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Understanding the Epidemic of Heart Failure: Past, Present, and Future

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Abstract Heart failure (HF) is a major public health problem affecting more than five million Americans and more than 23 million patients worldwide. The epidemiology of HF is evolving. Data suggests that the incidence of HF peaked in the mid-1990s and has since declined. Survival after HF diagnosis has improved, leading to an increase in prevalence. The case mix is also changing, as a rising proportion of patients with HF have preserved ejection fraction and multimorbidity is increasingly common. After diagnosis, HF can have a profound associated morbidity. Hospitalizations in HF remain both frequent and costly, though they may be declining as a result of preventive efforts. The need for skilled nursing facility care in HF has risen. The role of palliative medicine in the care of patients with advanced HF is evolving as we learn how to best care for this population with a large symptom burden.

Keywords Heart failure · Epidemiology · Incidence · Prevalence · Mortality · Readmission

Introduction

An estimated 5.1 million adults are currently living with heart failure (HF) in the USA, a clinical syndrome with a high associated morbidity and mortality [1]. The magnitude of this public health problem is reflected by the large economic burden imposed; the total cost of care for patients with HF is $31 billion and estimated to increase to $70 billion by 2030 [2•]. An appreciation of the factors that impact secular trends in HF is important to understanding the epidemic and anticipating future population needs. Strategies to prevent HF will reduce the incidence, while strategies to treat patients with established HF will reduce mortality, resulting in an increased prevalence of HF. As the prevalence of HF increases, our ability to care for the growing population of patients with HF becomes more complex, and issues such as readmissions and long-term care become of mounting importance. This review will focus on recent evidence regarding secular trends in the epidemiology and outcomes of HF.

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Epidemiology of Heart Failure

Definition of Heart Failure

An understanding of the variability in the definition used for HF is needed to interpret the reported results of epidemiologic studies. The American College of Cardiology Foundation (ACCF)/American Heart Association (AHA) guidelines define HF by stage (A to D) [3••], where only stage C and D patients have had active symptoms of HF. Stage A patients include the large proportion of the US adult population who have one or more risk factors for HF, such as hypertension and diabetes, whereas stage B patients have cardiac structural abnormalities but have never had clinical symptoms of HF. Most epidemiologic studies examining the prevalence of HF are restricting their definition to include only those patients with stage C (current or past symptoms of HF) or D (refractory, advanced symptoms) HF.

As HF is a clinical syndrome rather than a disease, it requires a clinical evaluation incorporating both elements of the clinical history and signs uncovered during physical examination and testing for diagnosis. Several criteria have been proposed to diagnose HF, including the Framingham criteria [4], the Gothenburg criteria [5], the Boston criteria [6], and the European Society of Cardiology (ESC) criteria [7]. Each relies on data that can be obtained from self-report, medical record documentation, and physical examination verifying that symptoms and signs of HF are present. In addition, each of the criteria also requires incorporation of data from testing such as chest radiograph (Framingham [4], Boston [6]), electrocardiogram (Gothenburg [5]), and cardiac imaging (ESC [7]).

The Framingham criteria require the presence of two major or one major and two minor criteria to diagnose HF [4]. Examples of major and minor criteria include paroxysmal nocturnal dyspnea, orthopnea, neck vein distension, rales, cardiomegaly, jugular venous pressure elevation, ankle edema, dyspnea on exertion, and pleural effusion. The Boston criteria categorize HF into definite, possible, or unlikely based on a score calculated by summarizing components of the history (such as dyspnea on exertion and orthopnea), physical examination (such as jugular venous distension), and chest radiography (such as pleural effusions and pulmonary edema) [6]. Both the Boston and Framingham criteria have 100 % sensitivity for the diagnosis of HF when compared with a cardiologist categorization. The Gothenburg criteria combines cardiac and pulmonary signs and symptoms of HF with use of HF medications (diuretics, digoxin) to define an HF stage, including 0 (HF absent), 1 (only cardiac symptoms present), 2 (cardiac symptoms plus either pulmonary symptoms or medication use), 3 (cardiac and pulmonary symptoms and medication use) to 4 (death due to HF) [5]. Finally, the ESC criteria require objective evidence of cardiac dysfunction in addition to symptoms of HF, such that cardiac imaging with echocardiography or another modality is required [7].

Di Bari et al. compared the four sets of criteria in an elderly Italian population [8]. HF was diagnosed in 11.9, 10.7, 20.8, and 9.0 % of participants using the Framingham, Boston, Gothenburg, and ESC criteria, respectively. The Boston criteria best predicted adverse cardiovascular events, including cardiovascular death and HF-related hospitalization, and are therefore recommended for use in older adults.

Incidence and Prevalence

In the USA, an estimated 5.1 million Americans are living with HF, with 550,000 new cases diagnosed each year [1]. A summary of studies that have examined the incidence and prevalence of HF is shown in Table 1. The prevalence and incidence of HF vary widely depending on the study population and HF diagnostic criteria used. While studies frequently use validated diagnostic criteria such as Framingham, Boston, and others previously reviewed, some rely on self-report or billing codes for the diagnosis of HF, the accuracy of which are unclear. Furthermore, many studies require a hospitalization event for detection and diagnosis, thereby missing outpatient cases. As HF can often be managed in an ambulatory setting, these studies may underestimate the incidence and prevalence of the diagnosis. In addition, shifts in coding of hospital discharge diagnoses to maximize reimbursement [9] may impact temporal trends observed.

Similarly, the population under examination can have major implications on reported findings. It is well established that the risk of HF increases with advancing age, with an incidence of 0.3 per 1,000 in those <55 years old up to 18 per 1,000 for those ≥85 years [10], with estimates as high as 47 per 1,000 in nonagenarians [11]. Therefore, studies limited to older populations, such as those focused on Medicare beneficiaries [12, 13], tend to have higher incidence rates, while those in young populations [14] may have very low incidence rates. The incidence of HF also varies by race and sex. Several US studies, including those in Medicare beneficiaries [12], those in the Henry Ford Health System [15], and in participants of the Multi-Ethnic Study of Atherosclerosis (MESA) [16], Atherosclerosis Risk in Communities (ARIC) [17], and the Coronary Artery Risk Development in Young Adults (CARDIA) [14] studies have reported a higher incidence of HF in blacks compared with whites. Only MESA specifically examined incidence rates in other races and reported the highest incidence in blacks, followed by Hispanics, whites, and Chinese individuals [16]. Most, but not all [10, 14], studies have found a higher incidence of HF in men compared with women.

Secular trends in the incidence of HF have been examined in many studies [12, 13, 15, 18–23]. Data reported from several studies suggest there may have been a decline in the incidence of HF since the mid-1990s. Croft et al. reported an increase in the incidence of HF among Medicare beneficiaries in 1993 compared with 1986 [12], though this may have been influenced by changes in billing patterns during the time period. Subsequently, Curtis et al. reported a decline in the incidence of HF among Medicare beneficiaries from 1994 to 2003 (Fig. 1) [13]. Similar declines after the mid-1990s in Western Australia, Scotland, Sweden, and Ontario, Canada, were reported [18, 21–23]. Two well-characterized population-based studies in the USA, the Framingham Heart Study and Olmsted County study, saw no changes in incidence through 2000 in men [19, 20], though a 31–40 % decline in women from 1990 to 1999 was seen in Framingham [19]. More contemporary data evaluating trends in the incidence of HF that have occurred in the last decade are needed.

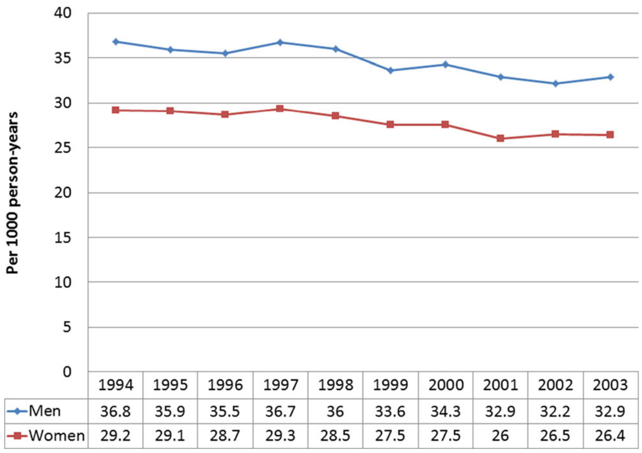
The prevalence of HF varies from 1 to 14 % based on available data from the USA and Europe (Table 1). The prevalence has increased over time due to improved survival after diagnosis of HF and aging of the population. Estimation of the lifetime risk for the development of HF is important for population health planning and risk communication. In the Framingham Heart Study, a primarily white US population, the lifetime risk of HF ranged from 20 to 33 % [24]. A recent

Table 1 Studies reporting on the incidence and prevalence of heart failure

Population source	Years	First author	Diagnostic criteria	Incidence	Prevalence	Mortality
North American studies						
NHANES-I	1971–1975	Schocken [88]	Self-report and clinical score	–	1–2 % self-report 2 % clinical score	10 year: 43 % self-report, 38 % clinical score
Medicare beneficiaries (≥65)	1986 1993	Croft [12]	Initial hospitalization with HF	1986: White: 22.4/1,000 person-years	–	In-hospital
				Black: 22.4/1,000 person-years		1986 White: 13 %, Black: 11 %
				1993: White: 24.6/1,000 person-years		1993 White: 10 %, Black: 9 %
				Black: 26.1/1,000 person-years		
Atherosclerosis Risk in Communities Study	1987–2002	Loehr [17]	Initial hospitalization for HF or HF death	Black women 8.1/1,000 person-years Black men: 9.1/1,000 person-years	–	1-year 22 % (similar by race)
				White women 3.4/1,000 person-years		
				White men: 6.0/1,000 person-years		
Cardiovascular Health Study	1989–1995	Gottdiener [42]	Physician diagnosis and HF treatment	Women: 14.6/1,000 person-years Men: 26.2/1,000 person-years	–	–
Henry Ford Health System	1989–1999	McCollough [15]	Framingham	1989: Women 3.7/1,000 person-years Men 4.0/1,000 person-years 1999: Women 4.2/1,000 person-years Men 3.7/1,000 person-years	1989: 4 % 1999: 14 %	1-year 17 % for incident cases
Framingham Heart Study	1950–1999	Levy [19]	Framingham	1990–1999: Women 3.3/1,000 person-years Men 5.6/1,000 person-years	–	5-year age-adjusted
						1950–1969: men 70 %, women 57 %
						1990–1999: men 59 %, women 45 %
Olmsted County	1979–2000	Roger [20]	Framingham	Women: 2.9/1,000 person-years	–	5 year age-adjusted
				Men: 3.8/1,000 person-years		1979–1984: 57 %
						1996–2000: 52 %
Worcester, Massachusetts	2000	Goldberg [10]	Framingham Hospitalized only	Women: 2.5/1,000 person-years Men: 1.9/1,000 person-years	–	In-hospital 5.1 %
Kaiser Permanente Northwest Region Health Plan	1970–1974 and 1990–1994	Barker [46]	Framingham	Women: 8.6/1,000 person-years	–	5-year age-adjusted
				Men: 11.7/1,000 person-years		1970–1974: men 83 %, women 61 %
				Women: 11.8/1,000 person-years Men: 12.7/1,000 person-years		1990–94: men 69 %, women 65 %
Multi-Ethnic Study of Atherosclerosis	2000–2005	Bahrami [16]	Physician diagnosis + medical treatment for HF	Black: 4.6/1,000 person-years Hispanic: 3.5/1,000 person-years	–	–
				White: 2.4/1,000 person-years		
				Chinese: 1.0/1,000 person-years		
Medicare beneficiaries (≥65 years old)	1994–2003	Curtis [13]	1 inpatient or 3 outpatient billing diagnoses of HF	1994: 32.2/1,000 person-years	1994: 9 %	5 year risk-adjusted
				2003: 29.1/1,000 person-years	2003: 12 %	1994: men 68 %, women 62 %

Table 1 (continued)

Population source	Years	First author	Diagnostic criteria	Incidence	Prevalence	Mortality
						2003: men 65 %, women 60 %
Ontario, Canada	1997–2008	Yeung [23]	Inpatient and outpatient billing diagnoses of HF	1997: 4.5/1,000 person-years 2007: 3.1/1,000 person-years	–	1 year risk-adjusted 1997: 27 % 2007: 25 %
CARDIA study (enrolled at 18–30 years old)	1985–2006	Bibbins-Domingo [14]	Hospitalization for HF + medical treatment	Black women: 1.1 % in 20 years follow-up Black men: 0.9 %	–	Death from HF by age 50 in 3 black men (4.5 % of deaths) and 2 black women (7.7 % deaths)
European studies						
West London	1995–1996	Cowie [89, 90]	ESC	Women: 1.2/1,000 person-years Men: 1.4/1,000 person-years	–	1-year unadjusted 62 %
Scotland	1990–1996	Stewart [21]	Initial hospitalization for HF (primary code)	1996 Women: 1.9/1,000 person-years Men: 2.2/1,000 person-years	–	1-year, sex-adjusted 1990: men 37 %, women 40 % 1996: men 37 %, women 36 %
4 practices in England (≥45)	1995–1999	Davies [91]	ESC	–	Women 1.7 % Men 3.0 %	–
3 practices Denmark (≥40)	1993–1995	Nielsen [92]	Boston	–	6.4 %	–
Rotterdam Study (Netherlands, ≥55)	1989–2000	Bleumink [11]	ESC	Women: 12.5/1,000 person-years Men: 17.6/1,000 person-years	1999: 7 %	1 year 37 % 5 years 65 %
Sweden	1987–2006	Barasa [18]	Initial HF hospitalization	Age 55–84 1987–1991: 7.2/1,000 person-years 2002–2006: 6.0/1,000 person-years	–	1 year age 55–84 1987–1991: 39 % 2002–2006: 27 %
Eastern Finland	1986–1988	Remes [93]	Boston	Women: 1.0/1,000 person-years Men: 4.0/1,000 person-years	–	–
Other locations						
Western Australia	1990–2005	Teng [22]	Initial hospitalization for HF (primary code)	Women: 0.9/1,000 person-years Men: 1.3/1,000 person-years	–	1 year unadjusted 1990–1993: 31 % 2002–2005: 23 %



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Men	36.8	35.9	35.5	36.7	36	33.6	34.3	32.9	32.2	32.9
Women	29.2	29.1	28.7	29.3	28.5	27.5	27.5	26	26.5	26.4

Fig. 1 Incidence of heart failure in Medicare beneficiaries, 1994 to 2003. The incidence of heart failure declined from 32 per 1,000 person-years in 1994 to 29 per 1,000 person-years in 2003 ($p<0.01$). The incidence was higher in men than women but declined in both sexes over time. Data from [13]

effort combining data from the Cardiovascular Health Study cohort and the Chicago Heart Association Detection Project in Industry estimated the lifetime risk of developing HF from age 45 through 95 years. The risk was similar for black and white women (ranging from 24 to 46 %) and lower for black (20–29 %) compared to white (30–42 %) men [25•]. This divergence in overall risk of HF, which tends to be highest in black men, and a lower lifetime risk of HF in black men appeared to be due to higher competing risks for noncardiovascular death among black men, due to causes such as homicide and renal failure. The Netherlands' Rotterdam Study reported a lifetime risk of HF of 33 % for men and 29 % for women from the age of 55, which is overall similar to the US findings [11].

Impact of Ejection Fraction

HF can occur in patients with preserved and reduced left ventricular ejection fraction (EF). While HF patients with preserved (HFpEF) and reduced (HFrEF) EF have a high associated mortality and share similar clinical symptoms of HF [26–29], in many ways they are different. They tend to occur in different patient populations [26, 28, 30], respond differently to therapies [27, 31–34], and display different patterns of ventricular and cellular remodeling [35].

Different thresholds to define preserved EF in HF have been proposed, primarily ranging from >40–55 %. Large US national HF registries have used ≥40 % as the cutpoint [31, 36], while the Olmsted County [26, 28, 29, 37] studies have defined preserved EF as ≥50 %, which is in accordance with the ACCF/AHA guidelines [3••]. While estimates have varied according to the study population and EF cutpoint used, approximately half of all patients with HF have HFpEF [38]. Table 2 summarizes epidemiologic studies reporting on the prevalence and clinical characteristics of patients with HFpEF. In general, they are more likely to be older, female, have comorbidities such as hypertension and atrial fibrillation, and less likely to have clinically evident ischemic heart disease compared with their HFrEF counterparts.

There are very few data informing us on secular trends in the incidence and prevalence of HFpEF. To the best of our knowledge, no study has specifically examined trends in the incidence of HFpEF, and these data are needed. Among patients hospitalized with HF in Olmsted County, Minnesota, the proportion with HFpEF increased from 38 to 54 % from 1987 to 2001 [28]. Given the aging of the population and increase in the comorbidity burden of patients with HF, one could hypothesize a similar trend in the incidence of HFpEF over the same time period.

Etiology of Heart Failure

Several population-based epidemiologic studies have examined the contribution of risk factors to the development of HF [39•, 40–45]. Several common factors that predispose to HF in the population have been identified, most notably hypertension (present in 44–91 % of cases at incident diagnosis) [10, 22, 40, 43, 46], diabetes (18–23 %) [10, 22, 23, 40, 46], coronary artery disease (29–63 %) [10, 13, 23, 40, 46], obesity (25 %) [40], and a history of smoking (51 %) [40]. It should be recognized that multiple risk factors may co-exist and interact with each other in an individual patient. In Olmsted County, the risk of developing HF was highest for patients with coronary heart disease and diabetes [40]. However, both the prevalence of a risk factor and its associated risk for the outcome are needed to determine the population impact of a risk factor on a disease (i.e., population attributable risk). Coronary disease and hypertension had the highest population attributable risks for HF, with each responsible for 20 % of cases [40]. In the ARIC cohort, lack of optimal control of five factors, namely blood pressure, cholesterol, diabetes, smoking, and body mass, was estimated to account for 88.8 % of incident HF events [41]. Subsequently, the impact of a modest reduction in the prevalence of modifiable risk factors in the population, was estimated [39•]. They reported that a 5 % decrement in the prevalence of diabetes in the USA, for example, may prevent 30,000 incident HF cases annually. Thus, even small reductions in the prevalence of risk factors as a result of preventative health efforts may translate into large improvements in our ability to prevent the onset of HF in the population. However, while data from the National Health Examination and Nutrition Survey (NHANES) demonstrated that the prevalence of risk factors including hypertension, hyperlipidemia, and smoking have declined, the prevalence of obesity and diabetes has risen [47, 48]. These data suggest that the importance of obesity and diabetes in the genesis of HF may

Table 2 Selected studies reporting on the prevalence and characteristics of patients with HFpEF

Population source	Years of study	First author	Definition of HFpEF	Prevalence of HFpEF	Demographic characteristics associated with HFpEF
Olmsted County	1987–2001	Owan [28]	EF≥50 %	47 % (2,167/4,596)	Older age, female, higher BMI, lower hemoglobin, hypertension, atrial fibrillation
Olmsted County	2003–2005	Bursi [26]	EF≥50 %	55 % (308/556)	Older age, female, no prior myocardial infarction
Framingham Heart Study	1981–2004	Lee [94]	EF>45 %	41 % (220/534)	Hypertension, female sex, atrial fibrillation, no prior myocardial infarction, lack of LBBB
Framingham Heart Study	1981–2008	Ho [95]	EF>45 %	43 % (196/457)	Older age, higher BMI, smoking, atrial fibrillation
Ontario, Canada	1999–2001	Bhatia [30]	EF>50 %	31 % (880/2,802)	Older age, female, hypertension, atrial fibrillation
Strong Heart Study	1993–1995	Devereaux [96]	EF≥55 %	53 % (50/95)	Older age, female, less ischemic heart disease
Cardiovascular Health Study	1989–1993	Gottdiener [97]	EF≥55 %	22.3 % (60/269)	Older age, female, hypertension, less ischemic heart disease, lower serum creatinine
OPTIMIZE Registry	2003–2004	Fonarow	EF≥40 %	51 % (21,149/41,267)	Older age, female, white, less ischemic heart disease
ADHERE Registry	2001–2004	Yancy [98]	EF≥40 %	50 % (26,322/52,187)	Older age, female, hypertension, no prior myocardial infarction
Community hospital registry	1995 and 1997	Philbin [99]	EF>50 %	24 % (312/1,291)	Older age, female, higher body weight, valvular etiology for HF
PREVEND study	1997–2010	Brouwers [100]	EF≥50 %	34 %[a] (125/374)	Female, nonsmoker, lower serum creatinine
Cardiovascular Research Network	2005–2008	Gurwitz [101]	EF≥50 %	52 %[a] (6,210/11,994)	Older age, female, hypertension, white, noncardiac comorbidities
Denmark Registry	1993–1996	Gustaffson [102]	Based on WMI	40 % (2,218/5,491)	Older age, female, less ischemic heart disease
UK-HEART study	1993–1995	MacCarthy [103]	EF≥50 %	31 % (163/522)	Lower serum creatinine
Euro HF Survey	2000–2001	Lenzen [104]	EF≥40 %	46 % (3,148/6,806)	Older age, female, hypertension, atrial fibrillation, less ischemic heart disease

BMI body mass index, *HFpEF* heart failure with preserved ejection fraction, *EF* ejection fraction, *WMI* wall motion index

[a] Represents the proportion of newly diagnosed HF cases that had preserved EF in the study period

rise and underscore the importance of targeted preventive efforts to address these two emerging epidemics.

The burden of risk factors in patients with established HF has increased over time [49, 50], and the majority of patients with HF exhibit multimorbidity [51]. In patients with incident HF, the number of risk factors per person increased by 30 % from 1979 to 2002 [49]. Furthermore, the number of patients with HF with five or more chronic conditions increased from 42.1 % in 1988–1994 to 58.0 % in 2003–2008 [51], and the prevalence of multimorbidity is higher in patients with HFpEF [52]. Thus, multimorbidity, which is highly prevalent in older adults [53] and increasing in prevalence in patients with HF, deserves further examination. Multimorbidity has strong implications in the clinical management of patients with HF, where both the comorbidity burden and the interaction of specific comorbidities can affect the metabolism of medications, determine eligibility for advanced heart failure therapies, and have implications on prognosis.

Secular Trends in Outcomes After Heart Failure Diagnosis

Mortality

Numerous studies have consistently shown that mortality from HF has steadily declined in recent decades [12, 13, 18, 19, 21–23, 46, 54, 55], largely reflecting the introduction of medications, such as angiotensin-converting enzyme inhibitors and beta blockers, which improve survival in patients with reduced EF. Secular trends in mortality from the time of initial diagnosis of HF are summarized in Table 1. However, despite these improvements, HF remains associated with poor outcomes. After initial diagnosis of HF, the estimated survival is 72–75 % at 1 year [18, 19, 23] and 35–52 % at 5 years [18–20]. Most studies have suggested that women have better survival than men after diagnosis, adjusting for age. In Framingham, the estimated 5-year mortality was 59 % in men and 45 % in women from 1990 to 1999 [19]. Similar improvements in survival over time and sex differences were reported in Olmsted County [20], elderly Medicare beneficiaries [13], and the Kaiser Permanente system [46] through the 1990s. More recent data from Medicare beneficiaries has suggested that mortality may have reached a plateau from 2001 to 2005 [56].

In-hospital mortality has also improved. A report using a large national dataset of US hospital discharges found that in-hospital mortality declined by 27 % from 4.5 % in 2001 to 3.3 % in 2009, though no improvements were seen in younger individuals [57•]. In Medicare beneficiaries hospitalized with HF, in-hospital mortality declined from 8.5 % in 1993 to 4.3 % in 2006 [58]. However, this was balanced, in part, by an increase in early postdischarge mortality (from discharge to 30 days postdischarge), such that the total 30-day mortality rate only declined by 2.1 % during the same period. This may reflect a movement toward discharging patients earlier as reimbursement from US government payers does not increase with longer length of stay.

There are very few studies examining the cause of death in patients with HF. In Olmsted County, 43 % of deaths were due to noncardiovascular causes, and the proportion was higher in patients with preserved EF [50]. Over time, a shift in the distribution of deaths occurred, with a decrease in the proportion of cardiovascular deaths from 74 % from 1979 to 84 to 51 % from 1997 to 2002. Concomitant increases in patient age and comorbidity burden were observed over the study period, which were felt to impact the shift toward noncardiovascular causes of death observed. In contrast, trial populations including highly selected patients with reduced EF have shown a much lower proportion of noncardiovascular deaths [59, 60].

Readmissions

Heart failure is the leading cause of hospitalization among Medicare beneficiaries in the USA. Patients hospitalized with HF have the highest 30-day readmission rate (~25 %) of any diagnosis [61], over half of patients are readmitted within 1 year, and multiple readmissions are common [49, 62]. In total, there are more than one million hospitalizations for HF each year in the USA [63]. Annual total direct medical costs for patients with HF are $21 billion and expected to increase to $53 billion by 2030 [2•], and hospitalizations account for up to three quarters of those costs [64]. Thus, hospitalizations in patients with HF are a major public health problem and have been a focus of the debate on healthcare reform. One of the provisions in the Affordable Care Act established the Hospital Readmissions Reduction Program [65], which required the Center for Medicare and Medicaid Services (CMS) to begin financial penalizing hospitals with higher-than-expected 30-day readmission rates for HF, pneumonia, and acute myocardial infarction. Beginning in fiscal year 2013, two thirds of hospitals who were identified as “underperformers” faced a financial penalty of up to 1 % of their total Medicare base payments, which was increased to a maximum 2 % penalty in 2014.

While patients hospitalized with HF are at high risk for readmission, the majority of hospitalizations in patients with HF are due to reasons other than HF. In Medicare beneficiaries, only 37 % of readmissions within 30 days of a HF hospitalizations are for HF [61], and total cardiovascular causes only account for about half of 30-day readmissions [66]. Over the lifetime after HF diagnosis, the average patient is hospitalized about once a year, and most (62 %) hospitalizations are for noncardiovascular causes [49]. Common noncardiovascular reasons for (re)admission include respiratory tract infections and other pulmonary disorders, renal disorders, and fractures [49, 61], likely reflecting the comorbidity burden in the population. While patients with HFpEF are more likely to experience noncardiovascular hospitalizations than those with HFrEF [67], the overall risk of hospitalization is similar in both groups [30, 49].

Several studies examining trends in hospitalizations for HF have demonstrated a peak in rates in the 1990s, followed by declines thereafter. These reflect reports from the USA [54, 57•], Canada [68], Sweden [69], the Netherlands [70], New Zealand [71], and Scotland [72]. Using data from a national database of hospital discharges in the USA, the HF hospitalization rate declined by a relative 26.9 % from 2001 to 2009 [57•] However, the declines were limited to older individuals, a pattern which was also seen in an Australian study [22]. While HF hospitalization rates appear to have declined since 2000, 30-day readmission rates after a HF hospitalization were stable in Medicare beneficiaries from 2004 to 2006 [73]. However, recent data from CMS suggests that there has been a reduction in the 30-day all-cause hospital readmission rate in 2012 to 18.4 % compared with 19 % from 2007 to 2011 [74]. These trends were not specific to patients discharged following a HF hospitalization, and further analyses are needed to determine whether efforts aimed at reducing readmissions in patients with HF have been successful nationally.

Use of Long-term Care Facilities

As the population of patients with HF has become older, use of long-term care facilities has risen. From 2000 to 2004, 13.4 % of those hospitalized for HF were discharged to skilled nursing facilities (SNF), compared with only 6.8 % from 1980 to 1984 [75]. Among Medicare beneficiaries in the Get With the Guidelines program, 24.1 % were discharged to a SNF after a HF hospitalization, though this varied widely by region, with the highest use in the Northeastern USA [76]. Patients discharged to a SNF after HF hospitalizations are at particularly high risk for adverse outcomes, with over half dying within 1 year [76]. While they may also be at slightly higher risk for readmission than those who are discharged home [76], variability in national rates of SNF use explains very little of the variation in 30-day readmission rates [77].

Impact of Advanced Heart Failure Therapies

The introduction and advancement in mechanical circulatory support technology has revolutionized our ability to care for selected patients with advanced HF. Orthotopic heart transplantation has been an option for several decades, but the availability of suitable organ donors has limited the number of heart transplants to approximately 2,200 per year in North America, which has been stated to be “epidemiologically trivial” [78] when considering the burden of HF in the population. However, left ventricular assist devices (LVAD) can now be used as both a bridge to transplantation (until a suitable organ becomes available) or as destination therapy (LVAD remains in situ until death). LVADs implanted as destination therapy improve survival and quality of life for patients with advanced HF who otherwise would be ineligible for heart transplantation due to advanced age and comorbidity [79]. Unfortunately, their use is currently limited to the subset of patients that have very reduced EF (<25 %), advanced symptoms despite optimal medical therapy, no other life-limiting illnesses, and are interested in device support. While the exact number of potentially eligible patients is unknown, estimates have ranged from 25,000 to 250,000, which represent only a small fraction of the more than five million Americans living with HF. Therefore, their use likely has minimal impact on secular population trends in outcomes of HF at this time. However, as technology continues to advance and evolve, smaller, less invasive devices may become options for a broader range of individuals.

Trends in End-of-Life Care

As previously noted, HF is a syndrome with a high associated mortality, and roughly 5 % of patients have end-stage disease that is refractory to medical therapy. The majority of these patients are ineligible for advanced HF therapies such as LVAD or heart transplant due to age, comorbidities, EF, or personal preference. HF can have a profound impact on an individual’s quality of life, and the symptom burden for patients with HF is as high as those with advanced cancer [80]. Palliative care focuses on relieving and preventing suffering for these patients, and palliative medicine specialists can be instrumental in helping patients to define goals of care and providing emotional support for the patient, family, and caregivers. While palliative care may be appropriate for patients with HF at any stage of the disease, hospice is a specific medical benefit provided by Medicare and many other insurers to provide comfort-focused care in patients who only have months to live. While the use of hospice services in patients with HF at the end-of-life has increased since 2000 [81–83], rates of hospice enrollment in patients with HF are still less than half those of patients with cancer [81]. Recent data from Medicare [82] and Olmsted County [84] suggest that approximately 40 % of patients with HF enroll in hospice prior to death. While there are no national trends on the use of palliative medicine services in patients with HF, the proportion of hospitals with palliative care programs grew to 62 % in 2009, which is an increase of 134 % compared with 2000 [85]. The importance of palliative care in the treatment of patients with advanced HF has been recognized by several agencies such as the AHA [86•] and ESC [87] and will likely continue to grow and evolve over time. As the clinical trajectory of HF can be unpredictable in individuals, there is a recognized need to proactively and iteratively discuss end-of-life wishes with patients with HF and to help them develop a plan for end-of-life care that aligns with their values, goals, and preferences [86•].

Conclusions

The HF population is changing. The incidence of HF varies across studies, but overall suggests that the incidence has decreased since the mid-1990s. The etiology and risk factors for HF are evolving, with improvements in the population burden of some factors such as hypertension and an upsurge in obesity and diabetes, all of which will impact future trends in HF incidence. Improvement in survival after diagnosis has led to an increase in the prevalence of HF, and the age and comorbidity burden have resulted in an increasing proportion of patients with HFpEF. Hospitalizations in patients with HF remain frequent and costly, but may be declining. Delivering high-quality, patient-centered care for the growing population of patients with HF who are often elderly with multimorbidity continues to represent a formidable challenge.

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Compliance with Ethics Guidelines

Conflict of Interest Shannon M. Dunlay and Véronique L. Roger declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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