contain information on patient characteristics, including demographics (age, sex, and race/ethnicity), primary insurance, quartile of median household income, urban/rural status, *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis and procedures, and patient comorbidities. The SEDD database also includes ED disposition. Primary insurance types were categorized into Medicaid, Medicare, private sources, self-pay, and other. Rural/urban status of the patient residence was defined according to the National Center for Health Statistics.<sup>17</sup> To control for potential confounding by patient mix, 29 Elixhauser comorbidity measures were derived based on the *International Classification of Diseases, Ninth Revision, Clinical Modification* codes using the Agency for Healthcare Research and Quality Comorbidity Software.<sup>18</sup> This risk adjustment method has been derived and validated extensively.<sup>19</sup>

## Outcome Measures

The primary outcome measure was the frequency of ED visits for AHFS in a given year for each patient. The patient's first ED visit in 2010 was identified as the index ED visit. Each patient was then followed for 365 days after the index visit; then, the total number of ED visits for each patient was summated during the follow-up period, including the index visit.

Other outcome measures of interest were 30-day ED revisits, hospitalizations, near-fatal events, and charges for both ED and inpatient services. Thirty-day ED revisit was defined as an ED visit for AHFS  $< 30$  days of the previous ED or hospital discharge. Hospitalization was defined as a hospital admission for AHFS from ED during the 1-year follow-up period after the index visit. Near-fatal event was defined as an ED visit or hospitalization for AHFS involving non-invasive or invasive mechanical ventilation<sup>20</sup>; the use of mechanical ventilation was identified using the Healthcare Cost and Utilization Project Clinical Classifications Software code 216. Charges reflect the total hospital fees aggregated for a given individual; this financial data were available for Florida but not for California. All charges were converted to 2011 US dollars using the medical component of the Consumer Price Index.<sup>21</sup>

## Statistical Analysis

For the purpose of this analysis, we categorized patients into 3 ED utilization groups according to their number of ED visits for AHFS: 1 ED visit (ie, index visit only), 2 ED visits, and  $\geq 3$  ED visits  $< 1$  year. First, we tested unadjusted associations between patient-level variables and the frequency of ED visits for AHFS using  $\chi^2$  test or Kruskal–Wallis test, as appropriate. The patient-level explanatory variables at their index visit were used for the analysis. Second, we fit multinomial logistic regression models to examine the associations between patient-level variables and frequency of ED visits, with 1 ED visit group as the reference, adjusting for patient mix using Elixhauser comorbidity measures. Third, we calculated the rate of 30-day ED revisits, hospitalizations, and near-fatal events according to ED visit utilization. The rates were defined as the total number of respective outcomes within a year of the index ED visit divided by the total number of ED visits for AHFS. Additionally, we examined associations between the frequency of ED visits and these rates. Finally, we constructed a linear regression model at the patient level to examine the association between the frequency of ED visits and charges.

In sensitivity analyses, to assess the consistency of associations between the frequency of ED visits and each outcome, we stratified the analysis by state. Additionally, we fit 2 models to account for unequal follow-up period among patients because those who died during the 365-day period could not contribute to the subsequent ED visits. First, we fit a negative binomial regression model with estimating dispersion (scale) parameter, accounting for overdispersion of the data and the follow-up period.<sup>22</sup> The follow-up period for each patient was defined as 365 days or days from the index visit until when in-hospital death was observed, whichever comes first. The log of the follow-up period was used as the offset to adjust for the regression estimates with unequal follow-up period. Second, we repeated the negative binomial model without the offset, after excluding patients who developed in-hospital death during the follow-up period. All analyses were performed with SAS version 9.3 (SAS Institute, Cary, NC). Results were presented with 95% confidence interval (CI), when appropriate; a 2-sided  $P$  value  $< 0.05$  was considered statistically significant.

## Results

All ED visits for AHFS made by patients aged  $\geq 18$  years in 2010 and 2011 ( $n=332\,205$ ) were identified in the California and Florida databases. From this population, we excluded ED visits made by patients who had no ED visit in 2010 ( $n=120\,247$ ), those occurred  $> 1$  year after the index visit ( $n=24\,446$ ), and those without a valid encrypted patient identifier ( $n=8047$ ). We also excluded ED visits made by patients with out-of-state residence ( $n=3809$ ) or who died at the index

ED visit ( $n=165$ ). After these exclusions, our final sample comprised 113 033 unique patients with 175 491 ED visits for AHFS.

### ED Visits for AHFS

Among this analytic sample, 78 240 patients (69.2%; 95% CI, 68.9–69.5%) had 1 ED visit during the 1-year study period, whereas 34 793 patients (30.8%; 95% CI, 30.5–31.1%) had  $\geq 2$  ED visits (with  $\geq 2$  denoting frequent hereafter). Figure 1 depicts the number of patients and ED visits for AHFS during the follow-up period by ED visit frequency. Patients with frequent visits accounted for 55.4% (95% CI, 55.2–55.5%) of all ED visits for AHFS.

The distribution of ED visit frequency was similar across states (Figure in Data Supplement). For instance, 31.1% of patients in California had frequent ED visits and accounted for 56.0% (95% CI, 55.7–56.3%) of all ED visits for AHFS; 30.4% patients in Florida had frequent visits and accounted for 54.6% (95% CI, 54.3–55.0%) of all ED visits.

### Patients With AHFS

Patient characteristics and comorbidities differed across the ED visit frequency groups (Table 1). Compared with patients with 1 ED visit for AHFS, patients with a higher frequency of ED visits were more likely to be men, non-Hispanic black race, and Hispanic ethnicity (all  $P<0.001$ ). Likewise, those with a higher frequency of ED visits were more likely to have several markers of low socioeconomic status, including Medicaid insurance and lower household income (both  $P<0.001$ ).

In the multinomial logistic regression model (Table 2), the associations between these patient characteristics and a higher frequency of ED visits remained significant. For instance, non-Hispanic black race (odds ratio, 1.99; 95% CI, 1.88–2.10), Hispanic ethnicity (odds ratio, 1.45; 95% CI, 1.38–1.53), and Medicaid insurance (odds ratio, 2.47; 95% CI, 2.26–2.71) were independently associated with  $\geq 3$  ED visits for AHFS. Similarly, several comorbid conditions, such as

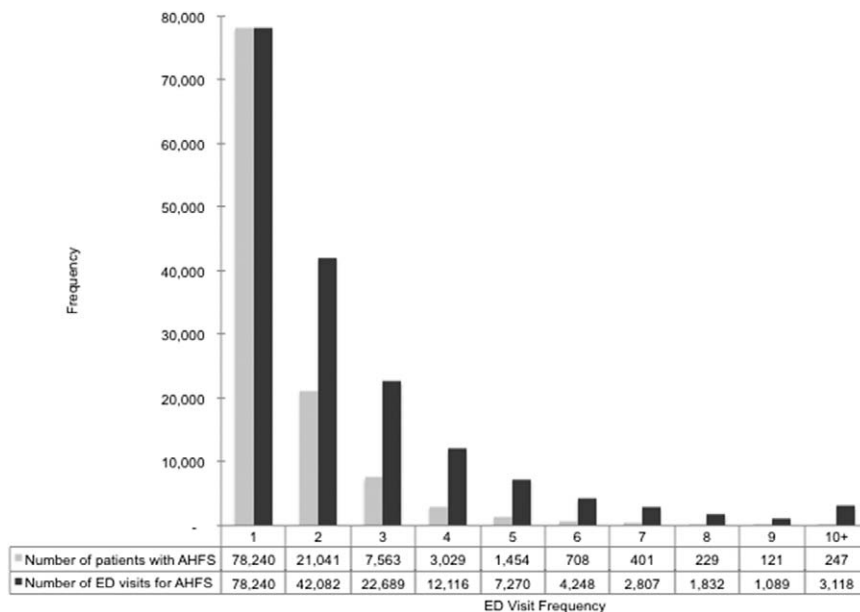
chronic pulmonary diseases, renal failure, diabetes mellitus, and drug abuse, were independently associated with a higher frequency of ED visits for AHFS. In the sensitivity analyses, these associations remained significant with stratification by state, use of negative binomial regression model accounting for unequal follow-up period, and exclusion of patients with subsequent death from the analysis (Tables I and II in the Data Supplement).

### 30-Day ED Revisits, Hospitalization, and Near-Fatal Events for AHFS

Table 3 summarizes unadjusted outcomes at the ED visit level. Overall, 30-day ED revisits consisted of 21.5% (95% CI, 21.2–21.7%) of ED visits for AHFS during the follow-up period. Patients with a higher frequency of ED visits were more likely to develop a 30-day ED revisit, regardless of state (all  $P<0.001$ ; Table 3; Table II in the Data Supplement).

Overall, 86.4% (95% CI, 86.3–86.6%) of all ED visits for AHFS led to a hospitalization. Patients with a higher frequency of ED visits had a lower proportion of hospitalization, regardless of state (all  $P<0.02$ ; Table 3; Table III in the Data Supplement). Patients with frequent ED visits accounted for 55.0% (95% CI, 54.8–55.3%) of total AHFS hospitalizations via ED. In an exploratory analysis (Table IV in the Data Supplement), compared with patients with no hospitalization, patients with at least 1 hospitalization for AHFS were more likely to be non-Hispanic black race and Hispanic ethnicity and to have markers of low socioeconomic status and comorbidities. Furthermore, non-ED routes of hospitalization (eg, hospitalizations from the clinic or direct hospitalizations) accounted for 13.4% (95% CI, 13.3–13.5%) of all hospitalizations for AHFS in 2010 and 2011.

In addition, 7.0% (95% CI, 6.9–7.2%) of ED visits for AHFS involved a near-fatal event. Patients with a higher frequency of ED visits had a higher proportion of near-fatal event, regardless of state (all  $P<0.001$ ; Table 3; Table III in the Data Supplement). Patients with frequent ED visits accounted for 58.1% (95% CI, 57.2–58.9%) of near-fatal events.



**Figure 1.** Number of patients and emergency department (ED) visits for acute heart failure syndrome (AHFS), according to ED visit frequency.

**Table 1. Demographic and Comorbidities of Patients With Acute Heart Failure Syndrome, According to the Number of ED Visits in 1 Year**

Variables*	1 ED Visit (n=78 240)	Frequent ED Visits		P Value
		2 (n=21 041)	≥ 3 (n=13 752)	
Age, median (IQR)	77 (64–85)	77 (64–85)	72 (59–83)	<0.001
18–34 y	771 (1)	224 (1)	208 (2)	<0.001
35–44 y	2209 (3)	528 (3)	574 (4)	
45–54 y	6074 (8)	1731 (8)	1618 (12)	
55–64 y	10 672 (14)	2861 (14)	2270 (17)	
65–74 y	14 766 (19)	3961 (19)	2739 (20)	
75–84 y	22 312 (29)	6085 (29)	3473 (25)	
≥85 y	21 476 (27)	5651 (27)	2870 (21)	
Male sex	38 807 (50)	10 736 (51)	7450 (54)	<0.001
Race/ethnicity				
Non-Hispanic white	49 199 (63)	12 052 (57)	6669 (48)	<0.001
Non-Hispanic black	10 315 (13)	3546 (17)	3334 (24)	
Hispanic	12 341 (16)	3729 (18)	2749 (20)	
Other	4737 (6)	1328 (6)	764 (6)	
Missing	1648 (2)	386 (2)	236 (2)	
Insurance status				
Medicare	59 073 (76)	16 070 (76)	9934 (72)	<0.001
Medicaid	6393 (8)	2110 (10)	2199 (16)	
Private	8005 (10)	1645 (8)	862 (6)	
Self-pay	2521 (3)	581 (3)	332 (2)	
Other	2247 (3)	632 (3)	425 (3)	
Quartiles for median household income of patient's ZIP code				
1 (lowest)	22 739 (29)	6456 (31)	4839 (35)	<0.001
2	20 408 (26)	5395 (26)	3587 (26)	
3	18 924 (24)	5010 (24)	3017 (22)	
4 (highest)	15 007 (19)	3847 (18)	2082 (15)	
Missing	1162 (1)	333 (2)	227 (2)	
Patient residence				
Counties of ≥1 million population	53 263 (68)	14 718 (70)	9765 (71)	<0.001
Counties of 250 000–999 999 population	17 323 (22)	4361 (21)	2728 (20)	
Counties of 50 000–249 999 population	3728 (5)	944 (4)	614 (4)	
Counties of <50 000 population	3911 (5)	981 (5)	604 (4)	
State				
California	43 193 (55)	11 746 (56)	7767 (56)	0.01
Florida	35 047 (45)	9295 (44)	5985 (44)	
Any comorbidities†	74 385 (95)	20 152 (96)	13 267 (96)	<0.001
Selected comorbidities				
Chronic pulmonary diseases	26 825 (34)	7852 (37)	5748 (42)	<0.001
Renal failure	27 876 (36)	9905 (47)	7192 (52)	<0.001
Diabetes mellitus, uncomplicated	23 202 (30)	6642 (32)	4642 (34)	<0.001
Diabetes mellitus, complicated	9327 (12)	3028 (14)	2203 (16)	<0.001
Depression	6040 (8)	1633 (8)	1214 (9)	<0.001
Drug abuse	1546 (2)	512 (2)	708 (5)	<0.001

ED indicates emergency department; and IQR, interquartile range.

\*Data were expressed as number (%) unless otherwise indicated.

†Comorbidity was defined as at least 1 Elixhauser comorbidity measure.

**Table 2. Multinomial Regression Models for Factors Associated With Frequent ED Visits for Acute Heart Failure Syndrome**

Variables	2 (vs 1) ED Visits		≥3 (vs 1) ED Visits	
	OR (95% CI)	P Value	OR (95% CI)	P Value
<b>Age</b>				
18–34 y	1.05 (0.89–1.23)	0.59	1.65 (1.38–1.97)*	<0.001
35–44 y	0.86 (0.76–0.96)*	0.007	1.62 (1.44–1.83)*	<0.001
45–54 y	1.01 (0.93–1.09)	0.85	1.60 (1.47–1.75)*	<0.001
55–64 y	0.95 (0.89–1.01)	0.12	1.33 (1.23–1.43)*	<0.001
65–74 y	0.94 (0.89–0.99)*	0.01	1.16 (1.09–1.23)*	<0.001
75–84 y	0.99 (0.95–1.03)	0.60	1.05 (0.99–1.11)	0.12
≥85 y	1 (Ref.)		1 (Ref.)	
Male sex	1.06 (1.02–1.09)*	<0.001	1.15 (1.11–1.20)*	<0.001
<b>Race/ethnicity</b>				
Non-Hispanic white	1 (Ref.)		1 (Ref.)	
Non-Hispanic black	1.40 (1.33–1.47)*	<0.001	1.99 (1.88–2.10)*	<0.001
Hispanic	1.19 (1.14–1.25)*	<0.001	1.45 (1.38–1.53)*	<0.001
Other	1.06 (0.99–1.13)	0.10	1.04 (0.95–1.13)	0.39
<b>Insurance status</b>				
Medicare	1.26 (1.19–1.35)*	<0.001	1.79 (1.65–1.94)*	<0.001
Medicaid	1.49 (1.39–1.61)*	<0.001	2.47 (2.26–2.71)*	<0.001
Private	1 (Ref.)		1 (Ref.)	
Self-pay	1.15 (1.03–1.29)*	0.01	1.09 (0.94–1.25)	0.26
Other	1.41 (1.26–1.57)*	<0.001	1.62 (1.42–1.84)*	<0.001
<b>Quartiles for median household income of patient's ZIP code</b>				
1 (lowest)	1.03 (0.98–1.08)	0.29	1.15 (1.08–1.22)*	<0.001
2	1.00 (0.96–1.05)	0.90	1.12 (1.05–1.19)*	<0.001
3	1.02 (0.97–1.07)	0.51	1.05 (0.99–1.12)	0.10
4 (highest)	1 (Ref.)		1 (Ref.)	
<b>Patient residence</b>				
Counties of ≥1 million population	1.00 (0.93–1.08)	0.98	1.01 (0.92–1.11)	0.81
Counties of 250 000–999 999 population	0.96 (0.89–1.04)	0.34	0.96 (0.87–1.06)	0.43
Counties of 50 000–249 999 population	0.96 (0.87–1.07)	0.46	0.99 (0.87–1.12)	0.88
Counties of <50 000 population	1 (Ref.)		1 (Ref.)	
<b>State</b>				
California	1.03 (0.99–1.06)	0.15	1.06 (1.02–1.11)*	0.003
Florida	1 (Ref.)		1 (Ref.)	
<b>Selected comorbidities*</b>				
Chronic pulmonary diseases	1.15 (1.11–1.19)*	<0.001	1.41 (1.36–1.47)*	<0.001
Renal failure	1.53 (1.48–1.58)*	<0.001	1.85 (1.78–1.93)*	<0.001
Diabetes mellitus, uncomplicated	1.12 (1.08–1.16)*	<0.001	1.21 (1.16–1.27)*	<0.001
Diabetes mellitus, complicated	1.08 (1.03–1.14)*	0.003	1.12 (1.06–1.19)*	<0.001
Depression	1.02 (0.96–1.08)	0.57	1.17 (1.09–1.25)*	<0.001
Drug abuse	1.19 (1.06–1.33)*	0.003	1.82 (1.64–2.02)*	<0.001

CI indicates confidence interval; ED, emergency department; and OR, odds ratio.

\*Statistically significant.

### Hospital Charges for AHFS in Florida

During the study period, the total charges for ED and inpatient services for AHFS in Florida were \$3.08 billion (95% CI, \$3.03–\$3.14 billion). Patients with frequent ED visits accounted for the majority of total charges (53.3%; 95% CI, 53.2–53.3%); this was driven by a significant monotonic

association between the frequency of ED visits and charges per patient ( $P<0.001$ ; Figure 2).

### Discussion

In our population-based study of 113 033 ED patients with AHFS, we found that approximately one third (31%) of

**Table 3. Unadjusted Outcomes of Patients With AHFS, According to the Number of ED Visits in 1 Year**

Variables	1 ED Visit	Frequent ED Visits		P Value
		2	≥3	
Number of ED visits for AHFS	78 240	42 082	55 169	...
30-d ED revisit rate for AHFS, % (95% CI)*	...	11.6 (11.3–11.9)	29.0 (28.6–29.4)	<0.001
Hospitalization rate for AHFS, % (95% CI)	88.4 (88.2–88.7)	86.7 (86.4–87.0)	85.2 (84.9–85.5)	<0.001
Near-fatal event rate, % (95% CI)	6.6 (6.4–6.8)	7.6 (7.3–8.4)	7.2 (7.0–7.4)	<0.001

AHFS indicates acute heart failure syndrome; CI confidence interval; ED, emergency department; and IQR, interquartile range.

\*Excluding the index ED visits and hospitalizations.

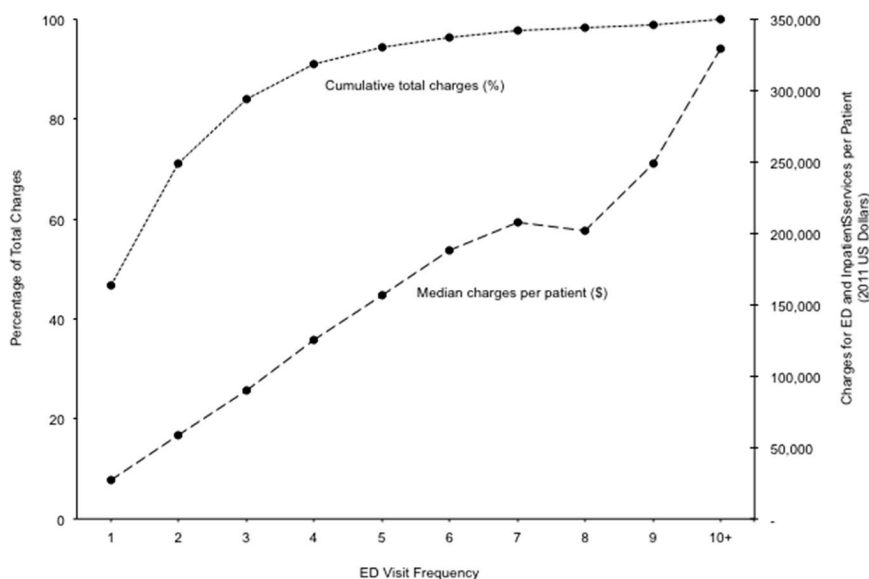
patients had frequent ED visits during 1-year follow-up period. The public health burden of this high-risk population, as measured by ED visits, hospitalizations, and near-fatal events, was large. The patients with frequent ED visits accounted for 55% of all AHFS ED visits and hospitalizations via ED and 58% of near-fatal events, all contributing to substantial health-care expenditure. Our study also demonstrated that non-Hispanic black race, Hispanic ethnicity, and lower socioeconomic status were associated with frequent ED visits for AHFS.

Most ED visits for AHFS are deemed to represent a failure in secondary prevention and are considered preventable through high-quality longitudinal management.<sup>1,2</sup> To date, most clinical and health services research has focused on examining readmissions<sup>5–7</sup>; however, focusing solely on hospital admissions may underestimate health-care utilization and discount the importance of the upstream ED visits.<sup>1,8,9</sup> To the best of our knowledge, this study is the first to identify individuals at greatest risk, that is, patients with frequent ED visits for AHFS. Frequent ED visits better reflect the failure of more prevention-oriented care and, accordingly, may serve as a patient-oriented metric. This metric may assist ongoing efforts to decrease hospitalizations for heart failure.

### Characteristics of Frequent ED Utilizers

Prior studies have reported social and health-care-related determinants of frequent ED visits across chronic conditions, such as socioeconomic distress, personal health behaviors,

and access to longitudinal outpatient care.<sup>23–25</sup> In agreement with these data in other conditions, we demonstrated that individuals at highest risk of frequent ED visits for AHFS were non-Hispanic black or Hispanic and of lower socioeconomic status. Our observations also support prior studies showing higher rates of AHFS ED visits<sup>13</sup> and hospitalization in these populations.<sup>7,26</sup> Furthermore, we also found that Medicare or Medicaid insurance status was independently associated with frequent ED visits for AHFS, which would also reflect the unique needs of this vulnerable population. Although the pathway through which socioeconomic status and health-care-related factors affect health-care utilization is undoubtedly complex, studies in other chronic conditions suggest that less self-management education and limited access to preventive care in this population might lead to a heavier reliance on episodic symptom treatment in the ED.<sup>27,28</sup> Additionally, our findings of higher rates of frequent ED visits in patients with comorbidities, such as diabetes mellitus, chronic kidney disease, and depression, are congruent with findings from several prior reports of ED and hospitalized patients with heart failure.<sup>3,29–31</sup> Our results may be helpful to those who are targeting care delivery interventions to this high-risk population with the intention of decreasing ED visits for AHFS. The policies of the Centers for Medicare and Medicaid Services that are directed at reducing health-care utilization and cost also should consider the implications of accounting for frequent ED visits for AHFS.



**Figure 2.** Median and cumulative charges for emergency department (ED) and inpatient services for acute heart failure syndrome, according to ED visit frequency. There was a significant linear association between frequency of ED visits and charges per patient ( $P<0.001$ ).

## Burden of Frequent ED Visits for AHFS

We were struck by the enormous burden of health-care utilization and expenditures by patients with frequent ED visits. However, ED visits for AHFS may be preventable with high-quality longitudinal care<sup>1,2</sup>; heart failure is characterized as an ambulatory care-sensitive condition by the Agency for Healthcare Research and Quality.<sup>32</sup> Accordingly, integrated efforts to develop and implement systems of care are warranted to curb heart failure morbidity and associated health-care expenditures. If recurrent ED visits after the index visit could be prevented, up to 62 458 ED visits and 53 234 hospitalizations would have been saved annually in the 2 states alone. In terms of expenditures, this would have saved \$1.06 billion, in Florida alone.

Although surveillance data are unable to explore more granular issues of AHFS care, our data can better inform a system of care for patients with heart failure. At the individual patient level, the evidence to identify heart failure patients at high risk for frequent ED visits remains scarce. Our observations should provide a strong foundation to continue efforts to evaluate determinants of ED visits for AHFS and to implement more targeted preventive care for patients with AHFS. In addition, at the population level, current reform efforts that directly and indirectly incentivize reducing readmissions may result in unintended consequences. For instance, patient care may shift to EDs and observation units in which health-care providers may be encouraged to avoid readmitting patients.<sup>8</sup> Even if readmission rates decrease, higher use of ED resource may lead to fragmented care and consequently contribute to duplication of services, conflicting care recommendations, and higher costs.<sup>33</sup> Our data underscore the importance of further efforts on how to reduce the enormous societal burden by targeting the upstream ED visits for AHFS as an integrated health policy, research, and community action.

## Limitations

Our study has several potential limitations. First, as with any studies using claims-based administrative data, there is a potential for errors in recording diagnoses, leading to misclassification of encounters. Although errors are possible, Healthcare Cost and Utilization Project data are rigorously tested and widely used to estimate diagnoses and visit frequency.<sup>34,35</sup> Second, our data are not a random sample of US patients with AHFS. Although it is tempting to dismiss the broader applicability of these results, our data from these large states include all ED visits and hospitalizations for ≈18% of the national population.<sup>36</sup> Furthermore, our findings persisted across the 2 geographically dispersed states, both suggesting a potential generalizability at the national level. Third, our study did not examine outpatient management, such as home-based care, management in a heart failure clinic, and remote telemonitoring programs.<sup>37–39</sup> Additionally, our data do not contain information on heart failure-specific disease severity measures. However, as a surrogate for severity for heart failure, we adjusted for Elixhauser comorbidity measures in our analysis. Fourth, our study used data on hospital charges, which may not accurately reflect actual hospital costs. However, it is still notable that patients with frequent ED visits accounted for the majority of total charges. Finally, our objective was to assess ED visits for heart failure and subsequent hospitalizations. We

surely underestimated total health-care utilization for AHFS through, for example, not counting outpatient office visits. However, as we focused on the characteristics and burden of frequent ED utilizers for AHFS, our observations are of direct relevance to the development of preventive strategies for patients at greatest risk.

## Conclusions

In our population-based study of 113 033 patients with AHFS, we found that 31% of ED patients had frequent ED visits and that non-Hispanic black race, Hispanic ethnicity, public insurance, and lower income level were associated with frequent ED visits for AHFS. This specific population accounted for the majority of all ED visits, hospitalizations, near-fatal events, and hospital charges for this condition. The high proportion of patients with frequent ED visits, reflecting the failure of current measures to manage these patients, presents an important public health challenge. For clinicians and researchers, our data underscore the importance of translating high-quality research into risk stratification, coupled with dissemination of these findings to improve secondary prevention for patients with heart failure. For policy makers, our findings underscore the importance of integrated strategies aimed at reducing health-care utilization for AHFS in an already stressed health-care system.

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## Disclosures

None.

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