



# Trends in health care expenditure among US adults with heart failure: The Medical Expenditure Panel Survey 2002-2011

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**Background** Population-based national data on the trends in expenditures related to heart failure (HF) are scarce. Assessing the time trends in health care expenditures for HF in the United States can help to better define the burden of this condition.

**Methods** Using 10-year data (2002-2011) from the national Medical Expenditure Panel Survey (weighted sample of 188,708,194 US adults aged  $\geq 18$  years) and a 2-part model (adjusting for demographics, comorbidities, and time); we estimated adjusted mean and incremental medical expenditures by HF status. The costs were direct total health care expenditures (out-of-pocket payments and payments by private insurance, Medicaid, Medicare, and other sources) from various sources (office-based visits, hospital outpatient, emergency department, inpatient hospital, pharmacy, home health care, and other medical expenditures).

**Results** Compared with expenditures for individuals without HF (\$5511 [95% CI 5405-5617]), individuals with HF had a 4-fold higher mean expenditures of (\$23,854 [95% CI 21,733-25,975]). Individuals with HF had \$3446 (95% CI 2592-4299) higher direct incremental expenditures compared with those without HF, after adjusting for demographics and comorbidities. Among those with HF, costs continuously increased by \$5836 (28% relative increase), from \$21,316 (95% CI 18,359-24,272) in 2002/2003 to \$27,152 (95% CI 20,066-34,237) in 2010/2011, and inpatient costs (\$11,318 over the whole period) were the single largest component of total medical expenditure. The estimated unadjusted total direct medical expenditures for US adults with HF were \$30 billion/y and the adjusted total incremental expenditure was \$5.8 billion/y.

**Conclusions** Heart failure is costly and over a recent 10-year period, and direct expenditure related to HF increased markedly, mainly driven by inpatient costs. (Am Heart J 2017;186:63-72.)

Heart failure (HF) is associated with a substantial burden of morbidity and mortality in the United States.<sup>1</sup> In 2012, an estimated 5.7 million Americans 20 years or older had HF, and this number is projected to increase by 46% by the year 2030.<sup>1</sup> Over time, the hospitalizations for HF have remained high and are a significant concern for the US health care system, especially in terms of costs,

which are heightened by the development and implementation of life-prolonging therapies, as well as aging of the population, which will lead to more people at risk for developing HF.<sup>1</sup> The HF costs are presumably driven by hospitalizations, home nursing or hospice service, and medical devices such as cardiac resynchronization therapy and ventricular assist devices, as well as transplantation. In the United States, total cost for HF was estimated to be \$30.7 billion in 2012, with 68% being attributable to direct medical costs.<sup>2</sup> It is purported that the costs of HF have been rising or will rise over time in the United States.<sup>2</sup> However, extant studies on HF costs have been limited to short period,<sup>3,4</sup> focused on a single aspect of expenses (mainly in-hospital costs),<sup>5,8</sup> or have not had a national reach.<sup>7,8</sup> These have either focused on limited period (a few years<sup>3</sup> or the last few months of life<sup>4</sup>) and/or have mainly predated the widespread use of novel devices such as cardiac resynchronization and defibrillator<sup>9</sup> or left ventricular assist devices.<sup>10</sup> Changes in the use of and spending on hospitalizations, outpatient visits, and other medical services related to HF care remain unclear. Few studies have comprehensively quantified the change in the use of all these medical

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components in the United States or used nationally representative data.<sup>7,8</sup> Overall, there is a lack of nationwide data over a prolonged period to reliably assess the trends in resource use among HF patients in the United States.

Using the framework of the Medical Expenditure Panel Survey Household Component (MEPS-HC),<sup>11</sup> the largest nationally representative survey of medical costs in the United States, we examined the changes over time in direct health care expenditures among US adults with HF from 2002 to 2011, with the aim of assessing how the changing demographics or quality of HF care the United States has impacted the cost of HF care for different US populations.

## Methods

### Data source and study population

We used data from the 2002-2011 MEPS. We identified 1,764 (weighted sample of 1,675,414) US adults (aged  $\geq 18$  years) with HF using an *International Classification of Diseases, Ninth Revision (ICD-9)* code from the MEPS-HC. The MEPS includes several waves of national surveys of families and individuals, their medical providers, and employers in the United States. It samples data on an average of 39,000 individuals per year to estimate the use of medical resources in the US population. The MEPS sample is drawn from reporting units in the previous year's National Health Interview Survey, a nationally representative sample (with oversampling for blacks and Hispanics) of the US civilian, noninstitutionalized population. The MEPS has a complex design consisting of clustering, stratification, and multistage and disproportionate sampling with oversampling of minorities. We included MEPS rounds of interviews covering 2 full calendar years from 2002 to 2011. The included participants were individuals 18 years and older with HF enrolled in the MEPS-HC during the 2002 to 2011 period. We merged data from HC survey of the medical condition files and full-year consolidated files using the unique person identifier (DUPERSID) on a one-to-one match.<sup>12</sup> We pooled 10-year data to ensure sufficient sample size and increase precision of our estimates. The medical conditions and procedures reported by the MEPS-HC related to HF were recorded by an interviewer as verbatim text and then converted by professional coders to *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* codes. The error rate for any coder did not exceed 2.5% on verification. To protect the confidentiality of respondents, fully specified *ICD-9-CM* codes were collapsed to 3 digits.<sup>12</sup>

The MEPS collects information on health care use, expenditures, sources of payment, health status, the status of health insurance coverage, and demographic and socioeconomic characteristics of the civilian, noninstitutionalized population of the United States. Medical use and expenditures were collected from both household respondents and their medical providers.

### Heart failure definition

People with HF were defined on the basis of self-report that led to medical visits or treatment within the interview year. The self-reported HF condition was transcribed and classified with *ICD-9* codes using the *ICD-9-CM* diagnostic code 428 for HF.<sup>12,13</sup> In the MEPS-HC, diagnoses codes are derived by professional coders based on survey interviews, and only the first 3 digits of these codes are reported in MEPS. Information on each respondent is annualized, in which a calendar year is the duration of time for which information is reported in MEPS. Respondents were included in the study based on the availability of an HF diagnosis at any time during the year, with no requirement for hospital admission to be included in the study.

### Outcomes

Our focus was on direct medical costs because these constitute most HF-related costs. These costs include the total direct health care expenditures for the calendar year for each individual. The direct medical costs of HF were estimated by point of service, with the following point-of-service categories used: hospital (inpatient, outpatient, and emergency department [ED]), physician (office-based visits), prescription, home health, and other (including nursing home, rehabilitation, vision, medical supplies, dental). The costs include out-of-pocket payments and payments by private insurance, Medicaid, Medicare, and other sources; medical expenditures include (including office-based medical provider, hospital outpatient, ED, inpatient hospital [including zero night stays], pharmacy, dental, home health care, and other medical expenditures reported during the calendar year). The cost over the 2002-2011 period were be adjusted to the 2014 dollar value using the consumer price index obtained from the Bureau of Labor Statistics.<sup>14</sup> We used the 10-year pooled cross-sectional data and adjusted the analytic sampling weight variable by dividing it by the number of years being pooled. The sum of these adjusted weights represents the average annual population size for the pooled period. We combined 10 years of data (2002-2011) because for each year, these have a common variance structure necessary to ensure compatibility of our variables within the complex sample design.

### Covariates

The covariates defined on the basis of self-report included demographic and clinical variables. Recent studies showed that sociodemographic and binary indicators of disease are important covariates that affect medical expenditures<sup>15</sup> and that binary indicators of disease are more effective in accounting for disease burden.<sup>16-18</sup> Covariates are age, sex, race/ethnicity, marital status, educational level, health insurance, metropolitan statistical area (MSA), region, poverty/income ratio (income level), calendar year, and comorbidities—diabetes, hypertension, cardiovascular diseases (CVDs), emphysema, joint pain,

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