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Innovation in Heart Failure Treatment

Life Expectancy, Disability, and Health Disparities

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ABSTRACT

OBJECTIVES The goal of this study was to illustrate the potential benefit of effective congestive heart failure (CHF) treatment in terms of improved health, greater social value, and reduced health disparities between black and white subpopulations.

BACKGROUND CHF affects 5.7 million Americans, costing $32 billion annually in treatment expenditures and lost productivity. CHF also contributes to health disparities between black and white Americans: black subjects develop CHF at a younger age and are more likely to be hospitalized and die of this disease. Improved CHF treatment could generate significant health benefits and reduce health disparities.

METHODS We adapted an established economic-demographic microsimulation to estimate scenarios in which a hypothetical innovation eliminates the incidence of CHF and, separately, 6 other diseases in patients 51 to 52 years of age in 2016. This cohort was followed up until death. We estimated total life years, quality-adjusted life years, and disability-free life years with and without the innovation, for the population overall and for race- and sex-defined subpopulations.

RESULTS CHF prevalence among 65- to 70-year-olds increased from 4.3% in 2012 to 8.5% in 2030. Diagnosis with CHF coincided with significant increases in disability and medical expenditures, particularly among black subjects. Preventing CHF among those 51 to 52 years of age in 2016 would generate nearly 2.9 million additional life years, 1.1 million disability-free life years, and 2.1 million quality-adjusted life years worth $210 to $420 billion. These gains are greater among black subjects than among white subjects.

CONCLUSIONS CHF prevalence will increase substantially over the next 2 decades and will affect black Americans more than white Americans. Improved CHF treatment could generate significant social value and reduce existing health disparities. (J Am Coll Cardiol HF 2018;■:■–■) © 2018 by the American College of Cardiology Foundation.

There is much concern about the increasing share of national income devoted to health care (1), but spending increases have been accompanied by significant health improvements. Most significantly, age-standardized death rates from all causes have fallen 43% since 1969 (from 1,279 deaths per 100,000 in 1969 to 730 per 100,000 in 2013) (2). Better cardiovascular outcomes have driven much of this improvement, with age-adjusted deaths from heart disease falling from 520 per 100,000 in 1969 to 168.5 per 100,000 in 2015 (2,3). Evidence-based treatment of associated risk factors has been credited with contributing to these declines (4).

However, progress may be slowing and, in some disease areas such as congestive heart failure (CHF), may even be reversing. An estimated 5.7 million American adults experience CHF, and CHF is a

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ABBREVIATIONS AND ACRONYMS

ADL = activities of daily living

BMI = body mass index

CHF = congestive heart failure

CI = confidence interval

DFLY = disability-free life year

EQ-5D = EuroQol Five-Dimension Questionnaire

FEM = Future Elderly Model

HRS = Health and Retirement Study

IADL = instrumental activities of daily living

MEPS = Medical Expenditure Panel Survey

QALY = quality-adjusted life year

contributing factor in 1 in 9 U.S. deaths (4). The Centers for Disease Control and Prevention reports that between 2011 and 2014, age-adjusted death rates from heart failure rose from 16.9 to 18.6 per 100,000 (5).

This trend may also exacerbate existing racial health disparities. African-American subjects develop heart failure earlier than white subjects and are more likely to be admitted to the hospital for this disease (6,7). In addition, the 5-year risk-adjusted all-cause mortality rate for patients with CHF is 34% higher for African-American subjects than for white subjects (8,9). Given these existing racial disparities, the fact that the age-adjusted death rates from CHF are increasing is particularly alarming.

Adding to the personal toll of CHF (premature death, disability, and loss of quality of life), its economic costs are substantial: almost $32 billion annually for U.S. treatment costs and lost productivity (7). Fortunately, recent treatment innovations suggest that the future impact of CHF on patient outcomes, economic productivity, and overall social value could be reduced, perhaps even in a way that mitigates health disparities (10-12).

The goal of the present paper was to model the potential benefits to population health from continued innovation in CHF treatment. Using U.S. population-wide simulations, we estimated trends in CHF prevalence and how much improved CHF treatments could improve overall social value, as well as reduce racial and sex differences in health outcomes.

METHODS

To illustrate the potential benefits of improved CHF treatment, we adapted the Future Elderly Model (FEM), an established economic-demographic microsimulation that has been used to study a wide variety of health policy questions. The FEM has been developed over time with support from the National Institute on Aging, the Department of Labor, the MacArthur Foundation, and the Centers for Medicare & Medicaid Services to study health care innovation in a wide variety of contexts, including heart disease (13-17).

OVERVIEW. The FEM simulates health and medical spending for Americans ≥51 years of age. The model uses initial demographic characteristics and health conditions for each individual to project their medical spending, health conditions and behaviors, disability status, and quality of life. A key advantage of the FEM is that it tracks individual-level health trajectories and patient outcomes, which allows us to consider the impact of innovation according to characteristics such as sex and race.

The FEM's core module uses individuals' current characteristics to calculate transition probabilities among health states, including mortality, functional status, body mass index (BMI), and 6 disease conditions: diabetes, high blood pressure, heart disease (including CHF), cancer (excluding skin cancer), stroke, and lung disease. The model uses inputs from 3 nationally representative datasets: the Health and Retirement Study (HRS), a biennial survey of the American population ≥51 years of age, which has been conducted since 1992; the Medical Expenditure Panel Survey (MEPS), a set of large-scale surveys of the noninstitutionalized U.S. population; and the Medicare Current Beneficiary Survey, a survey of Medicare beneficiaries about their health status, health care use, and insurance coverage. More details on the model and data sources are provided in Goldman et al. (18).

PREVALENCE AND INCIDENCE OF CHF. To predict which individuals have or will be diagnosed with CHF during the simulation, HRS historical data were used to build a 2-year CHF incidence model based on predictors, including age, sex, education, race, age-race interactions, BMI, smoking behavior, marital status, and the 6 disease conditions modeled. This model uses a first-order Markov process in which time-varying components enter via their status 2 years before. For example, diabetes status in the prior wave of the survey is a predictor of incident CHF in the current wave. All transition models in the simulation have this structure.

CHF status is included as a predictor of other outcomes of interest, including mortality, functional limitations (activities of daily living [ADL]), and instrumental activities of daily living (IADL) limitations. Mortality is estimated as a 2-year probit model, controlling for age, race, sex, education, widowhood, smoking status, the 6 chronic diseases, ADLs, and IADLs. The number of functional limitations is estimated as an ordered probit with 4 categories: none, 1, 2, and ≥3. This ADL model controls for the same set of variables as the mortality model, plus BMI. IADL limitations are also modeled with the same predictors, as an ordered probit with 3 categories: none, 1, and ≥2.

VALUING HEALTH BENEFITS. To value health benefits, quality-adjusted life years (QALYs) were predicted by using the EuroQol Five-Dimension Questionnaire (EQ-5D), a widely used health-related quality of life index. The EQ-5D instrument includes 5 questions regarding the extent of problems in mobility, self-care,