

What are the costs of heart failure?

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Heart failure, a syndrome associated with increasing prevalence, high mortality, and frequent hospital admissions, imposes a significant economic burden on western healthcare systems that is expected to further increase in the future due to the ageing population. Hospitalizations are responsible for the largest part of treatment costs and, thus, the main target for strategies aiming at cost reduction. Current literature suggests that evidence-based therapy with drugs, devices, and modern disease management programmes improves clinical outcomes of the large population of heart failure patients in a largely cost-effective manner. However, comprehensive knowledge about the cost of treatment is important to guide clinicians in the responsible allocation of today's limited health-care resources. This review provides information about the total cost of heart failure and the contribution of different treatment components to the overall costs.

Keywords Cost • Cost effectiveness • Heart failure • Hospitalization

Heart failure (HF) is a highly symptomatic syndrome that affects 2–3% of the population in industrialized countries with a marked rise in those aged >65.^{1,2} It has been estimated that ~15 (of 900) million Europeans and 5.8 (of 300) million US Americans suffer from HF.^{3,4} The prevalence of HF has been increasing over the past decades and is expected to further increase in the future, mainly due to the increasing proportion of elderly in the population and the improved survival of patients with cardiac and non-cardiac conditions such as acute myocardial infarction, hypertension, diabetes, renal failure, and metabolic syndrome that may trigger the development of systolic and diastolic ventricular dysfunction and clinical HF.

Over the past decades, the effectiveness of HF care has been markedly improved by the implementation of drug and device therapies with proven impact on mortality and morbidity but also by the development of advanced strategies for disease management in the outpatient setting.^{2,5} However, although these improvements have translated into better survival trends in some countries,^{6,7} HF is still characterized by high morbidity and mortality rates. The 5-year survival-rate in patients carrying the diagnosis of HF is close to 50% (with a poorer prognosis in men than in women), and compares unfavourably with many of the most common cancer diagnoses.⁸ Unlike cancer, however, HF has not received comparable attention in the western society, thus giving the impression that the disease is not a society-relevant problem but rather an individual issue. In contrast and important for the discussion on treatment costs, HF is associated with frequent hospital admissions and constitutes the most common diagnosis-related group in the USA. In Europe, ~5% of all acute hospital admissions are HF related.^{9,10} After discharge, HF patients are at high risk for

rehospitalization or death with a 3-month rate for death and readmission close to 14 and 25%, respectively.¹¹

As a consequence of demographic trends, the introduction of both advanced pharmacological and non-pharmacological treatments including catheter ablation, device therapy, and monitoring devices for HF, the disease puts significant financial burdens on patients, their families, and society as a whole. This article aims at summarizing current information about the total cost of HF and the contribution of the different treatment components to the overall costs.

Total costs

In the USA, the estimated annual cost of HF in 2010 is estimated to be \$39.2 billion or ~2% of the total US health-care budget.⁴ Evaluations from different European countries indicate a similar share of HF-related costs in relation to overall health-care expenditure.^{12,13} From an individual perspective, the diagnosis of HF is associated with annual costs of ~\$8500 per patient according to data from the National Heart and Lung Institute cardiovascular health study.¹⁴ These estimates may greatly undervalue the real costs as they are based on data with HF as the primary diagnosis while costs for HF treatment may also occur in many patients primarily hospitalized for one of the multiple comorbidities that typically accompany HF such as hypertension, diabetes, and renal or lung disease.

As a consequence of demographic trends and a broad expansion of the treatment armamentarium, the annual costs for HF have been steadily increasing. In the USA, for example, the estimated annual cost for HF rose from \$24.3 billion in 2003 to 39.2 billion

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in 2010 (Figure 1). Despite this, the percentage share of HF-related costs has been more or less constant in relation to the total costs spent for the treatment of all cardiovascular disease during this period. This indicates that there was no extraordinary 'cost explosion' specifically in the field of HF, but rather that the HF cost increase reflects the general increase in health-care expenditure observed in western societies.

The total costs for HF treatment can be divided into several major components. While in-hospital care is responsible for ~60% of HF-related costs in the USA, costs for disease management including regular outpatient follow-up by general physicians, cardiologists, and/or specialized HF nurses as well as the costs for chronic medication are far lower (Figure 2). A similar distribution pattern has been described for European countries.^{15–17} The costs for the implantation and maintenance of electrical devices, the main focus of this supplement issue, are difficult to allocate within such figures since they are not specifically listed as a discrete part of HF care in most of the relevant health economy analyses. While costs for regular follow-up and daily medication continuously accrue at a relatively low level in most patients in whom the diagnosis of chronic HF has been established, hospitalization events typically occur in individuals with more advanced disease and more complex co-morbidities. Only a minority of HF patients has an indication for device implantation but the initial costs for these devices are high and may significantly contribute to an overall increase in HF-related treatment costs. Surgical interventions such as heart transplantation or the implantation of a cardiac assist device are even more costly and possibly beyond currently accepted margins for cost effectiveness^{18–20} but are only carried out in a small subset of patients and yet have no major impact on overall costs.

Hospital care

Hospitalization episodes are costly, and about three-quarters of the total treatment costs for HF are associated with hospital admissions, in-hospital treatment, and patient care in nursing homes.^{16,21} Heart failure patients are not only frequently admitted to hospital but such admissions are often long although they appear to be substantially shorter in the USA (4.3 days in the ADHERE registry²²) than in Europe (average 11 days in the EuroHeart Failure Survey¹¹). It has been argued that the shorter duration of inpatient treatment may be at the cost of a higher risk for early readmission.²³ In fact, results from another US registry indicate that about one-third of patients still have signs and symptoms of congestion at discharge, which puts them at heightened risk for rehospitalization.²⁴

As hospital days are the main cost driver in HF, any treatment that reduces HF hospitalizations is more likely to be cost effective compared with other accepted health interventions. Nevertheless, it is worth remembering that HF is usually a syndrome of the elderly and that the need for frequent institutional care clearly increases with age.²⁵ These patients typically have a complex comorbidity profile and may be hospitalized for various other conditions than HF. Whellan et al.²⁶ studied over 1.3 million Medicare beneficiaries after an index HF hospitalization of whom 66% had a subsequent inpatient claim during the following year, HF

hospitalizations accounted for only 15% of the total inpatient costs whereas 57% were associated with non-cardiovascular diagnoses. This finding underlines the complexity of HF care and underlines the need for a multidisciplinary approach to HF patient management in order to achieve sustainable improvements in morbidity outcomes.

Disease management

Optimal management of patients with chronic HF typically requires regular and frequent outpatient visits to carefully monitor the patients' clinical status, improve patient education, and enhance the use of evidence-based therapies. To achieve these aims, many hospitals have built specialized HF disease management programmes and outpatient clinics that are often operated by specialized nurses. Owing to a favourable effect on hospitalization, these programmes are expected to reduce overall costs for HF care. In the pivotal trial by Rich et al.,²⁷ a nurse-directed, multidisciplinary programme significantly reduced the 90-day readmission rate and improved quality of life in a group of patients 70 years of age or older. This translated into a reduction of overall costs by \$460 per patient. A meta-analysis of 19 randomized controlled clinical trials evaluating HF disease management programmes in >5700 patients confirmed a significant decrease in all-cause hospitalization.²⁸ However, a large prospective randomized trial failed to demonstrate greater effects of moderate or intensive disease management delivered by a specialized nurse on the combined end points of death and hospitalization.²⁹ Thus, the literature does not uniformly show a reduction in hospital admission rates with more intensified follow-up strategies (compared with 'usual' care) and HF management programmes are currently only recommended for HF patients who were recently hospitalized and for others at high risk.

Nowadays, various telemedicine technologies for intensified patient surveillance by monitoring of blood pressure, heart rate, ECG, body weight, symptom response, patient compliance, and other parameters are increasingly used for the management of HF patients. Recent meta-analyses found that the inclusion of remote monitoring technology had a positive effect on clinical outcomes with a significant reduction in hospitalization and mortality.^{30,31} Klersy et al.³² showed that management of HF patients by remote monitoring is cost saving due to a substantial reduction in health-care resource utilization mostly driven by reduction in the number of HF hospitalizations. More importantly, the cost saving expected in both European and US health-care systems was linearly related to the implementation rate of remote monitoring. An important caveat of this analysis was the limited follow-up time of the most published studies reporting about remote patient management, which restricted the time horizon for the cost-effectiveness assessment to 1 year. Nevertheless, the efficacy of remote patient management was further supported by several sensitivity analyses which all consistently indicated that neither duration of follow-up nor geography in which remote patient management was tested would influence the obtained benefit.

However, as the organizational structure and choice of monitoring tools widely vary between HF disease management programmes due to regional differences in the organization of care it is currently

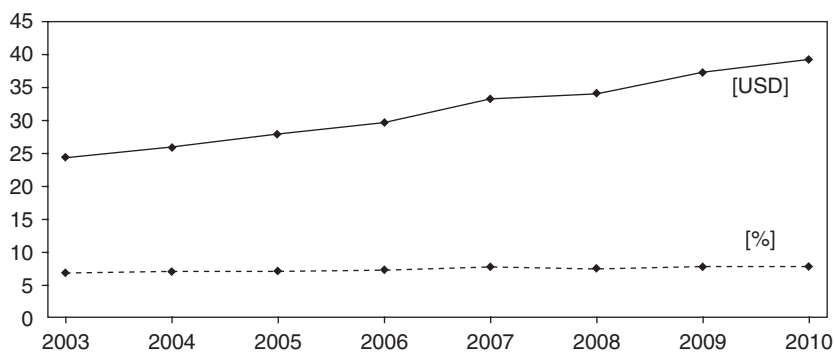


Figure 1 Costs for heart failure in the USA from 2003 to 2010. The straight line depicts the estimated total costs (including direct and indirect costs) for heart failure (in billions of dollars). The dotted line depicts the percentage of heart failure-related costs in relation to the total costs for cardiovascular disease. Source: Annual reports of the Heart Disease and Stroke Statistics Updates, from the American heart Association Statistics Committee and Stroke Statistics Subcommittee.

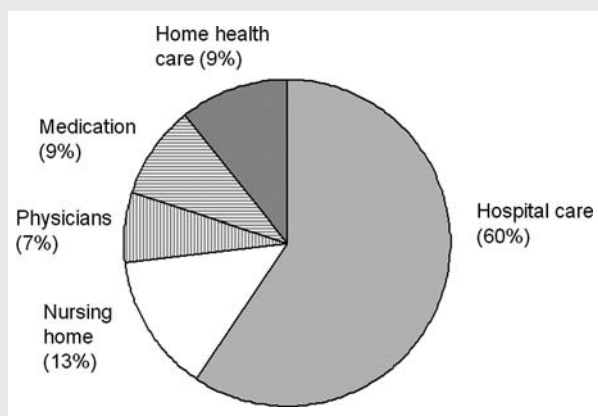


Figure 2 Distribution of costs for heart failure treatment in the USA. Data taken from reference.³

difficult to make a universally valid judgement on the cost effectiveness of HF management programmes in general and the use of telemedicine technology in particular.

Medication

Medical treatment with ACE-inhibitors and betablockers with the addition of angiotensin receptor blockers and/or aldosterone antagonists in more advanced stages of the disease and the optional use of diuretics and digoxin is still the mainstay of HF therapy aiming at reducing symptoms, improving functional status and survival, and reducing hospitalization. Thus, most HF patients take a large number of pills to treat their chronic HF and the various co-morbidities that are commonly present. Consequently, the costs for drug treatment are high and have been estimated to be \$3.2 billion per year in the USA. Despite this, the relative contribution of medication costs to the total cost of HF is low compared with that for hospitalization. The majority of drugs

recommended in guidelines for HF treatment, such as ACE-inhibitors, betablocking agents, and aldosterone antagonists, have lost their patent protection and are available at relatively low prices. A series of studies have been executed to assess the cost effectiveness of these drugs in different settings: these studies have generally found that their incremental cost is easily justified by the added benefits,^{33–36} and in some situations the use of such drugs is cost saving.^{37–39}

Recent attempts to prove clinical effectiveness of novel (and thus more expensive) substances for HF treatment have generally failed apart from ivabradine, which has been previously available for other indications.⁴⁰ In the USA, recombinant human brain natriuretic peptide (nesiritide) has been approved for treatment of acute decompensated HF in the hospital setting. Its expensive use for intermittent outpatient infusions in the form of repetitive scheduled visits led to a lively debate⁴¹ before its approval for this use was withdrawn. In Europe, the calcium sensitizer levosimendan can be given in acute decompensated HF and a subanalysis from the LIDO trial showed that its use is likely to be cost effective for this indication.⁴²

Devices

Cardiovascular implantable electronic devices (CIEDs) include cardiac pacemakers, implantable cardioverter-defibrillators (ICD), cardiac resynchronization therapy (CRT or CRT-D when combined with ICD), implantable cardiovascular monitors, and implantable loop recorders. Some of the CIEDs have become an effective treatment option in selected HF patients.^{2,5} In parallel with the mounting trial evidence of the clinical effectiveness of CIED therapies and their adoption into international guidelines, the number of device implantations has markedly increased over the past decade and so have the associated costs. In a recent report by Groeneveld *et al.*, time-series regressions between 2003 and 2006 in the USA indicated that a 1% increased ICD use in the HF population resulted in \$627 higher mean costs ($P < 0.001$). In aggregate, the

cost increase attributable to ICDs was \$893 million (29% of the total growth).⁴³

The majority of the cost for HF devices occurs at the time of implantation while the chronic treatment costs for maintenance of such therapy are relatively low. This pattern is significantly different from that of other therapies, especially medication, where costs steadily accumulate over time. Therefore, it is important to take a long-term perspective when analysing the cost effectiveness of devices⁴⁴ because the costs are largely paid up front but the benefit accumulates over time. In properly conducted studies, both ICD and, in particular, CRT devices have been reported to provide good value for money in developed countries. This supplement contains dedicated articles addressing the cost effectiveness of device therapies.

Other implantable devices that have been evaluated in preliminary studies include those for cardiac contractility modulation and haemodynamic sensors. However, these devices are not yet commercially available in most countries and no conclusions on costs and cost effectiveness can be drawn at the moment. Pacing and defibrillation devices also offer features and algorithms that can be used to improve the management of HF and have beneficial cost-effectiveness profile in preliminary evaluations.

Conclusion

Heart failure consumes large economic resources and, inevitably, costs will continue to increase due to the growing number of elderly individuals. Current HF treatment with drugs, devices, and disease management programmes are largely evidence based and are very likely to be cost effective. Thus, the costs for optimal HF treatment would appear to be a reasonable use of health-care resource, with improved survival and well-being of a large patient population. Future strategies to reduce costs should primarily focus on the reduction of hospitalization that represents the largest part of treatment costs and the identification of which patients are most likely to benefit from the range of interventions available. The most cost-effective strategies should be employed first: optimal drug therapy is essential to optimize the value for money of device therapy; device therapy and device-based monitoring should be considered an equally valuable proposition as much as drug therapy because they act synergistically to pharmacological therapy. More research about optimal resource allocation and cost of care are warranted.

Conflict of interest: none declared.

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