



## Depression and race affect hospitalization costs of heart failure patients

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### Abstract

**Objective:** Depression and anxiety are frequently observed in heart failure (HF) patients; however, the effect of such factors on hospitalization costs of HF patients, and whether such costs vary by race and gender remain poorly understood. This analysis delineated the prevalence of depression/anxiety among HF patients and estimated the effect of race and gender on hospitalization costs.

**Methods:** We examined the 2008 files of the Tennessee Hospital Discharge Data System (HDDS) on patients ( $\geq 20$  years of age) with a primary diagnosis of HF (ICD-9 codes 402, 404, and 428) along with demographic data, depression/anxiety diagnoses, hospital costs, and comorbidities. Among the HF sample ( $n=16,889$ ) 53% were female and 23% were black. Race and gender differences in hospital costs were evaluated for the following three groups: (1) HF patients with depression/anxiety (HF<sup>+D</sup>); (2) HF-only patients without depression/anxiety (HF<sup>0</sup>); and (3) HF patients with other mental diagnoses (HF<sup>+M</sup>).

**Results:** HF was significantly ( $p<0.000$ ) higher among blacks compared to whites, and higher among males than females. Nearly 25% of HF patients had depression/anxiety (more whites and females were depressed). HF patients averaged more than 3 comorbidities (blacks had a greater number of comorbidities and hospitalization cost for the year). Costs were higher among HF<sup>+D</sup> patients compared to HF<sup>0</sup> patients. Among HF<sup>+D</sup> patients, costs were higher for black males compared with white males. These cost patterns prevailed largely because of higher comorbidities that required more re-admissions and longer hospital stays.

**Conclusion:** Race and depression/anxiety are associated with increased hospitalization costs of HF patients. The higher costs among blacks reflect the higher burden of comorbidities, such as hypertension and diabetes, which calls for widespread dissemination, adoption, and implementation of proven interventions for the control of these comorbidities.

**Keywords:** Hospitalization costs; heart failure; race; gender; depression

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Received 10 April 2015;

Accepted 5 May 2015

### Introduction

#### *Prevalence of depression/anxiety in HF*

Heart failure (HF) is the most common Medicare diagnosis, and consumes more Medicare treatment dollars than any other diagnosis. The

incidence of HF has been reported [1] to be approximately 10 per 1000 population among those 65 years of age or older. One potential outcome of HF is depression or anxiety, which reportedly exists among



20%–50% of HF patients; the variation in prevalence depends on how depression/anxiety was measured [2–11]. These estimates, which include pre-existing depression among cardiac patients [2], are similar to rates of depression among patients with coronary artery disease (CAD), but are two-to-three times the prevalence of depression in the general population [11]. Depression in HF patients adversely affects the quality of life [12–15], adds to poorer treatment outcomes [16–19], and leads to increased service use, hospital re-admissions, and higher mortality rates [20–31]. The effect of therapy for depression on HF patients remains inconclusive with respect to cardiac functioning, and therefore needs further examination [32–36]. Although depression is more often diagnosed among females and whites, co-existing anxiety is more often reported for black patients [37–40].

### *Effect of depression on health care costs*

One study involving HF patients reported that 65% of health care costs is attributable to hospitalization [41]; however, these costs vary depending upon depression and other chronic conditions. For example, Sullivan and colleagues [27] reported that hospitalization costs of depressed HF patients were 29% higher compared to HF patients without depression. Similarly, other studies have reported between 31% and 54% higher costs for depressed HF patients compared to non-depressed HF patients [27, 29, 42, 43].

Very few studies have examined the effect of depression/anxiety on hospitalization costs by race and gender. Although the role of race in high health care costs has been demonstrated, the role of gender remains uncertain. For example, Burns and colleagues [30] reported that although female Medicare beneficiaries had a higher prevalence of depression and a higher use of outpatient services, the hospital costs attributable to depression were 47% higher among males compared to females (\$15,060 vs. \$10,240,  $p \leq 0.001$ ). In another study, there were no differences in hospital costs between patients with anxiety and those with depression (\$8613 vs. \$8420 respectively) [31]. Because the effect of depression/anxiety on hospitalization costs of HF patients by race and gender is relatively unknown, we examined variations in such costs, as follows: (i) comparing heart failure plus depression patients (HF<sup>+D</sup>) with non-depressed patients (HF<sup>0</sup>) and HF

patients with mental diagnoses other than depression/anxiety (HF<sup>+M</sup>); (ii) and examining variations in costs by race and gender in all three groups of HF patients.

## **Methods**

### *Patient data*

We used the 2008 Tennessee Hospital Discharge Data System (HDDS) to obtain relevant data on adult patients (>20 years of age) with a primary diagnosis of HF (ICD-9 codes 402, 404, and 428). Of 400,235 patients, 4.2% were discharged in 2008 with a primary diagnosis of HF ( $n=16,889$ ). The HF sample included 53% females and 23% blacks with an average age of 72 years; the black patients tended to be younger (63 years) compared to white patients (75 years).

All diagnoses were made by attending physicians and appeared only when patients were treated for those diagnoses. Because 97% of the Tennessee population is comprised of non-Hispanic whites and blacks, our analysis was confined to these two groups. The presence of secondary diagnoses from the HDDS files were used to define comorbidities, such as hypertension, diabetes, coronary heart disease (CHD), chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), and cardiovascular disease (CVD) events, affecting the patient. As there is a high overlap in symptoms of depression and anxiety (ranging from 48% to 91%) [44, 45], we combined the diagnoses of depression and anxiety as a single variable for our analyses [46].

### *Data analysis*

The prevalence of HF hospitalized patients (per 100,000) was age-adjusted and indexed to the year 2000 census per methodology provided by the CDC [47] for the population at risk. We used two indices of comorbidities: (1) a simple count of all present comorbidities; and (2) the Charlson Index of Comorbidity [48], which measures the severity of the comorbidity for each patient. Comparison of HF comorbidities by race and gender were evaluated with a Pearson  $\chi^2$  test and a Fisher exact test. Further, we computed two types of hospital costs: (1) HF costs when a patient was discharged with a primary diagnosis of HF (HF Cost \$); and (2) total hospital costs for year 2008, that is, when the same patient was re-admitted with diagnoses other than HF (Total Cost \$). Finally, to determine the effect



of depression/anxiety on hospital costs, we compared average race-gender costs for three HF groups: (1) HF patients with depression/anxiety (HF<sup>+D</sup>;  $n=4125$ ), (2) HF patients without depression/anxiety or any mental diagnosis, that is HF-only (HF<sup>0</sup>;  $n=8306$ ); and (3) HF patients with mental diagnoses other than depression/anxiety (HF<sup>+M</sup>;  $n=4458$ ).

## Results

### *Hospitalization costs of heart failure*

Hospital costs invariably reflect the complexity of comorbidities, number of admissions, and length of hospitalization. We developed an index of patient comorbidities by counting the number of cardiovascular disease conditions and events (a total of 9 comorbidities) that were listed as secondary diagnoses. Table 1 (column 2) shows that the average HF cost for a patient was \$36,184 annually and because these patients average approximately four complex comorbidities, the total hospital cost for the year was approximately 69% higher compared with a non-HF patient (\$82,509 vs. \$40,301 [columns 1 & 2],  $p\leq 0.001$ ). The higher total hospital cost for HF patients appears to result from complexities of comorbidities as reflected by the Charlson scores (3.10 vs. 1.6,  $p\leq 0.001$ ), which resulted in more re-admissions (2.83 vs. 1.49,  $p\leq 0.001$ ), and longer hospitalizations (16.1 days vs. 7.4 days [columns 1 & 2],  $p\leq 0.001$ ). These higher costs also reflect the age of HF patients; on average, HF patients tend to be older (72 vs. 55 years), are more likely to have coronary heart disease (CHD; 66.5% vs. 23.2%,  $p\leq 0.001$ ), and have higher rates of hypertension (87% vs. 52%,  $p\leq 0.001$ ), diabetes (50% vs. 23%,  $p\leq 0.001$ ), stroke (14.3% vs. 8.5%,  $p\leq 0.001$ ), myocardial infarctions (11.4% vs. 3.9%,  $p\leq 0.001$ ), and chronic obstructive pulmonary disease (45.4% vs. 17.6%, Table 1 [columns 1 & 2],  $p\leq 0.001$ ).

### *Effects of depression/anxiety on hospitalization costs (HF<sup>+D</sup> vs. HF<sup>0</sup> & HF<sup>+M</sup>)*

Table 1 shows that one-fourth (24.4%) of all HF patients had depression/anxiety. Interestingly, depression/anxiety was higher among white HF patients than black HF patients (27.4% vs. 14.5% [columns 3 & 4],  $p\leq 0.001$ ), and higher among female than male HF patients (29.2% vs. 19.0% [columns 5 & 6],  $p\leq 0.001$ ).

The effect of this variation in depression/anxiety on hospitalization costs was first examined by comparing the HF<sup>+D</sup> group to those without depression/anxiety (HF<sup>0</sup>). Table 2 (columns 2 & 3) shows that HF<sup>+D</sup> patients had more comorbidities, such as hypertension, diabetes, coronary heart disease, atrial fibrillation, chronic kidney disease, and chronic obstructive pulmonary disease. Further, these comorbidities increased HF costs significantly for HF<sup>+D</sup> patients compared to HF<sup>0</sup> patients (HF cost of \$37,830 vs. 35,946,  $p\leq 0.001$ , and the total cost for the entire year increased by 46% [\$109,390 vs. \$68,503,  $p\leq 0.001$ ]). These cost differences reflected not only the higher rate of comorbidities that HF<sup>+D</sup> patients had compared with HF<sup>0</sup> patients, but also the higher rate of re-admissions (3.9 vs. 2.2), and length of hospitalization (23.0 days vs. 12.3 days,  $p\leq 0.001$ ). Similarly, cost trends emerged when HF<sup>+D</sup> patients were compared with HF<sup>+M</sup> patients (\$109,390 vs. \$83,733,  $p\leq 0.001$  [a difference of 27%, Table 2, columns 2 & 4]).

### *Costs variations by race & gender in HF groups (HF<sup>+D</sup>, HF<sup>0</sup>, and HF<sup>+M</sup>)*

Table 3 shows the cost variations by race and gender among HF<sup>+D</sup> patients. Both costs (HF costs as well as total costs) were significantly higher for black HF<sup>+D</sup> patients compared to white HF<sup>+D</sup> patients (HF costs for blacks were 31% higher [\$49,038 vs. 36,040,  $p\leq 0.001$ ] and total costs were 35% higher [\$147,511 vs. \$103,303,  $p\leq 0.001$ ] {columns 1 & 2}). These higher costs appear, in part, because of a greater proportion of blacks who suffered from hypertension, diabetes, and chronic kidney disease that added to more re-admissions among blacks (4.6 vs. 3.8 [columns 1 & 2],  $p\leq 0.001$ ), and longer hospitalization than whites (29.6 days vs. 22.0 days,  $p\leq 0.001$ ). In fact, blacks in other HF groups (HF<sup>0</sup> & HF<sup>+M</sup>) also had longer hospital stays and higher costs relative to whites (Table 3 [columns 5 & 6 and 9 & 10]).

A similar effect of depression on health care costs among blacks in the HF<sup>+D</sup> group also emerged for gender comparisons. Males had higher costs than females (\$125,294 vs. 99,903 [Table 3, cols. 3 & 4],  $p\leq 0.001$ ). Similar cost differentials also appeared in other HF groups (columns 7 & 8 and 11 & 12). These higher costs among males (Table 3 [columns 3 & 4]) were largely caused by more comorbidities (4.5 vs. 4.0,  $p\leq 0.001$ ), more re-admissions (4.2 vs. 3.8,  $p\leq 0.001$ ), and



Table 1. Heart failure sample cardiovascular risk factors and annual hospitalization cost variables by race and gender

Factor	Non-HF patient n=383,346	Total HF patient n=16,889	HF black n=3921	HF white n=12,968	HF male n=7903	HF female n=8986	HF BM n=1880	HF WM n=6023	HF BF n=2041	HF WF n=6945
Col. →	1	2	3	4	5	6	7	8	9	10
Age	55	72	63	75	69	75	59	72	66	77
HF %	–	4.2	4.5	4.2	5.1	3.7	8.1*	4.7	4.5	3.4
HF Rate per 100 K	–	368.0	655.0	300.3	397.5	344.4	738.4	347.6	585.4	266.3
DepAnx %	19.5	24.4 <sup>a</sup>	14.5	27.4 <sup>b</sup>	19.0	29.2 <sup>c</sup>	10.1	21.8	18.6	32.3*
Risk Factor										
HTN %	52	87 <sup>a</sup>	93.8 <sup>b</sup>	85.0	88.1 <sup>c</sup>	85.8	94*	83	94	86
DM %	23	50 <sup>a</sup>	54.6 <sup>b</sup>	48.4	50.5	49.2	50	51	59*	46
CHOL %	7.8	13.1 <sup>a</sup>	11.3	13.6 <sup>b</sup>	13.9	12.4	10.5	15.0*	12.0	12.5
CHD %	23.2	66.5 <sup>a</sup>	55.1	77.0 <sup>b</sup>	73.3 <sup>c</sup>	60.6	56.3	78.6*	54.0	62.5
MI %	3.9	11.4 <sup>a</sup>	8.5	12.2 <sup>b</sup>	12.2	10.6	7.9	13.6*	9.1	11.0
STRK %	8.5	14.3 <sup>a</sup>	12.0	15.0 <sup>b</sup>	13.8	14.7	11.1	14.7	12.8	15.2*
AFIB %	17	5 <sup>a</sup>	43.9	60.9 <sup>b</sup>	58.9 <sup>c</sup>	55.1	45.4	63.1*	42.6	58.8
CKD %	8.5	43.2 <sup>a</sup>	50.1 <sup>b</sup>	41.1	47.7 <sup>c</sup>	39.2	53.0*	46.0	47.5	36.8
COPD %	17.6	45.4 <sup>a</sup>	34.5	48.7 <sup>b</sup>	47.6 <sup>c</sup>	43.5	33.7	51.9*	35.2	46.0
Hospital Cost										
# of Comorb.	1.56	3.77 <sup>a</sup>	3.56	3.84 <sup>b</sup>	3.94 <sup>c</sup>	3.63	3.51	4.10	3.60	3.60
Charlson Index	1.6	3.1 <sup>a</sup>	3.50 <sup>b</sup>	2.80	3.23 <sup>c</sup>	2.98	3.35*	3.06	3.63*	2.60
# of Re-Adm.	1.49	2.83 <sup>a</sup>	2.9	2.8	2.8	2.9	2.82	2.78	2.92*	2.85
LOS	7.4	16.1 <sup>a</sup>	18.11 <sup>b</sup>	15.4	15.7	16.4	17.4*	15.2	18.8*	15.7
HF Cost \$	–	36,184	45,099 <sup>b</sup>	33,489	40,150 <sup>c</sup>	32,697	46,810*	38,071	43,523	29,516
Total Cost \$	40,301	82,509 <sup>a</sup>	96,293 <sup>b</sup>	78,342	88,066 <sup>c</sup>	77,622	94,838*	85,953	97,633	71,741

“a” Differences are significant between columns 1 & 2 at  $p \leq 0.001$ ; “b” differences are significant between cols. 3 & 4 at  $p \leq 0.001$ ; “c” differences are significant between cols. 5 & 6 at  $p \leq 0.001$ ; \*Differences among race-gender groups cols. 7–10 are significant at  $p \leq 0.001$ ; WF, white females; WM, white males; BF, black females; BM, black males; DepAnx %, Depression/Anxiety %; HTN%, percent with high blood pressure; DM, diabetes mellitus; Chol %, percent with high cholesterol; CHD %, percent with coronary heart disease; MI %, percent with heart attacks; Strk%, percent with stroke; AFib%, percent with atrial fibrillation; CKD%, percent with chronic kidney disease; COPD%, percent with chronic obstructive pulmonary disease; # of Comorb., number of co-morbidities; Charlson Index, Charlson Index of Co-morbidity (higher score denotes greater severity of co-morbid conditions); # of Re-Adm., number of re-admissions; LOS, length of stay in days/total hospital days; HF Cost \$, hospital charges associated with HF as primary diagnosis; Total Cost \$, total hospital charges in 2008.

longer hospital stays (24.8 days vs. 22.1 days,  $p \leq 0.001$ ). In fact, a gender breakdown by race revealed that higher costs for males accrued for both black and white males compared to their respective female peers.

### Discussion

Our study has produced some interesting findings. First, the average hospitalization cost for HF treatment alone was

\$36,184, and because these patients were also treated on average for more than three comorbidities, the total hospital cost for a year increased to \$82,509. These higher costs occurred among blacks and males and among those HF patients who were also afflicted with depression and anxiety. The effect of depression/anxiety in increasing total hospitalization costs was nearly 46% higher for HF<sup>+</sup>D patients compared with HF patients who did not have such emotional afflictions. The



Table 2. Cardiovascular risk factors and annual hospitalization cost by HF group.

Variable	Total HF n=16,889	HF <sup>+D</sup> n=4125	HF <sup>o</sup> n=8306	HF <sup>+M</sup> n=4458
Col. →	1	2	3	4
Age	72	71	73	70
HTN %	87	92*	85	87
DM %	50	54*	50	46
Chol %	13.1	17*	11	13
CHD %	67	73*	64	66
MI %	11.4	14*	9	13
Stroke %	14.3	18*	11	17
AFib %	57	60*	56	55
CKD %	43.2	47*	41	43
COPD	45.4	56.7*	36.5	51.7
Hospital Cost				
# of Comorb.	3.77	4.2*	3.6	3.8
# of Re-Adm.	2.8	3.9*	2.2	2.9
LOS	16.1	23.0*	12.3	16.6
HF Cost \$	36,184	37,830*	35,946	35,105
Total Cost \$	82,509	109,390*	68,503	83,733

\* Differences between three HF groups (cols. 2–4) are significant at  $p \leq 0.000$ ; HTN%, percent with high blood pressure; DM %, percent with diabetes mellitus; Chol %, percent with high cholesterol; CHD %, percent with coronary heart disease; MI %, percent with heart attacks; Stroke%, percent with stroke; AFib%, percent with atrial fibrillation; CKD%, percent with chronic kidney disease; COPD%, percent with chronic obstructive pulmonary disease; # of Comorb., number of co-morbidities; # of Re-Adm., number of re-admissions; LOS, length of stay in days/total hospital days; HF Cost \$, hospital charges associated with HF as primary diagnosis; Total Cost \$, total hospital charges in 2008.

estimated higher costs attributable to depression/anxiety is similar to other studies that reported increased costs ranging from 29% to 54% because of depression/anxiety among HF patients [27, 29, 30, 42, 43].

Additionally, some interesting patterns also emerged in our data. For example, although having other mental illnesses (HF<sup>+M</sup>) increased hospitalization costs compared with HF<sup>o</sup> patients, depression/anxiety among HF patients notably increased hospitalization costs because of the complexities

of greater comorbidities resulting in longer hospitalization. Clearly, HF patients use more resources while hospitalized, and this higher economic burden may possibly continue when the patient returns to the community without needed resources [42].

Our analyses of racial differences revealed a more complex pattern. Although whites with HF had a higher prevalence of depression/anxiety (possibly related to older age or a pre-existing condition), black HF patients (both males and females) had incurred the greatest hospitalization costs. This was especially true of black males, whose hospitalization costs appear to be related to a greater number of comorbidities that may have produced more complex conditions. These observations were especially striking because black men were the youngest in our race-gender groups. Previous observations regarding the possibility of racial bias and discrimination in accessing services [49] may add to worsening of conditions in blacks, which results in higher costs. Further, higher per capita hospital costs among blacks (in particular black males) suggest that HF<sup>+D</sup> black males may seek services late in the progression of their disease [50], which in turn requires more services and longer hospitalization. In addition, given the general trend of increased prevalence of depression/anxiety combined with comorbid conditions, our data raise the concern that cultural differences in the expression of depressed symptoms may be different for blacks, and thus may not be measurable by our current standard instruments. Data on this postulation is limited.

Gender differences in hospital costs also require further research. Although more males than females have HF, a greater number of HF female patients had depression. Despite the total health care costs being higher among men, the fact that women outnumbered men in the HF<sup>+D</sup> group (64% vs. 36%) suggests that considerable savings might be realized if costs attributable to depression/anxiety are reduced among women first.

Finally, we noted that these HF patients had numerous comorbidities, such as hypertension, diabetes, and chronic kidney disease, that were highly prevalent among blacks; however, the high prevalence of these medical disorders among blacks calls for optimal therapy [51, 52] and both primary and secondary preventive programs to reduce hospitalization





Table 3. Heart failure patient characteristics and hospital costs of three heart failure groups by race and gender

Characteristic	HF <sup>+D</sup> n=4125				HF <sup>O</sup> n=8306				HF <sup>+M</sup> n=4458			
	B	W	M	F	B	W	M	F	B	W	M	F
Col. →	1	2	3	4	5	6	7	8	9	10	11	12
HTN %	97 <sup>a</sup>	91	92	91	93 <sup>c</sup>	82	83	86 <sup>d</sup>	93 <sup>e</sup>	84	87	88
DM %	68 <sup>a</sup>	52	56	53	56 <sup>c</sup>	48	51	48	47	46	46	47
CHOL %	16	17	20 <sup>b</sup>	15	10	12 <sup>c</sup>	12	11	12	13	13	12
CHD %	66	74 <sup>a</sup>	82 <sup>b</sup>	67	53	68 <sup>c</sup>	72 <sup>d</sup>	57	54	71 <sup>e</sup>	70 <sup>f</sup>	60
MI %	12	14	17 <sup>b</sup>	12	7	10 <sup>c</sup>	9	9	10	15 <sup>e</sup>	14	12
STRK %	18	18	19	18	9	11 <sup>c</sup>	11	11	14	18 <sup>e</sup>	15	19 <sup>f</sup>
AFIB %	49	62 <sup>a</sup>	64 <sup>b</sup>	58	44	60 <sup>c</sup>	59 <sup>d</sup>	54	42	61 <sup>e</sup>	56	54
CKD %	61 <sup>a</sup>	45	54 <sup>b</sup>	43	48 <sup>c</sup>	39	46 <sup>d</sup>	37	49 <sup>e</sup>	40	46 <sup>f</sup>	38
COPD %	44.2	58.6 <sup>a</sup>	60.5 <sup>b</sup>	54.4	28.1	39.1 <sup>c</sup>	38.8 <sup>d</sup>	34.4	39.6	57.0 <sup>e</sup>	53.7 <sup>f</sup>	49.2
Hospital Cost												
# of Comorb.	4.19	4.19	4.5	4.0	3.4	3.6	3.7	3.4	3.5	3.9	3.9	3.7
# of Re-Adm.	4.6 <sup>a</sup>	3.8	4.2	3.8	2.3	2.2	2.2	2.3	3.1	2.9	2.9	2.9
LOS	29.6 <sup>a</sup>	22.0	24.8 <sup>b</sup>	22.1	14.3 <sup>c</sup>	12.9	11.8	12.7 <sup>d</sup>	18.8 <sup>e</sup>	15.6	16.4	16.8
HF Cost \$	49,038 <sup>a</sup>	36,040	43,456 <sup>b</sup>	34,604	44,431 <sup>c</sup>	33,268	39,169 <sup>d</sup>	33,034	44,433 <sup>e</sup>	31,011	39,708 <sup>f</sup>	29,464
Total Cost \$	14,751 <sup>a</sup>	103,303	125,294 <sup>b</sup>	99,903	80,206 <sup>c</sup>	64,808	72,668 <sup>d</sup>	64,739	98,479 <sup>e</sup>	77,259	89,609 <sup>f</sup>	76,518

B, Blacks; W, Whites; M, males; F, Females; “a” differences between cols. 1 & 2 are significant at  $p \leq 0.001$ ; “b” differences between cols. 3 & 4 are significant at  $p \leq 0.001$ ; “c” differences between cols. 5 & 6 are significant at  $p \leq 0.001$ ; “d” differences between cols. 7 & 8 are significant at  $p \leq 0.001$ ; “e” differences between cols. 9 & 10 are significant at  $p \leq 0.001$ ; “f” differences between cols. 11 & 12 are significant at  $p \leq 0.001$ ; HTN%, percent with high blood pressure; DM%, diabetes mellitus; Chol %, percent with high cholesterol; CHD %, percent with coronary heart disease; MI %, percent with heart attacks; Strk%, percent with stroke; AFib%, percent with atrial fibrillation; CKD%, percent with chronic kidney disease; COPD%, percent with chronic obstructive pulmonary disease; # of Comorb., number of co-morbidities; # of Re-Adm., number of re-admissions; LOS, length of stay in days/total hospital days; HF Cost \$, hospital charges associated with HF as primary diagnosis; Total Cost \$, total hospital charges in 2008.

in underserved communities. Further reduction in hospitalization may also be achieved through coordination of community-based resources for the HF patients who have complex co-existing conditions. Overall, it is important to recognize the need to focus on widespread dissemination, adoption, and implementation of proven interventions for the control of HF and its associated comorbidities.

### Limitations

Our findings were limited because the hospital discharge files (HDDS) do not include patients from the Department of Veterans Affairs (VA) hospitals or mental health hospitals. Further, the HDDS data are administrative files compiled by the Division of Health Statistics (Tennessee Department of Health). These files provide limited demographic



information, such as patient age, gender, race/ethnicity, county of residence, postal zip code, date of admission/discharge, primary and secondary diagnoses (ICD-9 codes), principal procedure codes, and costs. These files do not provide data pertaining to patient marital status, education, or annual income. No clinical data are provided regarding medications used, tests performed, test results, severity or duration of illness, or symptom indices used in arriving at clinical judgments/diagnoses. Further, these files lack details of diagnoses or comorbid conditions, which may shed additional light on racial and gender differences in health care costs. For the sake of maintaining confidentiality of records, patient-assigned identification numbers change every year, and hence it is not possible to follow a patient in the hospital discharge data beyond a given year. Because these potential confounding factors might affect the magnitude of observed racial differences, there is a need for caution in interpreting the results, and for additional research based on expanded data. Despite these and other limitations, however, we believe the present data provide useful insights regarding the impact of depression on hospitalization costs in Tennessee. Additionally, the HF sample, including 23% blacks, represents the demographic characteristics of the Tennessee population.

## Conclusion

HF patients with depression/anxiety have higher hospitalization costs compared with those without such diagnoses or compared with those with other mental health diagnoses in these data. Both primary and secondary prevention programs, along with community-based resources, are needed to reduce length of hospital stays for HF patients. Although blacks have higher hospital costs than whites, epidemiologic studies are needed to examine whether or not the high health care costs among blacks are caused by delays in treatment and/or poor access to services, which in turn may lead to more complex problems, more extensive treatments, and longer hospitalizations. Although further studies are needed to unmask the factors that underpin the findings in this study, there appears to be a clear need for concerted efforts to improve the dissemination, adoption, and implementation of evidence-based interventions for HF and its associated comorbidities across all

patient groups in an effort to maximize the population health impact and reduce the economic burden of HF on our health care system.

## Acknowledgements

This paper was presented at the World Congress of Cardiology, Dubai, UAE.

## Conflict of Interest

The authors declare no conflict of interest.

## Funding

The work was partially supported by several grants to Tennessee State University (CDC grant #ED072081100, a NCI grant [5U54CA163066; B. Husaini, PI]). Partial support for Levine, Husaini, and Cain was also provided by NIH grant #P20MD000516 (National Center on Minority Health & Health Disparity to Meharry Medical College). Sampson's effort was supported, in part, by the Harold Amos Medical Faculty Award of the Robert Wood Johnson Foundation.

**Authors' contributions:** Husaini B, Levine R, and Sampson U wrote the manuscript text; Cain V, Novotny M, and Husaini, B analyzed the data and prepared the tables; Moonis M was involved with discussion development. All authors reviewed and approved the manuscript.

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