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Expenditure on Heart Failure in the United States

The Medical Expenditure Panel Survey 2009-2018

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ABSTRACT

BACKGROUND With rising United States health care expenditure, estimating current spending for patients with heart failure (HF) informs the value of preventative health interventions.

OBJECTIVES The purpose of this study was to estimate current health care expenditure growth for patients with HF in the United States.

METHODS The authors pooled MEPS (Medical Expenditure Panel Survey) data from 2009-2018 to calculate total HF-related expenditure across clinical settings in the United States. A 2-part model adjusted for demographics, comorbidities, and year was used to estimate annual mean and incremental expenditures associated with HF.

RESULTS In the United States, an average of $28,950 (2018 inflation-adjusted dollars) is spent per year for health care–related expenditure for individuals with HF compared with $5,727 for individuals without HF. After adjusting for demographics and comorbidities, a diagnosis of HF was associated with $3,594 in annual incremental expenditure compared with those without HF. HF-related expenditure increased from $26,864 annual per person in 2009-2010 to $32,955 in 2017-2018, representing a 23% rise over 10 years. In comparison, expenditure on myocardial infarction, type 2 diabetes mellitus, and cancer grew by 16%, 28%, and 16%, respectively. Most of the cost was related to hospitalization: $12,569 per year. Outpatient office-based care and prescription medications saw the greatest growth in cost over the period, 41% and 24%, respectively. Estimated incremental national expenditure for HF per year was $22.3 billion; total annual expenditure for adults with HF was $179.5 billion.

CONCLUSIONS HF is a costly condition for which expenditure is growing faster than that of other chronic conditions. (J Am Coll Cardiol HF 2022;■:■–■) Published by Elsevier on behalf of the American College of Cardiology Foundation.

Heart failure (HF) remains a major public health challenge. An estimated 2.4% of the U.S. population over the age of 20 years or 6.2 million people have HF.[1] The prevalence of HF is estimated to increase by 46% from 2012-2030, such that by 2030 over 8 million people will be affected.[1,2] Key risk factors for the development of HF are hypertension (HTN), coronary artery disease, substance use, diabetes mellitus (DM), and age. HF poses significant morbidity and mortality, and is 1 of the top 5 causes of hospitalization for Americans over the age of 65 years.[3] In 2008, the estimated 1-year mortality rate of HF was 29.6% among Medicare beneficiaries.[4] Between 2004 and 2013, the age-adjusted incidence was found to decrease by 32%, yet prevalence increased by 6.2% among Medicare beneficiaries.[5]

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

DM = diabetes mellitus

HF = heart failure

HTN = hypertension

ICD = International Classification of Diseases

MI = myocardial infarction

The increasing prevalence relates to aging demographics and improved survival among patients living with HF.[6]

As the prevalence of HF rises, the impact on health care utilization and expenditure becomes more urgent. In 2012, total direct and indirect cost of HF was estimated to be $30.7 billion with 80% of direct costs attributable to inpatient hospitalization.[2] In a pooled study from 2002-2011, the average annual expenditure for a patient with HF in the United States was $23,854 in terms of 2014-inflation adjusted dollars, compared with $5,511 for patients without HF.[7] How spending on HF nationally has changed in the recent era with changing demographics and new evidence-based therapeutics is not clear. The purpose of this study is to estimate current annual expenditures in the United States for individuals diagnosed with HF using nationally representative all-payer data from the MEPS (Medical Expenditure Panel Survey).

METHODS

DATA SOURCE AND SAMPLE. We obtained data on annual expenditures from the MEPS Household Component between 2009 and 2018. MEPS is a nationally representative survey of the U.S. civilian noninstitutionalized population administered by the Agency for Healthcare Research and Quality. Patients living in nursing homes or assisted living facilities are not included. Participants are drawn from a subsample of households that participated in the previous year's NHIS (National Health Interview Survey). MEPS has a complex, stratified, multistage probability design using overlapping panels. Data for each panel is collected over a 2-year period, and a new panel is added each year. Five rounds of interviews are conducted over a 2.5-year period to construct the data for each panel. Two panels are combined to construct continuous and current estimates of health care expenditures for each calendar year.[8] Abstracted employer, insurer, and medical provider data are combined with interview data to estimate health care utilization and expenditures.[9,10] The NHIS sampling frame reflects an oversampling of minority groups, including Black, Hispanic, and Asian persons, and the MEPS further oversamples low-income households. Information is collected via self-report and validated through comparison with medical and financial data collected from providers and pharmacies. MEPS sampling weights are tied to age, sex, race/ethnicity, region, and metropolitan statistical area.[10] To estimate the national prevalence of HF, we used data from the NHANES (National Health and Nutrition Examination Survey). Total national expenditures for HF were estimated by combining episodic data from MEPS with NHANES national prevalence data.[11] HF was defined for adults age older than 18 years with HF by International Classification of Diseases-9th Revision (ICD-9) or International Classification of Diseases-10th Revision (ICD-10) (Supplemental Table 1).[12]

VARIABLES OF INTEREST. We defined total medical expenditure as the sum of direct payments for care across medical service lines, including inpatient hospitalization stays, outpatient and office-based visits, prescription medication, emergency department visits, dental visits, home health care, and others. Payments were combined across payers, including Medicare, Medicaid, Tricare, and private insurance; out-of-pocket expenditure; and others. Expenditure and income data were converted to 2018 inflation-adjusted dollars using the Consumer Price Index.

Comorbidities of cancer, DM, HTN, and myocardial infarction (MI) were defined by either self-report or International Classification of Diseases code (Supplemental Table 1). The remainder of the comorbidities in MEPS, including angina, arthritis, asthma, other heart disease, high cholesterol, emphysema, and stroke, were based on self-report. Participants with missing comorbidity data were assumed to be free of that condition.

STATISTICAL ANALYSIS. All national estimates used appropriate survey design and weights per MEPS recommendations. Unadjusted mean expenditure by service line was reported for participants with and without HF. Unadjusted mean expenditure for participants with HF was compared with expenditure for 3 other conditions with high prevalence and mortality: cancer, MI, and DM, to better contextualize HF spending. We adjusted for comorbidities including angina, arthritis, asthma, cancer, coronary heart disease, hyperlipidemia, DM, emphysema, HTN, MI, stroke, and other heart diseases.

We used a 2-part model to estimate total expenditure while controlling for age, sex, race, educational level, insurance type, marital status, poverty category, region, annual income, and year. The first part of the model is a probit of the probability of any annual medical expenditures. The second part of the model is a generalized linear model with a gamma distribution to account for the skewed distribution of expenditure data. We estimated margins from the fitted model to assess incremental expenditure. For total national HF expenditures, we combined the NHANES prevalence estimate with MEPS annual per

person expenditure data. Statistical analysis was completed using Stata 17.0 (StataCorp). The University of California at Los Angeles Institutional Review Board determined this study was exempt from review.

RESULTS

The pooled adult population from 2009-2018 included 250,820 participants (240,414,681 weighted) (Table 1). Individuals with HF were more likely to have comorbid conditions such as HTN, DM, cancer, and coronary artery disease than those without HF. HF was more frequently identified among participants who identified as Black, representing 12.0% of the overall population but 16.2% of the HF population. Prevalence of HF was higher in the Midwest and South compared with the Northeast and West.

The mean unadjusted annual expenditure in terms of 2018 inflation-adjusted dollars for participants with HF was $28,950 compared with $5,727 for participants without HF, a nearly 5-fold difference (Table 2). Total mean unadjusted annual expenditure for participants with HF increased across the years from $26,864 in 2009-2010 to $32,955 in 2017-2018 (Supplemental Figure 1). This trend represented a 25% increase in unadjusted expenditure the 10-year period, compared with a 23% increase for participants without HF. Unadjusted mean annual inpatient expenditure for participants with HF increased from $12,166 in 2009-2010 to $13,054 in 2017-2018. This change represented an 7% increase in the 10-year period, compared with a 3% decline for participants without HF (Table 3). Median expenditure for those participants with HF typically exceeded expenditure for participants without HF in all categories of medical service (Figure 1). Inpatient expenditure for participants with HF accounted for 43% of total expenditure, the highest single component. Unadjusted office-based, prescription medication, and emergency department expenditure for participants with HF changed by 41%, 21%, and 22%, respectively, over the 10-year period (Central Illustration). There was a marked increase in emergency department expenditure in the 2013-2014 period for HF participants not observed for non-HF participants.

Compared with participants with a history of cancer or MI, participants with HF had a more rapid increase in total expenditure over time (23% compared with 14% each), as shown in Figure 2. This difference was magnified in the inpatient setting, with a 7% increase in inpatient expenditure for participants with HF compared with 1% and 7% decline for participants

TABLE 1 Sample Demographics of Participants With and Without HF

	All	HF	Non-HF
Weighted population, N	240,414,681	1,724,096	238,690,585
Sample size, n	250,820	1,742	249,078
Age, y			
<18	0.0	0.0	0.0
18-44	46.7	4.2	47.0
45-64	34.3	29.9	34.3
65-84	16.8	49.2	16.6
>85	2.3	16.8	2.14
Female	51.7	52.3	51.7
Race			
White	65.0	73.6	64.9
Black	12.0	16.2	12.0
Hispanic	14.9	5.2	15.0
Asian	5.8	2.0	5.8
Multiple races or other	2.3	3.1	2.3
Married	52.5	42.5	52.6
Education level			
No degree	23.2	32.4	23.2
High school diploma	38.4	40.4	38.4
Bachelor's degree	17.1	8.0	17.2
Insurance			
Private	54.3	11.3	54.7
Other public, Tricare, or uninsured	15.6	9.7	15.7
Medicare	17.0	55.8	16.7
Medicaid	9.8	7.7	9.8
Medicaid and Medicare	3.2	15.5	3.1
Census region			
Northeast	18.1	14.3	18.1
Midwest	21.3	28.1	21.2
South	37.2	42.8	37.2
West	23.5	14.8	23.5
Household income level			
<100% of FPL	11.9	17.5	11.8
≥400% of FPL	41.4	26.6	41.6
Chronic conditions			
Angina	2.4	20.2	2.3
Arthritis	25.8	68.8	25.5
Asthma	10.2	19.9	10.1
Cancer	11.9	32.7	11.7
Coronary artery disease	5.4	56.0	5.0
Hyperlipidemia	30.7	71.6	30.4
Diabetes	10.4	44.1	10.2
Emphysema	2.2	16.9	2.1
Hypertension	33.8	87.5	33.4
Myocardial infarction	3.8	33.4	3.6
Other heart disease	11.0	85.4	10.5
Stroke	3.8	25.8	3.6
Year category			
2009-2010	19.2	20.5	19.1
2011-2012	19.6	16.6	19.6
2013-2014	20.0	21.5	20.0
2015-2016	20.4	20.6	20.4
2017-2018	20.8	20.8	20.8

Values are %, unless otherwise indicated. N refers to estimated population size; n refers to unweighted sample size.

FPL = Federal poverty level; HF = heart failure.

TABLE 2 Mean Expenditure for Participants With and Without Heart Failure by Expenditure Setting

Cost type	Year Category	HF	Non-HF
Total costs			
	2009-2010	26,864 ± 31,325	5,336 ± 13,430
	2011-2012	25,616 ± 51,349	5,415 ± 17,780
	2013-2014	28,683 ± 31,532	5,405 ± 13,958
	2015-2016	29,939 ± 35,061	5,985 ± 16,369
	2017-2018	32,955 ± 44,048	6,441 ± 16,071
	All years	28,950 ± 38,756	5,727 ± 15,648
Inpatient			
	2009-2010	12,166 ± 23,368	1,487 ± 8,838
	2011-2012	11,859 ± 46,550	1,566 ± 10,671
	2013-2014	12,746 ± 24,521	1,358 ± 8,432
	2015-2016	12,867 ± 25,184	1,507 ± 10,001
	2017-2018	13,054 ± 33,718	1,437 ± 9,610
	All years	12,569 ± 30,882	1,471 ± 9,557
Medications			
	2009-2010	5,002 ± 5,700	1,206 ± 3,549
	2011-2012	5,146 ± 7,385	1,249 ± 10,273
	2013-2014	5,572 ± 8,273	1,302 ± 5,014
	2015-2016	6,544 ± 8,975	1,495 ± 6,272
	2017-2018	6,063 ± 9,168	1,619 ± 6,567
	All years	5,687 ± 8,092	1,378 ± 6,683
Office based			
	2009-2010	4,255 ± 11,454	1,316 ± 4,372
	2011-2012	3,742 ± 8,319	1,294 ± 3,565
	2013-2014	4,918 ± 7,676	1,350 ± 4,162
	2015-2016	4,033 ± 7,360	1,484 ± 4,748
	2017-2018	5,889 ± 16,133	1,637 ± 5,031
	All years	4,607 ± 10,789	1,420 ± 4,451
Outpatient			
	2009-2010	1,660 ± 6,712	523 ± 3,373
	2011-2012	875 ± 3,389	490 ± 3,364
	2013-2014	1,324 ± 4,373	527 ± 3,488
	2015-2016	1,553 ± 5,237	539 ± 3,804
	2017-2018	1,825 ± 5,214	607 ± 3,560
	All years	1,470 ± 5,160	538 ± 3,536

Continued on the next page

with cancer and MI, respectively (Table 4). Participants with DM had a rise in total expenditure of 25%, slightly higher than the growth rate for HF.

The adjusted incremental cost of a diagnosis of HF was $3,594 per person per year compared with those without a diagnosis of HF, after adjusting for demographics and comorbidities (Table 5). A diagnosis of cancer, MI, DM, or HTN lent $3,358, $1,291, $2,885, and $1,311 incremental annual cost, respectively. Demographic characteristics such as female gender, higher education such as a masters or doctorate degree, and higher income status were associated with higher expenditures. Adjusted nation-wide annual incremental expenditure for HF was extrapolated from the 2016 NHANES report that suggests HF prevalence of 6.2 million from 2013-2016, resulting in $179.5 billion in total annual expenditure for patients with HF in the United States, of which $22.3 billion is attributable to HF.

DISCUSSION

Expenditure for patients with HF in the United States increased from 2009-2018, with roughly $3,594/year attributable to HF. Average annual expenditure for a patient with HF was $28,950 in our analysis, roughly 5-fold higher than that of non-HF patients. In a longitudinal study of HF patients identified from 1992-2003, the 10-year cumulative cost of HF was 31% higher for HF patients than those without HF, although this study was limited to a Medicare population.[13] Together, these findings suggest that expenditure for a patient with HF reflects diagnosis and treatment for a variety of comorbidities present in this population. Notably, among the comorbidities included, HF was the most expensive.

Total expenditure for patients with HF grew by 23% from 2009-2018, comparable to the 28% rise from 2002-2011 noted by a prior study.[7] This trend may be driven by a few factors. First, the rising prevalence of HF may contribute to a continued increase in medical expenditure for HF. Therefore, population health strategies to effectively prevent HF or reduce its incidence or prevalence could substantially reduce total health care expenditures. Second, given that per-person expenditure increased over the study period as well, it is possible that rising cost is driven by improved diagnostics and therapeutics in HF and non-HF care over the last decade. Further longitudinal study would be needed to assess the clinical impact of such interventions. Moreover, according to extant literature, HF-related mortality increased or stayed the same over the past 10-15 years, which may suggest that increased spending did not translate to better care.[14,15] Finally, the transition from ICD-9 to -10, announced in 2009 and implemented in 2015, may have presented a shift in coding practices not accounted for in the MEPS, potentially overestimating or underestimating expenditure for heart failure.[16] Thus, in addition to study of expenditure, further study of the value of HF-related care is required to understand how increased spending translates to quality of care.

Given the high proportion of inpatient-related expenditure for HF, careful study of the value proposition of inpatient care for HF patients is warranted. Inpatient spending was a strong driver of the increase in expenditure for both the HF and non-HF groups, 23% and 25%, respectively, which is comparable after accounting for measurement error or changes in coding practice.[6,17] However, inpatient spend was a

notably higher proportion of overall spending in the HF group: 43% compared with 26%. This skew toward spending in the inpatient setting is corroborated by extant literature, which suggests that for HF patients, inpatient spending may account for 47% to 60% of total expenditure.[7,18] A study of 1,054 newly diagnosed HF patients in Olmsted County suggested that inpatient spend accounted for 77% of total expenditure. The areas of highest inpatient spend were room and board (43%), procedures (12%), and evaluation and management (10%).

Although the skew toward inpatient spending is well-established, the present study further identifies a rapid acceleration of expenditure in the outpatient setting from 2009-2018, compared with prior periods when a greater proportion of expenditure was devoted to the inpatient setting. Indeed, a prior study notes 40% relative increase in inpatient costs from 2002-2011 compared with 9% increase noted in the present study. The passage of the Heart Failure Readmissions Reduction Program (HRRP) in 2010 and its initial implementation in 2012 were associated with a decrease in both overall admissions and readmissions for HF, which is likely a driver of comparatively slower growth in inpatient expenditure from 2009-2018.[19] The natural shift of care to the outpatient setting is reflected in our findings of 38% and 66% growth in office-based and home health expenditures from 2009-2018, trends that were mirrored in the non-HF population as well. Specifically, office-based expenditure refers to care provided at a doctor's office, group practice office, medical clinic, managed care plan or health maintenance organization center, community health center, surgical center, urgent care clinic, or standalone laboratory or radiology facility.[9] Thus, the trend of rising expenditure for patients with HF during the study period calls into question whether the HRRP significantly reduced expenditure for HF patients or simply shifted expenditure to alternative settings.

Changes in administrative practices such as triage and coding sparked by the HRRP may also explain the shift toward increased spend in the outpatient environment.[19,20] For example, readmission-related penalties could be reduced by citing higher case complexity, which may have resulted in upcoding of patient risk. Penalties could also be avoided by declining or delaying admissions or increased use of observation stays (billed as outpatient services) rather than hospital admissions.[19] One study observed a decrease in admissions for HF as a primary diagnosis and an increase in admissions for HF as a secondary diagnosis from 2006-2014.[21] Although this study's estimates include cost for HF as a primary or alternative diagnosis, the change in coding practices is worth noting. Moreover, cost data in the MEPS is extrapolated from CMS payment data; thus, hospital penalties for HF readmissions during the HRRP period are likely not represented. These findings suggest that providers may have shouldered even more expense for HF-related care than reported by our analysis. Additionally, we note that emergency department expenditure rose dramatically in 2013-2014 for patients with HF but not those without HF, which may reflect an uptick in episodes of care coded as emergency department visits in the early years after HRRP implementation.[19]

TABLE 2 Continued

Cost type	Year Category	HF	Non-HF
Emergency department			
	2009-2010	720 ± 2,608	209 ± 1,258
	2011-2012	790 ± 1,886	214 ± 1,140
	2013-2014	1,032 ± 3,105	234 ± 1,374
	2015-2016	725 ± 1,554	239 ± 1,579
	2017-2018	879 ± 1,852	228 ± 1,084
	All years	833 ± 2,310	225 ± 1,300
Home health			
	2009-2010	2,450 ± 6,884	181 ± 2,662
	2011-2012	2,567 ± 7,940	202 ± 2,915
	2013-2014	2,321 ± 5,732	211 ± 3,123
	2015-2016	3,559 ± 12,238	282 ± 3,728
	2017-2018	4,058 ± 10,372	323 ± 3,840
	All years	3,005 ± 9,021	241 ± 3,327
Other			
	2009-2010	612 ± 1,479	414 ± 1,163
	2011-2012	638 ± 1,798	401 ± 1,258
	2013-2014	770 ± 1,483	423 ± 1,222
	2015-2016	658 ± 1,315	440 ± 1,256
	2017-2018	1,186 ± 1,904	590 ± 1,457
	All years	779 ± 1,613	455 ± 1,287

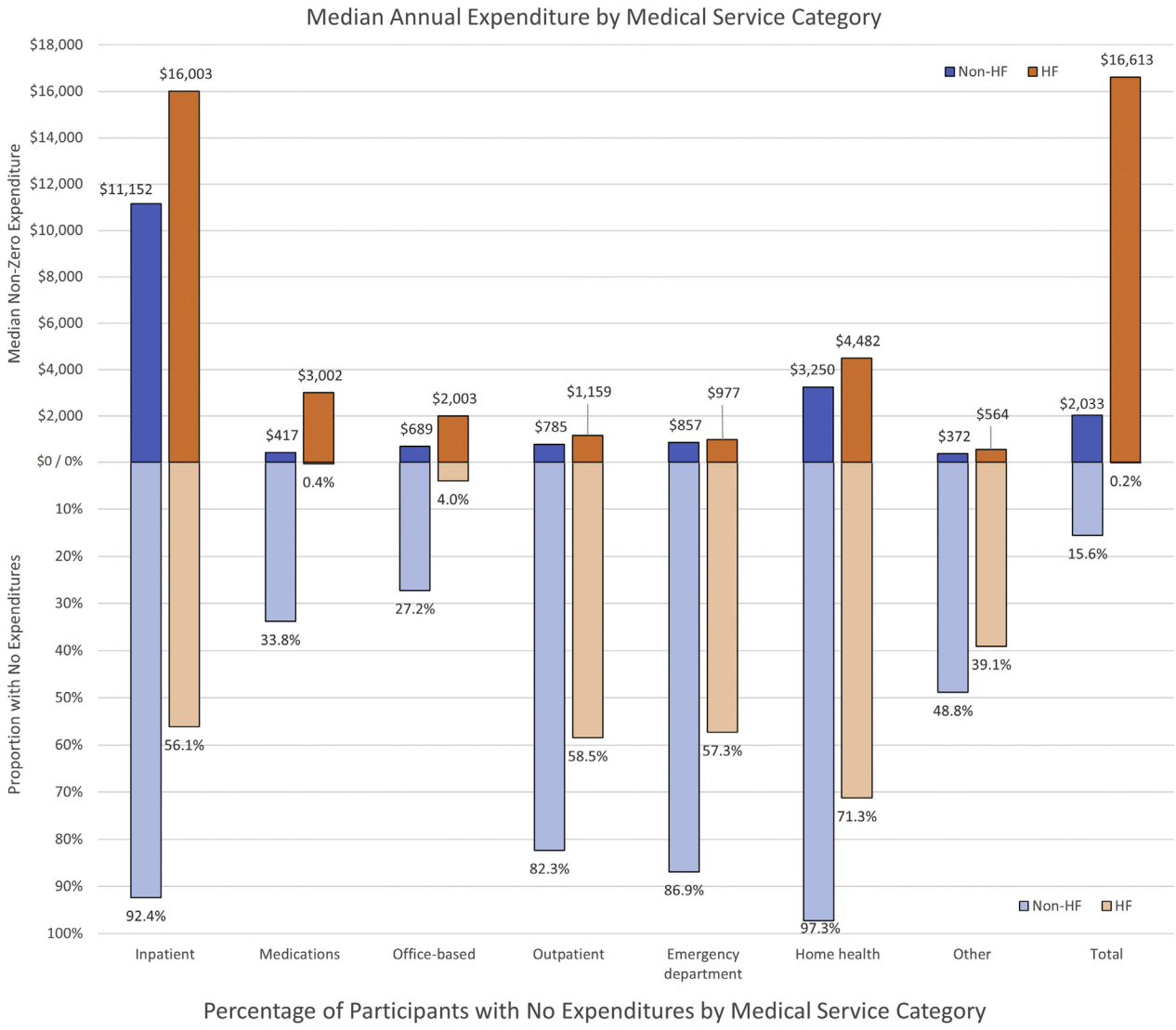
Values are mean ± SD. All values in terms of 2018 inflation-adjusted U.S. dollars.
Abbreviations as in Table 1.

TABLE 3 Change in Expenditure From 2009/2010 to 2017/2018

	HF	Non-HF
Total expenditure	22.7	20.7
Inpatient	7.3	−3.4
Medication	21.2	34.2
Office-based	38.4	24.4
Outpatient	9.9	16.1
Emergency department	22.2	9.1
Home health	65.6	79.0
Other	93.6	42.5

Values are %.
HF = heart failure

FIGURE 1 **Median Annual Expenditure by Medical Service Category for HF and Non-HF Participants**

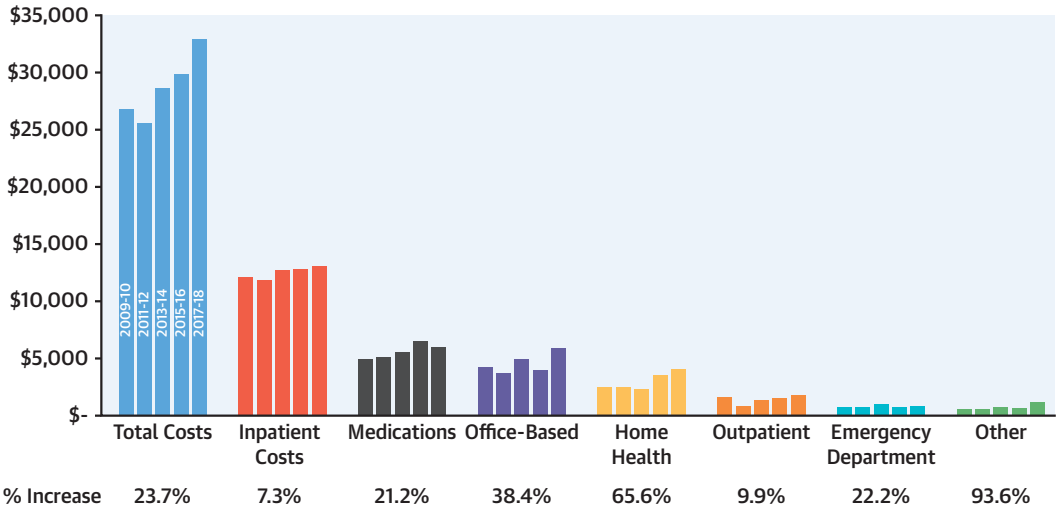


Median expenditures are calculated only for participants with nonzero expenditure for a particular category of spending. Median expenditure for heart failure (HF) patients was highest in the inpatient setting, and nearly all HF patients required expenditure for medications.

When considering the translation of expenditure to value, it is unclear whether care in the inpatient setting translates to better value for patients. Studies assessing the relationship between length of stay and 30-day and 1 year mortality rates among HF patients have conflicting results, suggesting that numerous factors affect the value proposition of inpatient care.[22-24] A recent focus on high-value-care has prompted a shift toward risk-sharing payment models between payers and providers, which has been associated with a shift of care from the inpatient to the outpatient setting.[25,26] Although hospitalization contributes to decreased functional status and reduced quality of life, ambulatory care may offer potential for faster access to care, shorter length of stay, and lower costs for patients. Further analysis of the cost efficacy of HF care across practice settings is warranted.

Prescription medication costs also rose during the study period for both HF and non-HF patients, by 21% and 34%, respectively. This relatively slower uptick in prescription medication expenditure may be

CENTRAL ILLUSTRATION **Trends in Per-Person Per-Year Expenditure by Service Line, 2009-2018**



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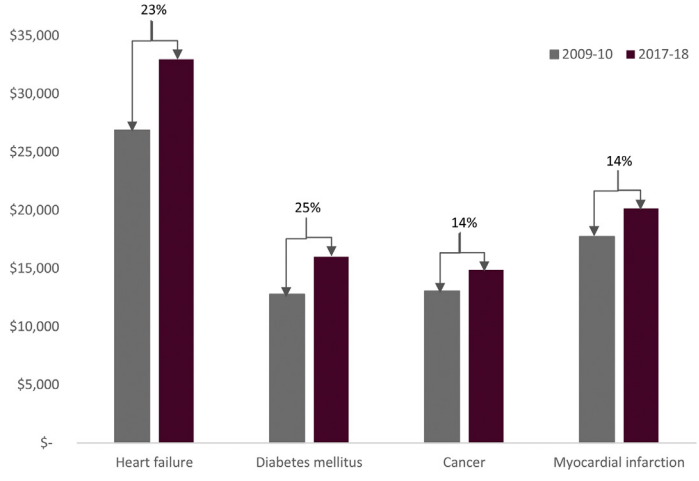
Annual mean expenditure for patients with heart failure (2009-2018, in 2-year increments). Among participants with heart failure, per person per year expenditure grew in all service lines from 2009-2018.

because more recent advancements in HF therapy such as angiotensin receptor-neprilysin inhibitors and sodium-glucose cotransporter-2 inhibitors had not yet achieved widespread adoption. Our estimate reports total prescription medication expenditure for HF patients as $5,687, likely overestimating HF-specific medication expenditure. A comparable benchmark using multiple data sources, including MEPS, reports $750 to $1,626 per person per year expenditure on medications for HF as the primary diagnosis or as a HF syndrome.[27] Reassuringly, HF therapy and transition to guideline-directed medical therapy are among the most cost-effective interventions.[28,29]

FIGURE 2 **Trend in 2009-2018 Expenditure Change by Clinical Condition**



The rate of overall expenditure growth from 2009-2018 was higher for heart failure–related spending compared with that of cancer or myocardial infarction

TABLE 4 Mean Expenditure for Participants With HF Compared With DM, Cancer, and MI

	HF	DM	Cancer	MI
Unweighted sample size, n	1,742	28,523	24,021	9,073
Weighted population, N	1,724,096	25,069,931	28,569,617	9,172,235
Mean annual per person expenditure	$28,950.44	$13,813.49	$13,519.29	$17,831.39
2009/2010	$26,864.07	$12,771.22	$13,049.26	$17,728.46
2017/2018	$32,954.55	$15,984.32	$14,870.32	$20,146.15
Percentage change, %	23	25	14	14
Mean inpatient expenditure	$12,568.87	$3,764.33	$3,848.43	$6,845.83
2009/2010	$12,165.53	$4,082.37	$3,853.51	$7,603.12
2017/2018	$13,053.80	$3,747.05	$3,812.08	$7,097.28
Percentage change, %	7	−8	−1	−7
Mean prescription medication expenditure	$5,687.32	$4,572.37	$2,943.85	$4,118.76
2009/2010	$5,001.76	$3,712.76	$2,585.20	$3,873.64
2017/2018	$6,063.26	$5,582.71	$3,547.41	$4,801.65
Percentage change, %	21	33	27	19
Mean office-based expenditure	$5,889.18	$2,705.77	$3,480.08	$3,058.28
2009/2010	$4,254.60	$2,408.32	$3,532.44	$2,554.74
2017/2018	$5,889.18	$3,102.67	$3,699.93	$3,489.68
Percentage change, %	38	22	5	27
Mean outpatient expenditure	$1,469.60	$971.43	$1,444.07	$1,107.20
2009/2010	$1,659.92	$1,104.18	$1,519.50	$1,451.14
2017/2018	$1,824.79	$1,044.59	$1,550.40	$1,219.98
Percentage change, %	10	−5	2	−16
Mean emergency department expenditure	$832.97	$385.55	$336.06	$638.44
2009/2010	$719.85	$391.57	$287.62	$635.92
2017/2018	$879.34	$397.12	$327.85	$588.21
Percentage change, %	22	1	14	−8
Mean home health expenditure	$3,005.00	$829.45	$722.23	$1,418.46
2009/2010	$2,450.08	$556.38	$572.36	$955.37
2017/2018	$4,058.47	$1,257.74	$930.77	$2,082.23
Percentage change, %	66	126	63	118
Mean other expenditure	$779.46	$584.59	$744.57	$644.41
2009/2010	$612.34	$515.63	$698.63	$654.52
2017/2018	$1,185.69	$852.44	$1,001.87	$867.11
Percentage change, %	94	65	43	32

DM = diabetes mellitus; HF = heart failure; MI = myocardial infarction.

Higher expenditures were associated with higher level of education and higher income status. This contrasts with extant literature suggesting that higher health literacy levels are related to lower health care utilization and expenditure.[30-32] Expenditure was lowest in the U.S. South, despite higher prevalence of HF in that region.[33] The inverse correlation between prevalence and expenditure in the South may be caused by a more rural geography in this region or reduced access to care from a shortage of medical professionals or facilities.[34] Higher expenditures were associated with use of Medicare and Medicaid, which may be explained by their elderly or complex patient populations, respectively. Alternatively, this finding may be caused by differences in patient utilization behavior or administrative differences in billing, eg, uncaptured cost of care for the uninsured. It is of note, however, that the incremental cost of HF exceeded that of cancer, DM, arthritis, and stroke, the next 4 most expensive conditions included in this analysis.

STUDY LIMITATIONS. This study depends on the representative sample included in MEPS. MEPS accounts for direct costs, although previous literature suggests that indirect costs may account for up to an additional one-third of direct costs.[2] We may underestimate the true cost of HF, because event-based expenditures that complicate other diagnoses, such as pneumonia, chronic obstructive pulmonary disease exacerbation, and so on, are not measured. Ascertainment of some demographic and comorbidity

TABLE 5 Incremental Expenditure Attributable to Comorbid Conditions

	Mean Expenditure	Incremental Expenditure
HF		3,594.03
No HF	$4,482.42	
HF	$8,076.45	
Angina		653.54
No angina	$4,489.08	
Angina	$5,138.68	
Arthritis		2,369.15
No arthritis	$3,976.74	
Arthritis	$6,349.16	
Asthma		1,510.05
No asthma	$4,361.67	
Asthma	$5,877.93	
Cancer		3,357.68
No cancer	$4,189.00	
Cancer	$7,553.66	
Coronary heart disease		976.30
No coronary heart disease	$4,454.59	
Coronary heart disease	$5,436.62	
Hyperlipidemia		490.69
No hyperlipidemia	$4,334.39	
Hyperlipidemia	$4,832.22	
Diabetes		2,885.09
No diabetes	$4,242.74	
Diabetes	$7,134.69	
Emphysema		1,084.46
No emphysema	$4,482.71	
Emphysema	$5,552.65	
Hypertension		1,310.85
No hypertension	$4,080.01	
Hypertension	$5,386.63	
Myocardial infarction		1,291.08
No myocardial infarction	$4,460.69	
Myocardial infarction	$5,740.11	
Other heart disease		1,295.47
No other heart disease	$4,373.19	
Other heart disease	$5,669.85	
Stroke		2,371.86
No stroke	$4,430.76	
Stroke	$6,797.25	

Values are U.S. dollars. Two-part regression model in which the first part is a probit of the probability of any annual medical expenditures and the second part is a generalized linear model with a gamma distribution to account for the skewed distribution of expenditure. The outcome variable is total health care expenditure. The marginal effect of each variable within the model is reported as the incremental expenditure attributable to the reported condition.

HF = heart failure.

data is based on self-report, which may not be accurately captured. MEPS may also underestimate certain lump-sum provider payments included as managed care agreements or community health clinic grants. MEPS excludes people living in institutions, such as nursing homes and assisted living facilities, who may have above average health care expenditures.[35] Shifts in MEPS methodologies may also create differences in the representation of household participants and national estimates.[35]

CONCLUSIONS

The economic burden of HF in the United States from 2009-2018 continues to increase. We find that nationally, an additional $22.3 billion is spent to provide HF-related medical services. Further research may characterize the nuanced relationship between health care utilization and expenditure, particularly as it varies by health care service line or payer type. A better understanding of the drivers of HF expenditure can help optimize programs and policies to control spending. The rapidly rising burden of HF on aging individuals in the United States and its financial toll on the nation necessitate a shift toward effective prevention strategies and higher-value care for this population.

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PERSPECTIVES

COMPETENCY IN SYSTEMS-BASED PRACTICE: HF is a costly condition for which expenditure is growing faster than that of other chronic conditions. Clinicians caring for patients with HF may find it interesting to note the factors that make this condition expensive to patients and the health care system, eg, frequent hospital admissions.

TRANSLATIONAL OUTLOOK: Innovations that address the costliest components of HF care may be the best target areas to enhance value for patients. Efficient adoption of interventions to reduce financial barriers to care for patients with HF is critical.

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KEY WORDS health care economics, health expenditure, heart failure (HF), Medical Expenditure Panel Survey

APPENDIX For a supplemental table and figure, please see the online version of this paper.