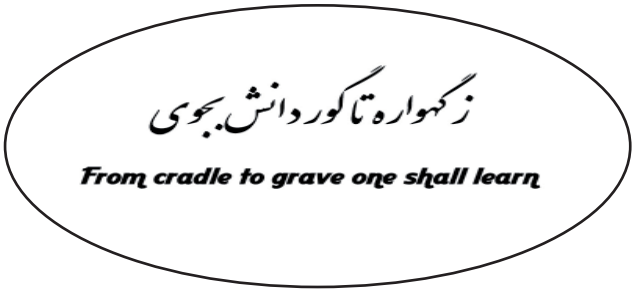
From the Department of Emergency and Cardiovascular Medicine,
Department of Medicine, Sahlgrenska University Hospital/Östra,
Institute of Medicine,
The Sahlgrenska Academy at University of Gothenburg,
Gothenburg, Sweden

Epidemiology of Heart Failure and Feasiblity of Home Care in Patients with Worsening Chronic Heart Failure

Masoud Shafazand



2009

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ISBN 978-91-628-7892-4

masoud.shafazand@vgregion.se

Department of Emergency and Cardiovascular Medicine,
Department of Medicine, Sahlgrenska University Hospital/ Östra,
Institute of Medicine, the Sahlgrenska Academy, University of Gothenburg,
Gothenburg, Sweden

Printed by Geson Hylte Tryck, Göteborg, Sweden 2009

To my uncles
Alireza Dalili and *Mohammadreza Dalili*
Who sacrificed their lives for a better world

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ABSTRACT

Aim: To investigate gender-specific trends in long-term mortality in patients hospitalised for ischaemic and non-ischaemic heart failure (HF) and explore temporal trends in the risk of HF complicating acute myocardial infarction (AMI). Another aim is to characterise patients with chronic heart failure (CHF) that seek an emergency department (ED) because of their deteriorating condition and evaluate the feasibility of home care (HC) in comparison with conventional care (CC) in patients with worsening CHF.

Patients and methods: In Papers I and II, data from the national hospital discharge and cause-specific death registers were linked through the personal identity number. The hospital discharge register has been in operation since the 1960s and has operated on a nationwide basis since 1987. Between April 2004 and May 2006, patients seeking care for dyspnoea were identified at the ED at Sahlgrenska University Hospital/Östra, Göteborg, Sweden. From this population, patients with known CHF were registered and further investigated on gender, age, socio-economic status, heart rate, blood pressure and symptoms and signs of HF. The information was saved in a registry. These data were subsequently used in Papers III and IV.

Results*:* Long-term mortality decreased, mainly during 1987–1995, with no further decrease after 2001. Survival improved more in men than in women, particularly in patients aged <65 years, and more in patients with ischaemic HF as compared in patients with non-ischaemic HF. The incidence of risk for HF decreased within three years after admission for AMI. In multivariate analyses risk of HF decreased by 4% yearly. Having had a stroke before admission increased the risk of HF by 37%, diabetes increased the risk by 76% and atrial fibrillation (AF) by 80%. Patients with any kind of valvular disease had a more than doubled risk. Of patients with worsening CHF that sought the ED, only 2% could be sent home directly. The remaining patients were admitted to hospital because of serious conditions, including pneumonia/respiratory disease, myocardial infarction, pulmonary oedema, anaemia, need to monitor cardiac rhythm, pathological blood chemistry and difficulties to communicate. There were no significant differences in clinical events, adverse events or in health-related quality of life (HRQL) between the HC and CC groups. The total cost related to CHF was lower in the HC group after 12 months.

Conclusion: Although long-term mortality after a first hospitalisation for HF has decreased dramatically in Sweden during the past two decades, mortality still remains high in this country. Our findings indicate a need for new strategies in the treatment of HF, potentially more so in patients with preserved left ventricular systolic function, a group representing almost 50% of the HF population, with larger proportions of women and older patients. The decrease in risk of developing HF after AMI found between1993 to 2004 mirrors the more effective medical and interventional treatments that have been developed to limit the infarct size. However, if patients already suffer from the disease, the vast majority of those with worsening symptoms seeking emergency care require hospital admission, where rapid stabilisation and treatment of co-morbidities should be prioritised. Furthermore, it may be possible that a specialist nurse could care for selected patients with worsening CHF in a home setting, even when the patients were assessed as being in need of hospital care.

Key words: Chronic heart failure, mortality, deterioration, hospitalisation, gender, home care, quality-adjusted life years, emergency care, health care costs, ischaemic, non-ischaemic, health-related quality of life, conventional care, acute myocardial infarction, coronary heart disease, heart failure

ISBN 978-91-628-7892-4 Göteborg 2009

LIST OF ORIGINAL PAPERS

This thesis is based on the following papers, identified in the text by their Roman numerals:

I Shafazand M, Schaufelberger M, Lappas G, Swedberg K, Rosengren A. Survival trends in men and women with heart failure of ischaemic and non-ischaemic origin: data for the period 1987-2003 from the Swedish Hospital Discharge Registry.
European Heart Journal 2009;30:671-678.

II Shafazand M, Rosengren A, Lappas G, Swedberg K, Schaufelberger M. Decreasing trends in the incidence of heart failure after acute myocardial infarction from 1993-2004. A study of 175,216 patients with a first AMI in Sweden.
Submitted.

III Shafazand M, Patel H, Ekman I, Swedberg K, Schaufelberger M. Why do patients with worsening chronic heart failure require hospital care?
Submitted.

IV Patel H, Shafazand M, Ekman I, Höjgård S, Swedberg K, Schaufelberger M. Home care as an option in worsening chronic heart failure - A pilot study to evaluate feasibility, quality adjusted life years and cost-effectiveness.
European Journal of Heart Failure 2008;10:675-681.

CONTENTS

ABBREVIATIONS

ACE-inhibitor	Angiotensin Converting Enzyme inhibitor
A.D.	After Christ
AF	Atrial Fibrillation
AMI	Acute Myocardial Infarction
ARB	Angiotensin Receptor Blocker
B.C.	Before Christ
CC	Conventional Care
CHD	Coronary Heart Disease
CHF	Chronic Heart Failure
CHFQ	Chronic Heart Failure Questionnaire
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
CRF	Case Record Form
CUA	Coast Utility Analysis
DHF	Diastolic Heart Failure
ECG	Electrocardiography
ED	Emergency Department
EF	Ejection Fraction
EQ-5D	The EuroQol Five Dimension Questionnaire
ESC	European Society of Cardiology
HC	Home Care
HF	Heart Failure
HFPEF	Heart Failure with Preserved Ejection Fraction
HFREF	Heart Failure with Reduced Ejection Fraction
HR	Hazard Ratio
HRQL	Health-Related Quality of Life
HUI	Health Utility Index
ICCU	Intensive Cardiac Care Unit
ICD	International Classification of Disease
IHD	Ischaemic Heart Disease
KCCQ	Kansas City Cardiomyopathy Questionnaire
LVCF	Last Value Carried Forward
LVEF	Left Ventricular Ejection Fraction
MI	Myocardial Infarction
MLHFQ	Minnesota Living with Heart Failure Questionnaire
N	Number
NYHA	New York Heart Association Classification System
OECD	Organisation for Economic Co-operation and Development
PCI	Percutaneous Coronary Intervention
QALY	Quality-Adjusted Life Years
QLQ-SHF	Quality of Life Questionnaire in Severe Heart Failure
Qol	Quality of Life
SD	Standard Deviation
SF-36	Short Form 36
SG	Standard Gamble
SHF	Systolic Heart Failure
TTO	Time Trade-Off
US (USA)	United States of America
VAS	Visual Analogue Scale
WHO	World Health Organisation

INTRODUCTION

Clinical scenarios and descriptions of heart failure (HF) date as far back as ancient Egypt and early Greek civilisation (1). Hippocrates (467-377 B.C.) was first to describe detailed symptoms of HF and Galen (130- ca 200 A.D.) depicted function of the heart as systole and diastole (1, 2).

It took several centuries before William Harvey (1587-1657) discovered the circulation and mentioned weakness of the pulse as a sign of HF (1). In the 18th century, HF research focused on changes in the architecture of the heart, where Rudolf Virchow (1821-1902) revealed inflammatory mechanisms behind failing hearts (2). After the discoveries of Frank in 1895 and Starling in 1918 (Frank-Starling law), a more biologically oriented research for regulatory mechanisms of heart function was initiated (2).

Blood-letting and leeches were used for centuries as treatment for HF (1). The benefit and appropriate clinical use of digitalis were described by Withering in 1785 (1). In the 19th and early 20th centuries, HF associated with fluid retention was treated with Southey's tubes, which were inserted into oedematous limbs that allowed some drainage of fluid (1). It was not until the 20th century that diuretics were developed. The early mercurial agents, however, were associated with substantial toxicity, unlike the thiazide diuretics, which were introduced in the 1950s (3).

During the 1970s and 1980s, considerable progress was made in the understanding of the pathogenesis of arterial hypertension and HF, especially in the renin-angiotensin system and when it comes to regulations of the sympathetic nervous system. Introduction of new treatments of HF in the past decades, including angiotensin converting enzyme (ACE) inhibitors, beta-blockers, angiotensin receptor blockers (ARBs) and aldosterone-antagonists, has been found to dramatically improve survival in selected study populations (4-7).

Diagnostic criteria

According to the guidelines of the European Society of Cardiology (ESC), HF is a clinical syndrome in which patients have the following features (8):

- Symptoms typical of HF: breathlessness at rest or on exertion, fatigue, tiredness, ankle swelling

and

- Signs typical of HF: tachycardia, tachypnoea, pulmonary rales, pleural effusion, raised jugular venous pressure, peripheral oedema, hepatomegaly

and

- Objective evidence of a structural or functional abnormality of the heart at rest: cardiomegaly, third heart sound, cardiac murmurs, abnormality on the echocardiogram, raised natriuretic peptide concentration
- A clinical response to treatment is supportive but not sufficient for diagnosis

Systolic and diastolic heart failure

Failure of myocardial function can be dominated by causes impairing mainly systolic versus diastolic function. In systolic heart failure (SHF) the pumping capacity is the main failure, whereas in diastolic heart failure (DHF) the filling of the ventricles is the major impairment. However, because both clinical description of these causes and clinical studies have been based on the left ventricular ejection fraction (LVEF), there is now a classification based on a reduced versus preserved ejection fraction (EF): HF with reduced EF(HFREF) and HF with preserved EF (HFPEF). There is no consensus concerning the cut-off level of EF for HFPEF, but usually values between 40-50% are used (8). Almost 50% of HF patients can be classified as HFPEF with more women among these patients (9). Overall, the prognosis essentially is similar to that of HFREF (7).

Aetiology of heart failure

The most common causes of functional deterioration of the heart are damage or loss of heart muscle that is caused by acute or chronic ischaemia, increased vascular resistance, which is the case in hypertension, or the development of a tachyarrhythmia, such as atrial fibrillation (AF) (8) (Table 1). Coronary heart disease (CHD) and hypertension are the most common aetiologies in almost 80% of patients with HF (9). HF often develops after an acute myocardial infarction (AMI) (10). Despite the decline in CHD in many European countries and in North America, AMI remains a serious clinical problem (11). During the past decades, introduction of new medical and interventional treatments such as thrombolytic strategies (12) antiplatelet agents (13), beta-blockers (14), ACE inhibitors (15), statins (16, 17) and percutaneous coronary intervention (PCI) (18), have improved prognosis in patients with AMI. The development of HF after AMI is serious because patients manifesting HF have a dramatic increase in mortality risk (19).

Table 1. Common precursors of chronic heart failure

- Coronary heart disease
- Chronic hypertension
- Cardiomyopathy
- Valve dysfunction
- Cardiac arrhythmias/conduction disturbance
- Pericardial disease
- Infection

Epidemiology and scope of the problem

HF is a major public health problem (20) that is rapidly growing, primarily because of the increasing number of elderly in the population and improved survival in cardiovascular diseases (21, 22). The prevalence of CHF, a dominant cause of hospitalisation in men and women >65 years (23), is estimated to be 2% in the Western

world (24). The prevalence of HF increases with age and is between 10 and 20% in 70-80 year-old people (8). The incidence of first-time diagnosed cases in Sweden is about 30 000 per year (25). The annual costs for treatment of HF in Sweden has been estimated to 500 million Euro (26), which constitute ~2% of the Swedish health care budget (27), where the major portion (75%) of these costs comes from hospital care (27). A similar pattern has been noted in the Netherlands, the UK, Spain, the USA and New Zealand (28).

Overall, survival in HF is poor, with one year mortality in patients hospitalised with HF over 25%, exceeding that of the most common forms of cancer (29, 30). However, from the late 1980s, and coinciding with improved treatment, a significant decrease in case fatality has been observed (31).

HF admission rates appear to be steadily increasing in all industrialised countries, especially in older individuals, and have doubled during the past two decades (32). A substantial number of HF hospitalisations are not initial admissions but readmissions. Hospital readmission rates of 30–50% within six months (33-35) and 11% within three months after discharge have been reported (36).

During the past three decades, the number of hospital beds in Sweden has been reduced from about 100 000 in the 1980s to about 26 000 in 2005. This reduction is largely due to health care reforms, financial pressures (e.g., budget cuts) and rationalisation (37). According to the Organisation for Economic Co-operation and Development (OECD) statistics from 2004, Sweden has the lowest number of hospital beds per thousand inhabitants in western European countries (2.2 hospital beds per 1000 inhabitants). In sharp contrast, Germany has three times as many hospital beds per inhabitant (37). The lack of hospital beds in Sweden has caused overcrowding in the wards, a circumstance that could lead to higher risk of contamination (38), possible difficulties to give adequate health care and, in some cases, discharging patients prematurely. Given the low number of hospital beds in Sweden and high hospital costs for HF patients, it would seem reasonable that efforts to reduce health care costs for HF should focus on hospitalisation.

Gender differences

Most studies have been directed towards the treatment of patients with HFREF. However, nearly half of the population hospitalised with HF have HFPEF (39), a category in which women constitute ~60% (40). With women more often having preserved left ventricular function and, additionally, less CHD as the underlying cause of their HF (40,41), improvement in survival in women might be expected to be less marked than in men. In addition, women with HF differ from men in several other respects, including being older and more often exhibiting hypertension, diabetes and AF (42, 43). Consequently, there are good reasons to expect that women may respond differently than men to modern treatment of HF.

Most studies on the treatment of CHF include only patients with reduced EF, i.e. those with preserved EF have largely been excluded. Partly because of this selection bias, women constitute only ~30% or less of many study populations (41).

Developments over time

In the past decades there have been substantial improvements in the treatment of heart disease. Specifically, treatment of CHD, a major underlying factor, has been profoundly changed, with a much more active approach both in patients with AMI and in the chronic phase. This more active approach employs both interventional and pharmaceutical strategies (12-18). Likewise, as already noted, there have been great improvements in the treatment of HF, particularly in patients with reduced LVEF (4-8). Accordingly, there is a need to investigate whether there have been changes in risk of developing HF in patients with CHD and whether there is a sustained improvement in long-term mortality in patients with HF. Swedish registries offer unique opportunities to investigate these issues in large, unselected patient populations.

Characteristics of patients with CHF that seek an emergency department (ED)

Shortness of breath, fatigue and fluid retention are hallmarks of the CHF condition (8). As many as 32 symptoms have been described, including dyspnoea, fatigue, pain, anxiety, loss of appetite, depression and sleeping disorders (44-46). Many patients treated for CHF experience worsening symptoms long before seeking medical attention (47), which, if discovered earlier, might be managed at home rather than in hospital. Knowledge about factors related to re-hospitalisations in patients with CHF is important in designing measures to prevent deterioration and avoid hospital admissions. Studies that have investigated the pattern of hospital readmissions in patients with worsening CHF identified abnormalities (e.g., respiratory infection, arrhythmia, non-adherence to prescribed treatment, coronary ischaemia and inadequate preadmission treatment) associated with clinical deterioration before admission (48-52).

Heart failure management programmes

To improve clinical outcome and Quality of Life (QoL) in patients with HF, multidisciplinary patient management programmes have been initiated from the 1980s. In Sweden, nurse-monitored HF outpatient clinics have existed for over two decades in more than two thirds of Swedish hospitals (53).

Several studies have reported difficulties in providing care for frail elderly patients with CHF when using current hospital-based disease management programmes (48). However, multidisciplinary management care programmes after discharge from hospital may reduce re-hospitalisations, mortality, or both (54-56). But in the COACH study (57), a multicentre, randomised, controlled trial published one year ago, neither moderate nor intensive disease management reduced the combined endpoint of death and hospitalisation in comparison with standard follow-up.

Many patients treated for CHF experience worsening symptoms long before seeking medical attention (47). Recently, evidence of the feasibility and patient satisfaction with a physician-led “Hospital at Home” model for patients with an exacerbation of CHF or with other diagnoses has been presented (58, 59). However, patients with

worsening CHF that are assessed in a hospital setting have never been sent home with only specialist nurse follow-up.

Health-related quality of life (HRQL)

"Health is not merely the absence of disease but state of complete mental, physical and social well-being "(WHO) (60).

QoL is a multidimensional evaluation comprising the areas of physical symptoms, psychological well-being, social ability and perceptions about one's own heath, which is difficult to measure (61). It is important to measure QoL both for researchers and caregivers in daily practise as a guide to modify treatment. QoL refers to individuals' own values, expectations and satisfaction with life, whereas HRQL is defined as the subjective perception of the impact on health status, including disease and treatment on physical, psychological, social functioning and well-being (62, 63). HRQL is impaired in patients with CHF in comparison to the general population and other chronic medical conditions [e.g., chronic haemodialysis, chronic obstructive pulmonary disease (COPD) and depression] (64).

There are two kinds of instrument to measure HRQL:

Generic instruments: These instruments [e.g., Short Form 36 (SF-36) and the Euro-Qol five-dimension questionnaire (EQ-5D)] are multidimensional that include items on physical, mental and general health, vitality, QoL and social dimensions. These instruments attempt to measure the core dimension of HRQL.

Disease-specific instruments: These instruments focus more on aspects of HRQL specific for the disease (e.g., CHF). The Kansas City Cardiomyopathy Questionnaire (KCCQ), the Minnesota Living with Heart Failure Questionnaire (MLHFQ), the Chronic Heart Failure Questionnaire (CHFQ) and the Quality of Life Questionnaire in Severe Heart Failure (QLQ-SHF) are scales used to measure HRQL in patients with CHF (65).

Quality-adjusted life year (QALY)

QALY takes into account both quantity and QoL generated by healthcare interventions (66). It is the arithmetic product of life expectancy and a measure of the quality of the remaining life years. Klarman and colleagues (66) first introduced the concept of QALY and Weinstein and Stason (67) described the QALY gained as the appropriate measure of effectiveness. QALY places weight on time in different health states. A year of perfect health is worth 1, whereas a year of less than perfect health life expectancy is worth less than 1. Death is considered to be equivalent to 0; however, some health states may be considered worse than death and therefore have negative scores (67). QALY weights can be obtained in three principal ways (68). The first uses direct methods, such as time trade-off (TTO) or standard gamble (SG) questions (69, 71), or a visual analogue scale (VAS) (71). The second uses indirect methods, such as the EQ-5D (72, 73) or the McMaster Health Utility Index (HUI), in which

predefined states are given predefined utility weights (74). The third method derives QALY weights from disease-specific descriptions/classifications or QoL instrument values into QALY weights, or by associating predefined QALY weights with each of the different health states (69).

QALYS is a common unit of measure of health gain related to health economics and that is designed to aid priority settings in health care and to take into account QoL in addition to survival (75). QALYs are far from perfect as a measure of outcome, with a number of technical and methodological shortcomings. Nevertheless, the use of QALYs in resource allocation decisions does mean that choices between patient groups competing for medical care are made explicit and commissioners are given an insight into the likely benefits from investing in new technologies and therapies.

AIMS

* To investigate gender-specific trends in long-term mortality in patients hospitalised for ischaemic and non-ischaemic HF.

* To investigate temporal trends in the risk of HF complicating AMI and determine whether these trends differ by gender or age.

* To characterise patients with CHF that seek an ED because of their deteriorating condition and to explore why they require hospital care.

* To evaluate the feasibility of home care (HC) versus conventional care (CC) in relation to HRQL and cost-utility in patients with worsening CHF.

PATIENTS AND METHODS

Papers I and II

All Swedish hospitals register principal and contributory discharge diagnoses for all patients in the national hospital discharge register. In Papers I and II data from the national hospital discharge and cause-specific death registers were linked through the personal identity number (Swedish: personnummer), which is unique for all Swedish citizens. The hospital discharge register has been in operation since the 1960s, operating on a nationwide basis since 1987.

Validity of the registers

In the period 1987–96, a primary discharge diagnosis was lacking in 1% of all admissions to Swedish departments of internal medicine, including cardiology (76). HF and AMI diagnoses in Sweden, according to the hospital discharge register, have been validated. HF, as the principal diagnosis, was shown to have a validity of 95%, whereas HF in any position had a validity of 82% (77). Similarly, validation of coronary heart disease discharge diagnoses in Sweden demonstrated high sensitivity (94%) and a high positive predictive value (86%) regarding definite AMI (78).

Patient population Paper I

In Paper I, all men and women aged 35–84 years hospitalised for the first time in the 19 counties with complete registration since 1984 and with a principal diagnosis of HF during the period 1987–2003 were included. Information from the register for the years 1980–1986 was used to detect re-admissions for the study period 1987–2001. This introduces a possible under-detection bias for the first years of the study. However, the high morbidity and mortality of HF should minimise this bias because the remaining censoring within the years 1980–1986 was considered as adequate to ensure that data on hospitalisations for each separate year from 1987 to 2001 were treated as uniformly as possible.

Mortality from all causes within three years of the index admission was calculated through 31 December 2004. The International Classification of Diseases version 8 (ICD-8) was used until 1986, ICD-9 between 1987 and 1996 and ICD-10 from 1997 onwards. The discharge codes applied to HF were 427.00, 427.10 (ICD-8), 428A, 428B, 428X (ICD-9) and I50 (ICD-10).

Because the main goal of the study was to investigate long-term mortality, we excluded patients who died during hospitalisation or in the immediate post-hospitalisation period, i.e. up to 28 days from admission. For the present study, three-year mortality was calculated up to 31 December 2004 in patients alive 29 days after the index admission. HF that was due to ischaemic causes was defined as having been discharged at any time before and up to one year after the index admission with a principal or contributory diagnosis of ischaemic heart disease (IHD) [410–414 (ICD-9) and I20-I25 (ICD-10)].

Age- and gender-specific analyses were done for each successive year, as well as for five fixed three-year intervals of admission: 1987–1989, 1990–1992, 1993–1995, 1996–1998 and 1999–2001. Moreover, we investigated the three-year mortality for HF of ischaemic and non-ischaemic aetiology separately. Survival curves for all cohorts were calculated, which included patients hospitalised from 2002 to 2003.

Statistics Paper I

Age- and gender-specific case fatality from day 29 until three years was calculated. Using 95% confidence intervals (CIs) by the proportional hazards regression procedure in SAS software version 9.1 (SAS Institute**,** Inc, Cary, NC, USA), calculation of age- and gender-specific changes in the three year case fatality was performed.

To assess whether there were any differences between men and women regarding period effect an interaction term was used in the model as the product of period, time and gender. The respective mortality rates were used as the dependent variable in each calculation and a three-year calendar year period was used as the independent variable, with the initial period of 1987–1989 as reference. Age was defined as age at admission. Survival was estimated according to the Kaplan–Meier method. A Cox regression model was used to estimate the independent and combined effect of the main factors (year with the co-variables gender, age group and ischaemic/non-ischaemic cause of HF on mortality risk).

Interactions between the co-variables were also entered into the model in order to increase the fit and possibly find statistical evidence for the observed varying effect of the period of time on risk of death across different group categories. In addition, separate simpler Cox models were used to estimate hazards within different combinations of age groups, gender and ischaemic/non-ischaemic cause of HF (2x2x2 models), where the period of time was adjusted for age measured in years.

These results were calculated to provide more detailed analytic and descriptive information on the structure of the association between period of time and risk of death and guided us to adapt and estimate the final main model as mentioned earlier (which included all the data).

In our Cox regression model we included additionally time dependent variables corresponding to year, gender and age to resolve the tentative problem of non-proportionality of the hazards for these variables. The estimates remained more or less unchanged. Accordingly, the assumption of proportional hazards was not essential to our conclusions.

The significance level for testing whether the model parameters are different from zero (two-sided test) was $\leq 5\%$. No corrections were made for multiple testing in the separate models for each age group and gender category. These can be regarded as a step towards the final model. Moreover, Kaplan–Meier survival estimates were calculated and presented in diagrams for the different periods to provide a more intuitive feeling of the gradual risk reduction across the time scale.

Patient population Paper II

In Paper II, patients from the whole of Sweden aged 35 to 84 years with a first time admission for AMI from 1993 to 2004 were included. We divided the patients into two age groups: 35-64 and 65-84 years. Patients with a discharge diagnosis of HF or IHD in any position before the index admission were excluded.

The study period was divided into four 3-year intervals of admission: 1993-95, 1996-98, 1999-2001 and 2002-2004. Incidence of HF for men and women was calculated for 30 days, 30 days to one year and one year to three years after admission for AMI. HF concomitant with AMI was defined as HF within 30 days.

The discharge codes used to define AMI were 410 (ICD-9) and I21 (ICD-10); to define HF the codes were 428A, 428B, 428X (ICD-9) and I50 (ICD-10). HF was defined by the diagnostic codes, irrespective of whether it was a principal or secondary diagnosis. Codes used to define IHD were 412, 414 (ICD-9) and I22, I23 and I24 (ICD-10).

Statistics Paper II

All analyses were carried out using SAS, version 9.1, and the R statistical computing system, version 2.9.0. Means and proportions for continuous and categorical variables were calculated.

Estimates of the conditional probability of HF within 30 days, 30 days to 1 year and 1 year to 3 years are presented for each period of AMI admission, gender and age group. The estimates are calculated through the cumulative incidence function for HF with death as a competing risk (79).

Additionally, the cumulative incidence functions for HF and death from any other cause than HF are illustrated graphically for the whole population, from AMI admission and up to each time point within the three-year intervals. Different curves are presented for each period of AMI admission. Further, a graph illustrating age-adjusted cumulative incidence functions for men and women is presented. Age adjustment was done implicitly through comparison of subsets of men and women with exactly the same age structure.

The average annual change in HF incidence within different time intervals was estimated using Poisson regression while controlling for age, gender and differences in co-morbidity**.**

Papers III and IV

Between April 2004 and May 2006, patients seeking care for dyspnoea were identified at the ED at Sahlgrenska University Hospital/Östra, Göteborg, Sweden, a hospital covering approximately 250 000 inhabitants and with about 40 000 annual visits at the ED. From this population, patients with known CHF were registered and further investigated for gender, age, socio-economic status, heart rate, blood pressure and

symptoms and signs of HF. Additional blood samples were drawn if necessary according to the study protocol if not already ordered by the patient's physician. All data were recorded in a case record form (CRF) and the information was saved in a registry. These data were used in Papers III and IV.

Patient population Paper III

During the study period, 2648 patients with dyspnoea were screened. Of the screened patients with dyspnoea, 1127 were previously diagnosed as having CHF (Figure 1).

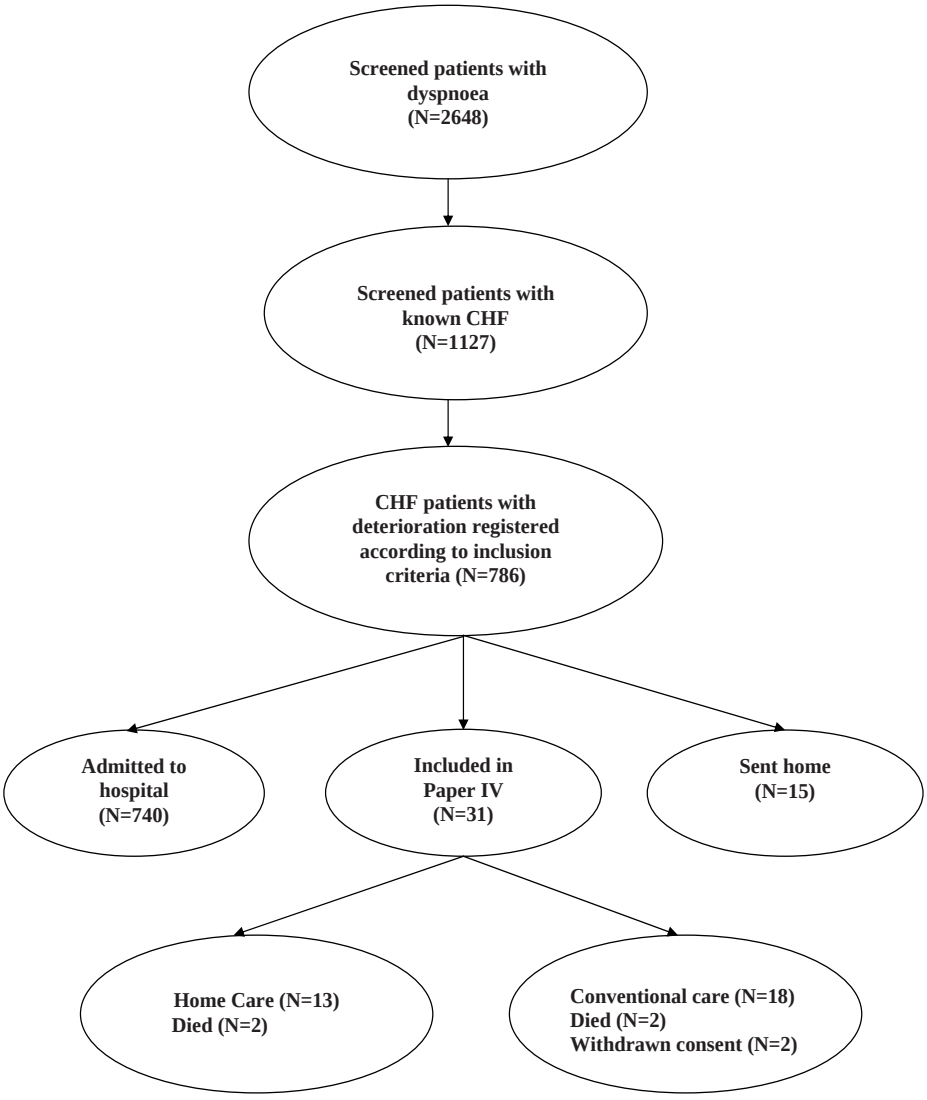

Figure 1. Patient flow and data availability for Papers III and IV.

Of all patients with CHF, 785 were registered according to inclusion criteria listed in Table 2. Patients with CHF that were included because of their worsening condition had a prior diagnosis of CHF based on ESC Guidelines (80). In addition, the patients complaining of dyspnoea required hospital care according to the attending physician. In this study a number of demographic variables were registered together with the reason for admission as well as echocardiographic findings.

Table 2. Inclusion and exclusion criteria used to screen patients in Papers III and IV

Inclusion criteria
Earlier diagnosed with chronic heart failure with diastolic or systolic left ventricular dysfunction
Deterioration of HF ≥3 days with symptoms of increasing dyspnoea, orthopnoea, weight gain ≥2 kg, debuting peripheral oedema or abdominal swelling
Clinical signs, e.g. extended jugular vein, leg oedema, tachypnoea, pulmonary rales, ascites and third heart sound
At least one symptom and one sign should be present
New York Heart Association class II–IV
Exclusion criteria
Unwillingness to participate
Worsening of CHF <3 days
Newly onset HF
Pulmonary or pre-pulmonary oedema
Need for monitoring of arrhythmia
Other morbidities indicating need for hospitalisation
Living at an institution
Inability to follow instructions
S-Haemoglobin <100 g/L or a decrease of S-Haemoglobin >20 g/L
S-Creatinine >250 µmol/L
S-Potassium >5.5 mmol/L or <3.4 mmol/L
S-Troponin T>0.05 µg/L
Creatine kinase-MB>5 µg/L
ASAT and ALAT >three times above the normal value
Systolic blood pressure <95 mm Hg
Heart rate <45 or >110 beats/min
Systolic heart failure was defined as:
Ejection fraction ≤45%.
Heart failure with preserved ejection fraction was defined as:
Ejection fraction >45% and signs of diastolic dysfunction:
One of the following criteria should be fulfilled:
• Posterior wall thickness + interventricular septum thickness /2>1.3 cm.
• Enlarged left atrium (female >42 mm, male >46 mm) in the absence of atrial fibrillation.

Statistics Paper III

Statistical analyses were performed using SPSS version 14.0 for Windows (SPSS Inc., Chicago, IL, USA). A range of descriptive statistics [i.e. frequency, percentage, median, mean and standard deviation (SD)] was calculated. Continuous variables were compared using Student's *t* test. A nominal significance level of 0.05 was used (all tests were two-tailed).

Design and setting Paper IV

Patients seeking care for deterioration of CHF were identified within 24 h after admission from three medical facilities: an ED, a HF outpatient clinic and a medical ward. After one year, the protocol was amended, with an extension of time to 48 h for study inclusion. Eligible patients were those with a prior diagnosis of CHF according to the ESC Guidelines (80), assessed as being in need of hospital care by their consulting physician and complying with all of the inclusion and exclusion criteria (Table 2).

Procedure

After being given oral and written information, patients were invited to participate in the study. The enrolling cardiologist conducted a complete history and physical examination. Four questionnaires were administered while awaiting the blood test results.

Echocardiography was considered valid if less than one year-old; otherwise, a new test was performed. Patients were randomised using a random number generator to either HC under the direction of a specialist nurse or to hospital admission, i.e. CC.

Intervention

Home care group

Patients in the HC group were initially treated in the ED or in the ward for up to 48 h and subsequently sent home. To ensure medical safety the specialist nurses responsible for the patients in the HC group followed a care plan written by a physician that included details of when to adjust medications. The nurses could always consult a cardiologist if necessary.

It was considered medically safe to treat patients at home if they had a S-Potassium level between 3.4 and 5.5 mmol/L, systolic blood pressure >95 mmHg, S-Creatinine <250 μmol/L and less than a 50% increase from the baseline value during drug adjustment. All patients were followed-up the day after returning home by a specialist nurse from the HF clinic. The patients were visited at their home daily or every other day by the specialist nurse for the next 5–7 days as determined by the patients' health status.

The home visits were terminated when a patient:

(1) was symptomatically stable or improving
(2) had stable or falling weight
(3) had no signs of pulmonary rales
(4) had no oedema above the ankle

If necessary, the patients could contact the specialist nurse by telephone during office hours. Nurses at the intensive cardiac care unit (ICCU) could be reached by telephone after office hours. Up to one month after the last home visit the specialist nurse was also available for telephone counselling. A cardiologist was always available for telephone consultation. After termination of the home visits, patients were referred to the HF clinic for drug up-titration if necessary.

Clinical signs and symptoms were assessed at each home visit in accordance with the study protocol. Moreover, blood samples for analysis of S-Sodium, S-Potassium and

S-Creatinine were collected. If there was no improvement in dyspnoea, orthopnoea, leg oedema and weight or if pulmonary rales persisted, intravenous diuretics were administered and drug adjustments were performed in line with the study protocol or after consultation with a cardiologist. Patients were informed at home visits about their medicines, treatments and the importance of symptoms in relation to their poor condition. Routines for weighing were established, with the goal that the patients weigh themselves at least twice a week. After each home visit, the nurse and study physician had a short consultation to discuss the patients' condition.

Conventional care

The patients randomised to the CC group were treated in accordance with hospital treatment guidelines. All data were collected in the same way as in the HC group.

Data collection

Baseline

Baseline data collection was similar in the two treatment groups (HC and CC), i.e. demographics and baseline characteristics, interviews and questionnaires were performed in the same sequence for all patients in both groups to avoid order effects.

Patients' functional status was assessed according to the NYHA classification system. In addition, weight, blood pressure, heart rate, breathing frequency, jugular venous distension, pulmonary rales, leg oedema, symptoms, blood electrolytes and NT-proBNP were also assessed. HRQL and symptoms were measured with the disease specific KCCQ (81), one global question from the SF-36 (82), EQ-5D of HRQL with the VAS (71-73) and the utility-based SG (69,70).

Follow-up

Patients in both groups completed four follow-up sets of questionnaires at 1, 4, 8 and 12 months. Patients' clinical status was documented and information about clinical events was elicited through patient interviews and complemented by the patients' medical records.

Resource utilisation

Information on all health care utilisation specific to CHF was elicited by patient interviews and complemented by data from the patients' medical records.

Costs for the patients in the CC group were based on compensation charged by the hospital for each patient. Costs for patients in the HC group included the time costs for the specialist nurses and for physicians' consultation time, prescriptions, referrals and other practical tasks performed.

Further, the laboratory tests and the costs for intravenous diuretics administered to patients in the HC group were also included in the costs for the patients in this group. Information on the number of visits and telephone contacts to the HF clinics, emergency visits and hospitalisations that were due to HF was obtained through patient interviews at each of the follow up visits and complemented by data from the patients'

medical records. Because the majority of patients were retired, only direct costs were considered in this study. Costs for the patients in the CC group and readmissions for patients in both groups were obtained from the hospital's financial department.

Statistics Paper IV

Statistical analyses were performed using SPSS version 14.0 for windows. Summary statistics are presented as mean (SD), median (interquartile range) and proportions.

Wilcoxon signed-rank test was used to determine clinical improvement over time within the two groups. We performed Wilcoxon signed-rank test for weight, NYHA and NT-proBNP.

The non-parametric Mann–Whitney test was used to compare differences between groups at baseline and follow-ups for ordinal data from the SF-36 (Q.1), the KCCQ (QoL and symptom domain), the categorical variable NYHA and the continuous data (hospital days, costs, QoL, QALYs, weight and NT-proBNP).

The cost-utility analysis (CUA) assessed the HC and CC groups on the basis of monetary costs and QALYs using VAS and SG techniques. Spearman's rank correlation coefficient was used to assess the association between QALYs derived from the SG and VAS measurements. Further, the Kaplan–Meier non-parametric analysis was utilised to determine whether the probability of re-hospitalisation differed between the two treatment groups (83).

RESULTS

Paper I

The mean age of the study population was 74.1 years [SD 8.4 years] [men 72.9 years (SD 8.7 years) and women 75.6 years (SD 7.6 years)], with no difference in age between patients with ischaemic and non-ischaemic HF; 44.3% were women. Co-morbidities (Table 3) in men and women with non-ischaemic and ischaemic HF were broadly similar.

Table 3. Co-morbidity at discharge in patients with heart failure of ischaemic and non-ischaemic origin

		Non-ischaemic heart failure			Ischaemic heart failure		
		Gender		All	Gender		All
		M	F		M	F	
Diabetes	n	8288	7123	15 411	8980	7637	16 617
	%	17	17	17	22	25	23
Hypertension	n	9003	8375	17 378	8503	7684	16 187
	%	18	20	19	20	26	23
Stroke	n	9158	6795	15 953	8428	5654	14 082
	%	18	16	17	20	19	20
Valve disease	n	4536	4564	9100	3752	3463	7215
	%	9	11	10	9	12	10
Atrial fibrillation	n	15 013	12 632	27 645	10 478	7868	18 346
	%	30	30	30	25	26	26
Cardiomyopathy	n	1810	737	2547	792	329	1121
	%	4	2	3	2	1	2
Pulmonary embolism	n	1376	1430	2806	1201	1140	2341
	%	3	3	3	3	4	3
COPD	n	5913	4395	10 308	4724	2975	7699
	%	12	10	11	11	10	11
Asthma	n	1871	2067	3938	1677	1541	3218
	%	4	5	4	4	5	4
Cancer	n	6163	4615	10 778	4559	2837	7396
	%	12	11	12	11	9	10

COPD, chronic obstructive pulmonary disease

Survival curves showed an overall improvement in long-term prognosis over time (Figures 2-5) for men and women and in both age groups. However, most of the reduction in mortality occurred in the beginning of the study period. After 1995, only smaller reductions were observed, with no further decrease in mortality noted in the last period studied (2002–03).

Gender differences

In younger patients (i.e. 35–64 years) prognosis in men improved more than in women (Table 4). Men aged 35–64 years had a hazard ratio (HR) of dying within three years after discharge of 0.40 (95% CI 0.36–0.45) during the period 1999–2001 when compared with the period 1987–1989. In women aged 35–64 years the corresponding HR was 0.58 (0.48–0.69). Still, for those discharged from 1999 to 2001, 17% of the men and 19% of the women aged 35–64 years died within three years, which corresponds to an annual mortality of ~6%. In older patients (>64 years) HRs of dying

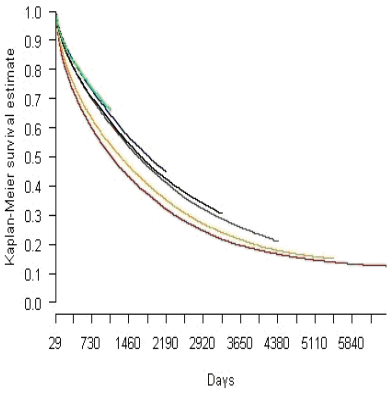

Figure 2. Men of age 35-64.

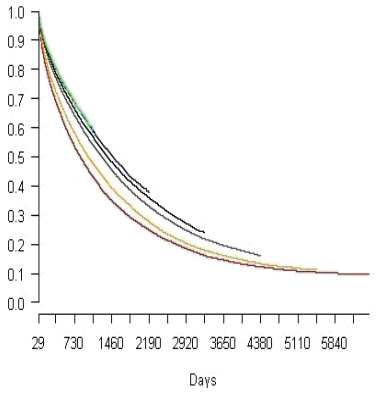

Figure 4. Women of age 35-64.

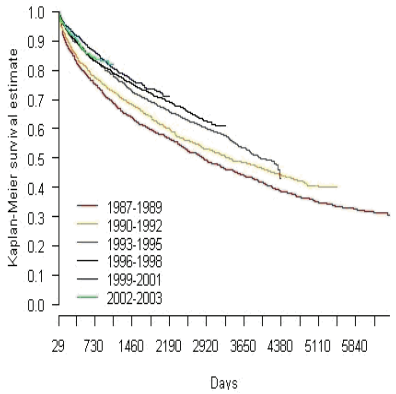

Figure 3. Men of age 65-84.

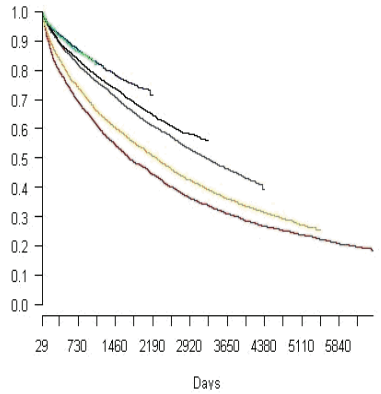

Figure 5. Women of age 65-84.

Table 4. Three-year mortality for men and women after a first hospitalisation with a diagnosis of heart failure in 19 Swedish counties from 1987 to 2001 as a function of gender and age (n, number of deaths)

	Period	Three year mortality in men				Three year mortality in women			
		n	%	HR	95% CI	*n*	%	HR	95% CI
Age 35–64 years	87–89	2205	39	1.00		930	31	1.00	
	90–92	2475	34	0.85	0.77–0.94	1027	27	0.86	0.73–1.02
	93–95	2895	24	0.57	0.51–0.62	1318	22	0.67	0.57–0.79
	97–99	2709	22	0.52	0.47–0.58	1150	21	0.64	0.54–0.76
	99–01	2480	17	0.40	0.36–0.45	1101	19	0.58	0.48–0.69
		Mean decline per year, % (95% CI)			7.5 (6.7–8.2)	Mean decline per year, % (95% CI)			4.7 (3.5–6.0)
		P-value			<0.0001	*P*-value			<0.0001
Age 65–84 years	87–89	13 007	57	1.00		11 546	50	1.00	
	90–92	14 004	52	0.87	0.85–0.90	12 136	46	0.89	0.86–0.92
	93–95	15 437	46	0.72	0.70–0.75	13 456	39	0.70	0.68–0.73
	97–99	13 811	43	0.66	0.64–0.68	11 665	38	0.68	0.66–0.71
	99–01	11 568	41	0.61	0.58–0.63	9699	36	0.62	0.59–0.65
		Mean decline per year, % (95% CI)			4.3 (4.0–4.5)	Mean decline per year, % (95% CI)			4.1 (3.8–4.4)
		P-value			<0.0001	*P*-value			<0.0001

within three years in 1999–2001 (compared with 1987–99) were practically identical in men and women, i.e. 0.61 (0.58–0.69) in men and 0.62 (0.59–0.65) in women. After three years, 41% of the men and 36% of the women had died, corresponding to annual mortality rates of almost 14% in men and 12% in women aged 65-84 years.

Heart failure with and without ischaemic origin

Of the 144 619 patients who survived the first 28 days, 61 586 (42.6%) were diagnosed with IHD, either before or within one year of being admitted to hospital with HF. The most marked decrease in three-year mortality was observed in men aged 35–64 years with HF of ischaemic origin, with a mortality reduction from 46 to 19% (HR 0.36, 0.31–0.43) (Table 5).

Table 5. Three-year mortality after a first hospitalisation with a diagnosis of heart failure in men and women agged 35-64 years in relation to ischaemic and non-ischaemic origin (n, number of deaths)

		Three year mortality in men				Three year mortality in women			
	Period	*n*	%	HR	95% CI	*n*	%	HR	95% CI
35–64 years, ischaemic	87–89	1178	46	1:00		357	38	1:00	
	90–92	1122	39	0.83	0.73–0.94	402	36	0.92	0.73–1.17
	93–95	1287	27	0.52	0.45–0.59	501	26	0.65	0.51–0.82
	97–99	1101	25	0.47	0.40–0.54	434	25	0.59	0.46–0.76
	99–01	882	19	0.36	0.31–0.43	371	22	0.53	0.40–0.67
		Mean decline per year, % (95% CI)			8.4 (7.3–9.4)	Mean decline per year, % (95% CI)			5.7 (3.9–7.6)
		P-value			<0.0001	*P*-value			<0.0001
35–64 years, non-ischaemic	87–89	1027	30	1:00		573	27	1:00	
	90–92	1353	30	0.96	0.83–1.11	625	22	0.81	0.64–1.02
	93–95	1608	22	0.68	0.58–0.79	817	19	0.69	0.55–0.86
	97–99	1608	20	0.64	0.55–0.75	716	19	0.68	0.54–0.86
	99–01	1598	16	0.50	0.42–0.59	730	18	0.63	0.50–0.79
		Mean decline per year, % (95% CI)			5.8 (4.7–6.9)	Mean decline per year, % (95% CI)			3.8 (2.1–5.5)
		P-value			<0.0001	*P*-value			<0.0001

Table 6. Three-year mortality after a first hospitalisation with a diagnosis of heart failure in men a women aged 65-84 years in relation to ischaemic and non-ischaemic origin (n, number of deaths)

		Three year mortality in men				Three year mortality in women			
	Period	*n*	%	HR	95% CI	*n*	%	HR	95% CI
65–84 years ischaemic	87–89	6607	65	1:00		5085	61	1:00	
	90–92	6469	60	0.86	0.83–0.90	4993	55	0.84	0.80–0.89
	93–95	6805	52	0.67	0.64–0.70	5581	45	0.63	0.60–0.67
	97–99	5805	49	0.61	0.58–0.64	4634	44	0.61	0.58–0.65
	99–01	4376	46	0.55	0.53–0.58	3596	42	0.56	0.53–0.60
		Mean decline per year, % (95% CI)			5.2 (4.8–5.5)	Mean decline per year, % (95% CI)			5.1 (4.6–5.5)
		P-value			<0.0001	*P*-value			<0.0001
65–84 years non-ischaemic	87–89	6400	48	1:00	0.88–0.97	6461	41	1:00	0.91–1.01
	90–92	7535	46	0.93	0.78–0.86	7143	40	0.96	0.75–0.83
	93–95	8632	42	0.82	0.72–0.80	7875	34	0.79	0.73–0.82
	97–99	8006	39	0.76	0.68–0.76	7031	34	0.78	0.67–0.75
	99–01	7192	38	0.72		6103	32	0.71	
		Mean decline per year, % (95% CI)			2.8 (2.4–3.2)	Mean decline per year, % (95% CI)			3.0 (2.6–3.4)
		P-value			<0.0001	*P*-value			<0.0001

Reductions in mortality were less marked in men with HF of non-ischaemic origin and in women, particularly in women with HF of non-ischaemic origin, where the reduction in mortality was from 27 to 18% (HR 0.63, 0.50–0.79). In the 65–84-year patient group (Table 6) reduction in mortality was more pronounced in those with HF of ischaemic origin as compared with patients with HF of non-ischaemic origin, but with no gender differences.

Paper II

Of 193,460 patients aged 35 to 84 years with a first time admission for AMI, 175,216 (64% men) had no prior diagnosis of HF or IHD before admission. Of these patients, 43034 (25%) were registered with a diagnosis of HF within three years from admission (58.5% men). Almost 70% of all HF cases were registered either concomitantly with the index AMI admission or within the first 30 days after admission. Descriptive data for the study population are provided in Table 7.

Table 7. Characteristics of study population at the time of their AMI

	Men n=112,373	**Women n=62,843**	**Total n=175,216**
Age at MI, years, mean (SD)	67.1 (11.1)	72.0 (9.8)	68.9 (10.9)
Angina pectoris	15,334 (13.6)	9,103 (14.5)	24,437 (13.9)
Diabetes	13,270 (11.8)	8,880 (14.1)	22,150 (12.6)
Hypertension	17,134 (15.2)	12,270 (19.5)	29,404 (16.8)
Atrial fibrillation	8,657 (7.7)	5,920 (9.4)	14,577 (8.3)
Valvular disease	2,312 (2.1)	1,898 (3.0)	4,210 (2.4)
Prior stroke	9,179 (8.2)	6,154 (9.8)	15,333 (8.8)
Asthma	1,463 (1.3)	1,338 (2.1)	2,801 (1.6)
COPD*	3,497 (3.1)	2,489 (4.0)	5,986 (3.4)

* COPD: Chronic Obstructive Pulmonary Disease

Figure 6 demonstrates a decreasing trend of developing HF up to 3 years after an index admission for AMI. Furthermore, the figure shows that mortality of patients admitted for AMI who did not develop HF decreased during all periods up to 3 years.

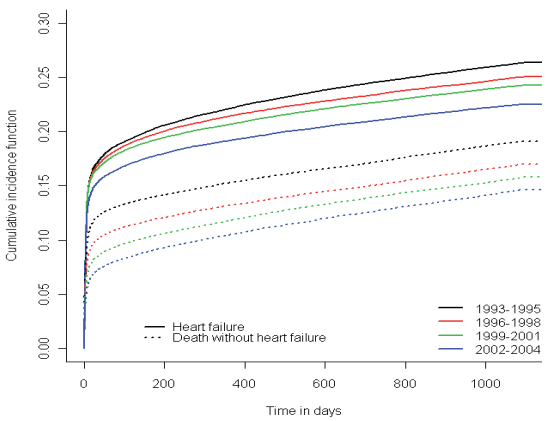

Figure 6. Probability of heart failure after acute myocardial infarction for the whole population during different periods between 1993 and 2004 and mortality in patients with AMI without developed HF

Table 8 shows the probability of developing HF within 30 days, 30 days to one year and one year to three years, by age, separately for men and women. There were decreasing trends for every time interval up to three years after admission in both genders. Overall, 14.4 % of patients aged 35 to 64 years and 31.5 % of those aged 65 to 84 with AMI in 1993 to 1995 developed HF within three years. Corresponding figures for patients with AMI in 2002 to 2004 were 11.5 and 28 % (Table 8).

Table 8. Probability of developing heart failure within defined periods after an acute myocardial infarction while considering death from other causes as competing risk

Period	AMI, n	HF within 30 days, n	%	AMI surviving 30 days without HF n	HF 31 days to 1 year, n	%	AMI surviving 1 year without HF n	HF 1 to 3 years, n	%	AMI surviving within 3 years without HF (n)	HF within 3 years, n	%
Men 35-64												
93-95	10950	938	8.57	9520	302	2.75	9033	263	2.40	8588	1502	13.72
96-98	10475	885	8.45	9208	238	2.27	8819	176	1.68	8448	1299	12.40
99-01	10437	844	8.09	9298	210	2.01	8935	176	1.69	8579	1230	11.78
02-04	10957	865	7.89	9810	208	1.90	9490	145	1.32	9178	1218	11.12
Women 35-64												
93-95	3022	336	11.09	2507	115	3.81	2355	61	2.02	2253	512	16.91
96-98	2984	287	9.62	2592	92	3.05	2452	68	2.31	2333	447	14.98
99-01	3389	300	8.82	2937	90	2.69	2796	71	2.10	2668	461	13.60
02-04	3490	312	8.94	3075	67	1.92	2958	68	1.95	2819	447	12.81
Men 65-84												
93-95	19045	3651	19.17	12672	1085	5.70	10799	931	4.89	8832	5667	29.76
96-98	16983	3271	19.26	11602	954	5.62	9926	725	4.27	8377	4950	29.15
99-01	16754	3236	19.31	11779	838	5.00	10199	750	4.48	8611	4824	28.79
02-04	16772	2989	17.82	12267	809	4.82	10689	679	4.05	9085	4477	26.69
Women 65-84												
93-95	13309	2959	22.23	8157	867	6.51	6806	695	5.22	5600	4520	33.96
96-98	11815	2633	22.29	7573	696	5.89	6424	553	4.68	5344	3882	32.86
99-01	12324	2680	21.75	8223	665	5.40	7041	544	4.41	5869	3889	31.56
02-04	12510	2467	19.72	8813	670	5.36	7616	573	4.58	6369	3710	29.66
Overall 35-64												
93-95	13972	1273	9.11	12027	416	2.98	11387	324	2.32	10840	2013	14.41
96-98	13459	1172	8.71	11797	329	2.44	11270	245	1.82	10779	1746	12.97
99-01	13826	1143	8.27	12234	301	2.18	11730	247	1.79	11247	1691	12.23
02-04	14447	1177	8.15	12885	275	1.90	12447	213	1.47	11997	1665	11.52
Overall 65-84												
93-95	32354	6610	20.43	20829	1951	6.03	17605	1626	5.03	14432	10187	31.49
96-98	28798	5904	20.50	19175	1650	5.73	16350	1278	4.44	13720	8832	30.67
99-01	29078	5916	20.35	20002	1503	5.17	17239	1294	4.45	14479	8713	29.96
02-04	29282	5456	18.63	21080	1479	5.05	18305	1252	4.28	15454	8187	27.96

In the multiple regression model (Table 9) the mean incidence of HF after AMI decreased by 4% per year between 1993 and 2004, independently of age, gender and comorbidities. The risk increased markedly with age, with every additional year increasing the 3-year incidence by 6%. Women had a 6% higher incidence of HF than men, whereas men with an index admission for AMI who did not develop HF had higher mortality than women (Figure 7). Having had a stroke before admission increased HF risk by 37%, diabetes increased the risk by 76% and AF by 80%. Patients with any kind of valvular disease had a more than doubled risk (Table 9).

Table 9. Probability of developing heart failure within defined periods after an acute myocardial infarction while considering death from other causes as competing risk

	Risk ratio (95% confidence interval)
Calendar year of onset	0.96 (0.95-0.96)
Age (year)	1.06 (1.06-1.06)
Gender (male/female)	1.06 (1.04-1.08)
Diabetes (yes/no)	1.76 (1.70-1.81)
Atrial fibrillation (yes/no)	1.80 (1.75-1.84)
Valvular disease (yes/no)	1.22 (1.12-1.32)
Stroke (yes/no)	1.37 (1.33-1.41)

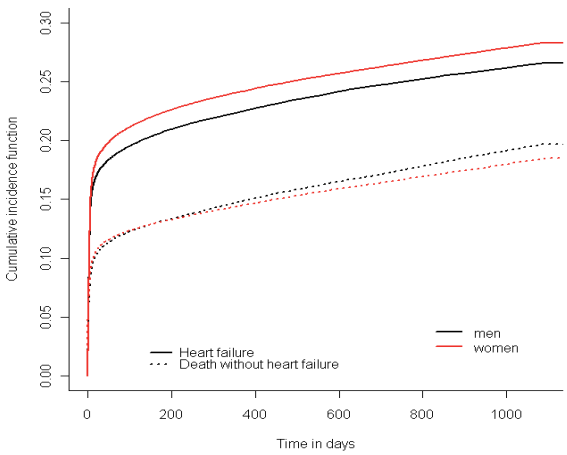

Figure 7. Probability of heart failure after acute myocardial infarction in men and women up to 3 years after admission between 1993 and 2004 and mortality for both genders after AMI without developed HF

Paper III

In Paper III, 2648 patients were screened with dyspnoea during the study period [mean age 75 years (SD 14 years)]: 51% were women with a mean age of 77 years (SD 15 years) while men had a mean age of 73 years (SD 14 years) ($p<0.001$). Of the screened patients with dyspnoea, 1127 were previously diagnosed as having CHF [mean age 79 years (SD 11 years)]. In this group 46% were women with a mean age of 82 years (SD 12 years); the mean age of the men was 76 years (SD 11 years) ($p<0.001$).

Of all patients with CHF, 785 were registered based on the inclusions criteria listed in Table 2. Those patients had the same age and gender characteristics as the whole study group.

Echocardiography was performed in 38% of these patients (N=295). More than half (55%) of these patients had SHF with an EF ≤45% (33% women versus 67% men), 18% had HFPEF (64% women versus 36% men) and 16% had HF that was due to valvular disease (53% women versus 47% men). Owing to insufficient information, 11% of the echocardiography examinations were difficult to classify.

Of the 785 CHF patients with deterioration, only 2% (N=15) could be sent home directly from the ED after acute medical treatment while 4% (N=31) were included in a randomised trial assessing the feasibility of HC in this context (Paper IV). The rest of the patients were admitted to hospital because of serious conditions [e.g., pneumonia/respiratory disease, myocardial infarction (MI), pulmonary oedema, anaemia, need to monitor cardiac rhythm, pathological blood chemistry and communication difficulties resulting from dementia, stroke and other medical conditions] (Table 10).

Table 10. Reasons for hospital admission for patients with worsening CHF

Reason for hospital admission	Proportion
Pneumonia/respiratory disease	35.4%
Need to monitor cardiac rhythm	15.6%
Communication problem (such as dementia, stroke and aphasia)	22.3%
Pulmonary oedema	11.3%
Myocardial infarction	6.2%
Anaemia*	5.2%
Pathologic blood chemistry other than haemoglobin**	3.7%
Hypotension	2.1%

*S-Haemoglobinb<100 g/L or a decrease of S-Haemoglobin>20 g/L, ** S-Creatinine>250 µmol/L, S-Potassium>5.5 mmol/L or <3.4 mmol/L, S-Troponin T>0.05 µg/L, Creatine kinase-MB>5 µg/L, ASAT and ALAT>three times above the normal value

Paper IV

In this study the patients (N=31) improved clinically in both groups and there was no significant between-group difference (Table 11). Treatment with beta-blockers, ACE inhibitors and ARBs was optimised during the study period in both groups.

Table 11. Changes in clinical status and medication for the home care and conventional care groups. Both groups improved clinically, but there was no significant difference in change between groups

Clinical status	**HC** median (IQR)				
Follow-ups (month)	**Initial**	**1**	**4**	**8**	**12**
Weight (kg)	72 (61-83)	67 (58-82)	67 (60-81)	72 (63-81)	68 (66-78)
NYHA	3 (3-3)	2.5 (2-3)	2 (2-3)	2 (2-3)	2.5 (2-3)
NT-proBNP (pg/ml)	4420 (1690-14350)	2510 (1412-8535)	3430 (1400-6500)	3300 (980-5515)	2365 (777-7088)
Medical treatment (%)					
ACE or ARB	54				64
Beta blockers	69				100
Spironokactone	0				45
Diuretics	92				91
	CC median (IQR)				
Weight (kg)	79 (68-90)	78 (72-86)	77 (66-92)	77 (67-92)	78 (64-90)
NYHA	3 (3-3)	3 (2-3)	3 (2-3)	3 (2-3)	3 (2-3)
NT-proBNP (pg/ml)	9335 (3375-13350)	4100 (2700-8137)	3630 (1995-5625)	2450 (1425-4290)	4570 (1368-13100)
Medical treatment (%)					
ACE or ARB	89				77
Beta blockers	78				77
Spironolactone	23				31
Diuretics	89				100

HC; home care, CC; Conventional care, NT-proBNP; N-terminal pro-brain natriuretic peptide NYHA; New York Heart Association classification system, ACE; Angiotensin Converting Enzyme, ARB; Angiotensin Receptor Blocker, IQR; Interquartile range

Resources used, measured in terms of time and monetary units, are presented in Table 12. Health care costs were higher in the CC group ($p<0.001$ after initial intervention, and $p=0.04$ at the end of the study). However, large variation in patients was observed. Details of the various costs at inclusion and at the follow-ups are displayed in Figure 8.

The difference between groups was still significant after inclusion of costs for the HF clinic visits, which occurred after termination of the home visits ($p=0.05$). Sensitivity analysis with last value carried forward (LVCF) resulted in group differences: median € 5110 for the CC group versus € 1122 for the HC group ($p=0.05$) at the end of the study and € 5150 for the CC group versus € 2680 for the HC group ($p=0.08$) when including costs from the HF clinic visits.

Table 12. Changes in clinical status and medication for the home care and conventional care group

Resources used	Home care	Conventional care	P-value
*Time consumed for intervention or initial hospitalization (hours)	12 (7-34)	120 (90-192)	0,000
Number of home visits	4 (3,5-4,5)	-	
Total physician time consumed, (hours)	0,53 (0,3-1,1)	-	
Number of visits to HF clinic, Mean (SD)	7,2 (10)	3,6 (5,2)	ns
Time to the first hospitalization, (days)	45 (95)	41 (70)	ns
HF related – ED visits, (n)	0,3 (0,6)	0,3 (0,5)	ns
- Hospitalization	0,5 (0,8)	0,6 (0,8)	ns
- Hospitalization days	5,6 (9,4)	4,5 (6,2)	ns
Costs			
Nurses cost for intervention	386 (244-1107)	-	
Physician consultation cost	35 (19-74)	-	
Transportation cost for home visit	96 (53-127)	-	
**Total initial cost for intervention or hospitalization	586 (334-1125)	3277 (2125-5750)	0,000

All values are Median (IQR) if not otherwise indicated. IQR; Interquartile range. *Time for intervention included preparation time before and after home visits and during the home visits, telephone consultation with patient and cardiologist and transportation time). ** Included cost for blood samples, i.v. diuretics and consumed nurses and physician's time.

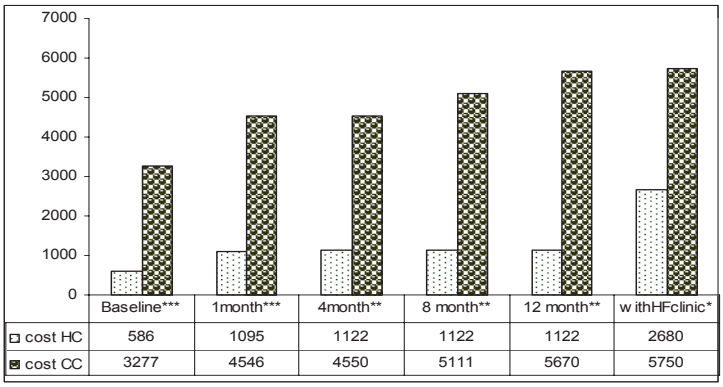

Figure 8. Median cost for the CC and HC groups in Euros. Baseline = cost for initial intervention. Included cost for blood samples, i.v. diuretics and consumed nurses and physician´s time. Cost for all events included in the total cost at follow-ups. With HF clinic = cost includes all cost up to 12 months and cost for HF clinic visits. ***p<0.0001, **p<0.05, *=0.05

The mean QALYs generated by SG were 0.71 (HC group) and 0.64 (CC group). The mean QALYs generated by EQ-5D were 0.44 (HC group) and 0.43 (CC group) for patients remaining in the study at the 12-month follow-up. The mean number of QALYs in the CC group was 0.75 (SG) and 0.50 (EQ-5D) when assigning the value "0" to those patients who died and LVCF to patients who dropped out during the study. Spearman's rank correlation between QALYs generated by SG and EQ-5D was 0.70 ($p<0.001$).

No differences were observed when QALYs were estimated with different approaches, regardless of method. Cost/QALY was lower in the HC group though this difference did not reach statistical significance.

The groups did not differ in the utilisation of unplanned health care related to HF [i.e. number of visits to the emergency ward, HF clinics, hospital days or time to health care utilisation after discharge (CC)/last home visit (HC)].

The Kaplan–Meier analysis, which was used to compare the distribution of time to the first event for the groups, revealed no statistically significant difference between the groups.

DISCUSSION

The introduction of several new treatments over the past three decades has been demonstrated to improve morbidity and mortality of HF in selected study populations (84-86). The use of ACE inhibitors and beta-blockers became widespread in the beginning of the 1990s and increasingly so during the past decade, leading to improved survival in patients with HF (43). In several studies from the late 1990s the use of aldosterone antagonists and ARBs, in addition to ACE inhibitors and beta-blockers, has been found to improve survival further (84, 87), which may reflect the results found in Paper I.

A decline in the prevalence of hypertension in the population and the increased use of antihypertensive drugs may have also played a significant role in reducing the severity and incidence of HF (88-90). The frequency of hypertension in non-ischaemic and ischaemic HF reported from different studies (21, 42) ranged from 50–70%. In our material we observed a very low frequency (20%) of hypertension in non-ischaemic HF patients. Hypertension as co-morbidity is probably underestimated in our material, not only because of probable omission of registration of this diagnosis in the hospital register in a number of cases, but also because hypertension may be undetected or obscured by medication, a failing myocardium, or both.

Women with HF differ from men in several respects: women are generally older and their co-morbidities include more hypertension, diabetes and AF but less IHD (42,43). Furthermore, HFPEF is more prevalent in women, with accompanying lower mortality (40-43). Some studies have suggested that women with HF receive poorer quality of care than men (87) but findings have been inconsistent. A recent European multicentre survey of the quality of care in patients admitted to hospital with HF found that fewer women with evidence of left ventricular systolic dysfunction were treated with drugs, with a documented impact on survival, but were more often treated with cardiac glycosides (91). Conversely, in an international survey of treatment in primary care settings women were similarly likely to receive ACE inhibitors/ARBs or beta-blockers (92). In two US studies gender differences in quality of care were minimal or non-existent (93, 94). So far, most investigations of interventions aimed at the reduction of mortality in HF have been performed in patients with reduced systolic function, a strategy that excludes a large proportion of women with HF. In large outcome trials assessing treatment effects on mortality only 20–30% of the patients have been female (6, 41).

There is limited experience from trials and available guidelines for the optimal treatment of HFPEF. Accordingly, lack of knowledge concerning treatment of HFPEF may have contributed to our finding that mortality in women decreased less than that in men during the study period.

The treatment of MI improved dramatically during the past few decades (95, 96), which may have reduced long-term complications, including HF. During the past two decades, the incidence of MI has decreased in Sweden, probably partly because of a reduction in risk factors (76, 97). Furthermore, there are indications that the size of

the MI is becoming smaller (98), which could contribute to less risk of subsequent HF and, potentially, to less severe cases.

Several studies have investigated changes over time in the risk of developing HF in AMI survivors. Although some studies found a decrease in incidence of HF after AMI (99-101), two recent studies found increasing incidence, partly thought to be due to increased survival (102,103).

In Paper II, we demonstrated a steady decrease in the risk of developing HF after AMI between 1993 and 2004. This decrease was similar in men and women and in younger and older patients. However, the three-year risk of HF remains high, with nearly a third of AMI patients aged 65 to 84 developing HF within three years, and more than 1 in 10 of patients aged below 65 years (Table 8). Overall, we found that 25% of patients with a first AMI developed HF within three years. In the literature this figure varies from 30 up to 75% depending on the population studied and time of follow up (three- or five-year follow up) (103-105). Studies consistently show that most HF cases develop either in relation to the AMI or within the first few months after the AMI as in our study (99,100,103).

The majority of registry studies have shown a decline in the incidence of HF after AMI during the past decade (99-101), but in one Canadian study (103), which investigated the incidence of HF after a first AMI in elderly patients (>65 years) between 1994-2000, the incidence increased and 76% of those patients developed HF after AMI within five years. This finding is in contrast to our study where we observed a decline in the incidence of HF after AMI during almost the same time interval (1993 to 2004). A possible explanation for the discrepancy could be that in the Canadian study all incident HF were registered, including patients managed in primary health care as well as in hospital, whereas our study only included HF patients who were hospitalised.

A hospital diagnosis of HF in Sweden has been validated against ESC criteria for the definition of HF (77), with a validity of 95% for a principal diagnosis of HF. While admission criteria might have varied over the period, we probably captured the majority of severe HF cases with reasonable accuracy. However, we were unable to capture milder cases managed on an outpatient basis or in primary care. In patients with stable CHF a hospital admission for worsening HF will markedly increase the risk of subsequent death (106).

Velagaleti et al. (102) observed an increase over time in the incidence of HF after AMI in 676 Framingham Heart study participants with a first AMI in 1970 to 1999, 165 of which developed HF. The careful case-finding method of the Framingham Heart study is obviously different to that of our study, but the limited size of their study population, as well as differences in identification of HF cases makes it difficult to draw conclusions regarding the discrepancies between our study and theirs.

The explanation for the decrease in hospitalisations for HF found in the present study is concomitant with better treatment both in the acute stage of AMI with rapid revas-

cularisation/lysis in ST elevation MI and improved secondary prevention (95, 96). These developments may have reduced long-term complications, including HF. AMI diagnosis that is based on serial biomarker measurements has substantially increased the detection of AMI cases in comparison with a diagnosis based solely on history and electrocardiography (ECG) findings (107). At the same time, there are reports that the size of the MI is becoming smaller (108), an event that could contribute to less risk of subsequent HF and, potentially, to less severe cases, which might partly explain the declining incidence of HF after AMI. However, even though new criteria result in a substantial increase in the diagnosis of AMI, patients diagnosed by these criteria may not necessarily be less sick or have a better prognosis. In one study (109) patients identified with the new criteria, and who would have been missed by the old criteria, had more co-morbidities and worse 6-month outcomes.

The most common predictors for HF after AMI in previous studies were age, diabetes, previous MI, history of hypertension and reduced renal function (110-112). In our study of patients with a first AMI the most important predictors were age, valvular disease, AF, diabetes and previous stroke. Hypertension did not predict HF, possibly because hypertension as a co-morbid condition will not be adequately captured by a hospital diagnosis (113).

Even if HF incidence is decreasing and prognosis has improved in Sweden, it is still a costly condition. More importantly, for the patients it is characterised by progressive deterioration with disabling symptoms and frequent hospital admissions. To influence hospitalisation rates it is crucial to identify precipitating factors. In Paper III, we found that of 785 patients with worsening CHF seeking care in the ED, only 2% (N=15) were sent home directly while the rest were admitted to hospital care. In the CHF patients who underwent echocardiography 55% presented SHF and 16% valvular heart disease. The number of patients with valvular heart disease in this study is higher than in previous studies (113-115). Data on underlying conditions of CHF may vary substantially depending on the type of study. Where community populations have been investigated (114, 115) or populations of admitted HF patients (116), about 10% of the CHF patients had valvular disease. In clinical randomised trials these patients are usually excluded and thus the demographics between trials and practise differ in this context. The high prevalence of valvular heart disease in our study may have been due to the high age of the study population [mean age 79 years (SD 11 years)]. Pneumonia and other respiratory diseases were the most common reason for hospital admission in patients with CHF. Other common reasons included the need for rhythm recording and communication problems (such as dementia, stroke and aphasia), which are in accordance with the pattern found in earlier studies of patients readmitted for worsening CHF (48-52).

Hence, even if the treatment and care of CHF have developed in the past years, the reasons patients with worsening CHF need hospital admission mostly remain the same. Furthermore, the signs and symptoms seem similar today as they were years ago for patients with worsening CHF that attend an ED (47). The life-prolonging therapies offered today might postpone, but cannot significantly alter, the art of how worsening CHF is presented.

Considerable effort has been devoted to educate patients and their relatives in identifying symptoms and signs of worsening CHF, but none of these models seem to be sufficient as suggested by the fact that when CHF patients seek the ED they are admitted because of different complicating conditions. Further research is needed to determine whether this could be prevented by telemonitoring of CHF patients at home with new devices or new health care forms (e.g., "hospital-at-home") or home visits by specialised nurses in primary care.

In Paper IV, we sought to assess the HC and CC care procedures in relation to medical safety, HRQL and cost-effectiveness in patients eligible for hospital care because of worsening CHF. Our study population was at high risk because of their age, severe symptoms and signs and several co-morbidities. It is particularly noteworthy that these patients were assessed as requiring hospital care but were nevertheless sent home.

Worsening of CHF is often complicated by other serious conditions that call for hospital care. The exclusion criteria were devised to exclude only those patients at the highest risk of complications. To ensure the patients' safety and minimise the risks of relapse a conservative policy was implemented to prevent patients being sent home with electrolyte disturbances (117) that might cause arrhythmias, renal failure (118), ischaemic events (119) and acute HF. Exclusion criteria in our study mirrored those in large CHF studies, i.e. S-Potassium ≥5.5 mmol/L and S-Creatinine ≥265 μmol/L (6,120).

The study results show no severe adverse events in the HC group, suggesting the strategy may be safe even in severely ill patients. The patients in the HC group were referred more frequently to the HF outpatient clinic because initially fewer patients were treated optimally with indicated medications in this group.

As expected, the analysis of the breakdown of health care costs showed that hospitalisation of the patients accounted for the largest proportion of the costs. Because of the small sample size, the contribution of a single patient's health care consumption can substantially influence the mean value; therefore, the results are presented as median values. The major portion (96%) of the costs in the HC group was attributable to personnel costs. In contrast, costs for laboratory analyses and medication (intravenous diuretics) were very small (4%) in the HC group.

Ekman et al. (48) suggested that patients with CHF could be cared for in their homes because 29% of the patients in their study were not able to come to the HF clinic, mainly because of fatigue. In our study the impact of place of care had no effect on HRQL and medical safety though HC was found to reduce health care costs. Clinical and economic efficacy and feasibility, as well as greater satisfaction with care for diverse groups have been demonstrated with a "Hospital at home" model that included continuous nursing supervision and daily home visits by a physician (58, 59). A specialist nurse visited most of the patients in our study on alternate days and thus fewer resources were consumed without any serious adverse events. However, information on cost-utility requires further investigation in well-powered studies.

LIMITATIONS

Papers I and II

One limitation was that the diagnosis of HF was taken from administrative registers, with no formal internal validation. Another limitation concerns a lack of information about additional clinical data, left ventricular function, prescribed medication or the use of structured follow-up.

In Paper I, an additional limitation was that in comparison with other studies, (43) an unexpectedly low proportion of the patients had IHD, indicating that the disorder is under diagnosed. If this were the case, the difference in mortality trends between patients with HF of ischaemic and non-ischaemic aetiology would likely have been underestimated.

In Paper II, a further limitation was that diagnostic criteria for AMI changed over the period, with the adoption of new and sensitive markers in 2001 (121). However, the decline in risk of HF after AMI started already in the mid-1990s, and the fact that smaller MIs were caputred may, as already discussed, not necessarily mean that these patients had an overall better prognosis.

Papers III and IV

These studies were small and single centred and therefore the results cannot be generalised beyond the context of the studies.

In Paper III, results from an echocardiogram were available for only 38% of the eligible patients. This low figure makes the findings of a high percentage of valvular heart disease in the patients who required hospital admission somewhat uncertain.

In Paper IV, despite randomisation, there were differences between groups for some variables (Table 13). This may have affected patients' health and thus causing differences in health care costs, HRQL and the probability of a serious event between groups; the study was too small to adjust reliably for the imbalance. A further limitation in Paper IV was that this study only explored the impact of the intervention, i.e. it did not analyse other variables, such as the quality of care provided by home-help services or relatives.

Table 13. Baseline demographics and clinical characteristics of the study population

	Home care (n = 13)	**Conventional care** (n = 18)	**P-value**
Male n (%)	6 (46)/7 (54)	15 (83)/3 (17)	0.03
Age (years) Mean (SD)	77 (10)	78 (8)	ns
Marital status n (%)			
Divorced	2 (15)	3 (17)	ns
Single	1 (8)	2 (11)	ns
Widowed	7 (54)	5 (28)	ns
Education n (%)			
≥ 9 years	1 (8)	8 (44)	0.02
			ns
Weight Kg Mean (SD)	71 (13)	79 (15)	ns
NT-proBNP pg/ml (Median and inter- quartile range)	4420 (1690-14350)	9335 (3375-13350)	ns
LVEF % Mean (SD)	36 (13)	33 (12)	
Preserved ejection fraction CHF n (%)	3 (23)	2 (11)	
Systolic CHF n (%)	10 (77)	16 (89)	
NYHA class n (%)			
II		1 (5.5)	
III	13 (100)	16 (89)	
IV		1 (5.5)	
Signs Mean (SD)			
Heart rate beats/minute	76 (13)	77 (13)	ns
Breathing rate	21 (7)	20 (6)	ns
Systolic BP mmHg	130 (20)	132 (24)	ns
Pulmonary rales n (%)	8 (62)	13 (72)	ns
Leg oedema	8 (62)	14 (78)	ns
Comorbidities n (%)			
Total comorbidities ≥ 3	9 (70)	17 (93)	ns
Ischemic heart disease	9 (70)	12 (67)	ns
Hypertension	5 (38)	11 (61)	ns
Stroke/TIA	1 (8)	6 (33)	0.09
Diabetes	2 (15)	10 (56)	0.02
Atrial fibrillation	8 (61)	10 (56)	ns
Respiratory disease	4 (31)	7 (39)	ns
Valve disease	5 (38)	2 (11)	0.09
Renal failure	1 (8)	0 (0)	ns

NYHA; New York Heart Association, BP; blood pressure, LVEF; left ventricular ejection fraction, NT-proBNP; N-terminal pro-brain natriuretic peptide

CONCLUSION

Long-term mortality after a first hospitalisation for HF has decreased markedly in Sweden during the past two decades, particularly in younger patients, in men, and more for patients with HF of ischaemic aetiology as compared with a non-ischaemic cause. However, in the last observation period (2002-2003) no further improvement was seen and mortality in all groups remains relatively high. Our findings indicate a need for new strategies in the treatment of HF, potentially more so in patients with HFPEF, a group representing almost 50% of the HF population. This group contains larger proportions of women and older patients.

We observed a steady decrease in the risk of developing HF after an index AMI from 1993 to 2004, regardless of gender and age. However the risk of developing HF remains high. Factors associated with higher risk of developing HF include diabetes, AF, prior stroke and valvular disease. Women had a slightly higher incidence rate of HF than men.

Our findings indicate that the majority of patients with worsening CHF seeking emergency care at the ED required hospital care. Furthermore, we demonstrated that it may be possible to care for some patients with worsening CHF in a home setting through a specialist nurse, even when the patients were assessed as requiring hospital admission. Hence, to support patients with CHF, HC models must be further developed to detect early deterioration of the condition or concomitant diseases.

POPULARVETENSKAPLIG SAMMANFATTNING

Bakgrund

Hjärtsvikt är en allvarlig sjukdom med en 5-års överlevnad på bara 50%. Förekomsten av kronisk hjärtsvikt (CHF) är 2% och insjuknandet i CHF är 4/1000 personår. Nyligen har en minskning av ett-årsdödlighet efter sjukhusvård för hjärtsvikt rapporterats. Hur mortaliteten förändras på längre sikt, hos män och kvinnor, och med olika bakgrundsorsaker har inte studerats liksom inte heller utvecklingen av hjärtsvikt efter hjärtinfarkt, en av de vanligaste orsakerna till hjärtsvikt.

Kostnaden för vården av patienter med hjärtsvikt är 2% av den svenska sjukvårdsbudgeten varav sjukhusvård utgör 75%. Återinläggningsfrekvensen inom 6 månader är upp till 50%, men många patienter vill inte läggas in. Sjuksköterskebaserade specialistmottagningar för hjärtsvikt har visat sig effektivt på stabila patienter. Effekten av behandling av specialistsjuksköterska i hemmet på patienter med försämrad hjärtsvikt vilka annars skulle ha behövt sjukhusvård, med avseende på säkerhet, livskvalitet och kostnad har inte studerats.

Frågeställning

Hur har långtidsprognosen påverkats vid hjärtsvikt och är dödligheten lika stor, oberoende av kön och etiologi?

Hur har utvecklingen av hjärtsvikt efter infarkt påverkats under perioden 1993-2004?

Vad är orsakerna till att patienter med kronisk hjärtsvikt behöver sjukhusvård?

Är det lika säkert att behandla patienter med försämrad kronisk hjärtsvikt i hemmet som på sjukhus?

Är vård i hemmet av patienter med försämrad kronisk hjärtsvikt kostnadseffektivt, i form av kostnad/QALY (kvalitetsjusterade levnadsår) och återinläggningar?

Metoder

Genom samkörning av svenska nationella diagnos- och dödsorsaksregistren har data för arbete 1, 3-årsmortalitet efter första diagnos hjärtsvikt med avseende på ålder, kön och bakomliggande orsak slutförts. På samma sätt har diagnos- och dödsregistren använts för att beräkna insjuknandet i hjärtsvikt efter en första inläggning för hjärtinfarkt i arbete 2. Alla patienter som sökte akut på SU/Östra för misstänkt försämring av CHF mellan april 2004 och maj 2006 screenades. Bl a bakomliggande orsak till hjärtsvikten, hjärtfunktion, kön och ålder registrerades. Detta material utgör underlag för arbete 3 och för arbete 4, där också detaljerade data om symtom och tecken fördes in i speciella ”case record forms” för varje patient. I arbete 4, patienter som uppfyllde inclusions kriteria och hade inga exclusions kriteria randomiserades antigen i hemvård grupp eller sjukhusvård grupp.

Resultat

I arbete 1 observerade vi att dödligheten i hjärtsvikt sjönk kraftig under perioden 1987-2001 men vi observerade inga ytterligare minskningar efter 2001. Dödligheten för hjärtsvikt sjönk mer för män än för kvinnor, mera för patienter under 65 år än för patienter 65-84 år och mer för ischemisk hjärtsvikt än icke-ischemisk hjärtsvikt. Trotts minskningen av dödligheten i hjärtsvikt under senaste 20 åren, är den fortfarande väldigt hög t ex för dem som skrevs ut med diagnosen hjärtsvikt under 1999-2001 var dödligheten nästan 20% bland yngre patienter (35-64) och 40% bland äldre patienter(65-84) inom tre år.

I arbete 2 observerade vi att risken för att drabbas av hjärtsvikt efter inläggning for hjärtinfarkt upp till tre år efteråt minskade stadigt. Risken minskade för både män och kvinnor och med samma takt. Multivariat analys påvisade att kvinnor har 6 högre insjuknande i hjärtsvikt efter inläggning for hjärtinfarkt än män. Andra sjukdomar ökade risken att få hjärtsvikt som: stroke med 37%, diabetes med 76%, förmaksflimmer med 80% och klaffsjukdom nästan dubblerar risken.

I arbete 3 observerade vi att bara 2% av patienterna med försämring av kronisk hjärtsvikt som söker sjukhus kunde skickas hem direkt från akutmottagningen. Resterande fick läggas in pga olika allvarliga hälsotillstånd som lunginflammation, hjärtinfarkt, lungödem, anemi, behov av rytmövervakning osv. 55% av patienterna med kronisk svikt som sökte pga försämring hade nedsatt pumpfunktion i hjärtat.

I arbete 4 observerade vi att det inte fanns någon skillnad mellan sjukhusvård och hemvård i form av specialutbildad sjuksköterska för patienter med kronisk hjärtsvikt som försämrats (som var inkluderade i vår studie) när det gällde kliniska händelser, återinläggning och livskvalitet. Men totalkostnaden var mindre för hemvård med sjuksköterska i jämförelse med sjukhusvård.

Slutsatser

Långtidsdödligheten i hjärtsvikt har minskat kraftig under senaste 20 åren i Sverige. Dödligheten har minskat mer för män än kvinnor, mer för ischemisk hjärtsvikt än icke-ischemisk hjärtsvikt. Men dödligheten i hjärtsvikt är fortfarande hög. Våra fynd tyder på ett behov av nya strategier för behandling av hjärtsvikt, i högra grad hos patienter med hjärtsvikt med bevarad systolisk funktion, en grupp som företräder cirka 50% av patienter med hjärtsvikt.

Risken att utveckla hjärtsvikt efter hjärtinfarkt har minskat stadigt under perioden 1993-2004 i Sverige. Detta återspeglar framgångsrik vård av patienter med akut hjärtinfarkt och patienter med hjärtsvikt under senaste två decennier. Kvinnor har 6% högre risk än män att utveckla hjärtsvikt efter hjärtinfarkt. Stroke, diabetes, förmaksflimmer och klaff fel ökar risken att utveckla hjärtsvikt efter hjärtinfarkt.

Majoriteten av patienter med kronisk hjärtsvikt som söker akut pga försämring behöver inläggning pga allvarliga hälsotillstånd. Bara 2% av patienterna kan skickas hem direkt från akutmottagningen. På sjukhuset bör vården inriktas på snabb sta-

bilisering of patientens tillstånd och behandling av bakomliggande sjukdomar som orsakat försämringen.

Hemvård av specialutbildad sjuksköterska kan vara en alternativ till sjukhusvård för patienter med kronisk hjärtsvikt som söker pga försämring. Denna typ av vård kan eventuellt bli inkorporerad i sviktmottagningar och erbjudas patienter som söker akuten eller sviktmottagningarna efter att ha utvärderats ytterligare.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to all those who helped me during the work on this thesis. I wish to thank all research patients, my family, friends, colleagues and staff at the Department of Medicine at the Sahlgrenska University Hospital/Östra in Göteborg.

I especially wish to express my deepest appreciation to my supervisors:

Associate Professor *Maria Schaufelberger,* for all her support and encouragement during my clinical work and research, for her enormous amount of knowledge in cardiovascular medicine and for her friendship which always helped me through difficult moments.

Professor *Annika Rosengren*, for her excellent knowledge in cardiovascular epidemiology and statistics, for introducing me to epidemiological research and her encouraging support during my work.

Professor *Karl Swedberg*, head of the research department, for his generosity in sharing his enormous amount of knowledge in research, cardiovascular medicine and in writing scientific articles, as well as for providing a stimulating research environment and supporting my research.

I wish to thank my co-authors:

Professor *Inger Ekman*, for her superb knowledge about symptom and signs, for her opinions and advice about the care of chronically sick patients and for introducing me to research about patient-centred care.

Georgios Lappas, for his excellent knowledge in statistics and introducing me to the confusing world of statistics.

Harshidaben Patel, for her help in collecting patient data and performing in our joint research project.

Associate Professor *Sören Höjgård*, for his profuse knowledge in health economics and for his help in providing me with a better understanding of the importance of this field of research.

I specially wish to thank:

Eva Thydén, for her kind support during the preparation of this thesis.

Ann-Britt Johansson, for her perfect assistance in all kinds of problems I have met during my clinical and research work.

Ingalill Östgren, for her help in collecting patient data.

My colleagues in the heart failure research group: *Annika Odenstedt, Kim Fahlén, Sven-Eric Hägelind, Azar Hedemalm, Jonna Norman* and *Kajsa Jacobsson.*

Head of the Department of Medicine: *Barbro Westberg* and *Putte Abrahamsson.*

My colleagues at the Department of Medicine at the Sahlgrenska University Hospital/Östra:

Bengt-Olof Fredlund, Sven Wallerstedt, Henry Eriksson, Mikael Dellborg, Peter Eriksson, Kurt Andersson, Björn Hornestam, Filip Jacobsson, Per Johanson, Eva Furenäs, Martin Pilhall, Morteza Shafazand, Jerzy Kaczynski, Mats Börjesson, Henrik Norrsell, Tommy Berglund, Jan Hammarström, Wilhelm Ridderstråle, Gert Hermansson, Magnus Johansson, Vuk Kujacic, Reza Alami, Tomas Schultz, Smita Dutta-Roy, Ott Saluveer, Bachar Ghanoum, Linda Landén and *Per Ladenvall*.

My colleagues at the Thoracic centre at Karlskrona hospital:

Bengt Lindström, Björn Eklund, Anita Hjort, Carl-Magnus Pripp, Ingrid Larsson, Jessica Persson, Malin Persson, Michael Ringborn, Per Johansson, Marita Sideström, Karim Mokhtar, Jan Medin, Jan W Johansson, Elisabeth Olin and *Dan Westelin*.

My loving parents, *Porandokht* and *Majid*, for encouraging me and supporting me at all times. My father, although you are not longer among us, I know that you are happy for my achievements. I will love you forever.

My beloved son, *Amir Masoud*, the most precious I have in the world, for all your love and concern, for encouraging me and never complaining during difficult moments. I love you with my whole heart.

My brothers, *Saied, Soheil* and *Amir* (my computer guru), for all your help, your concern and your friendship. You are always in my heart.

Many thanks to rest of my family, for all the love and support I have received.

This thesis was financially supported by grants from The Heart/Lung Council, the Swedish Research Council, the Swedish Council for Working Life and Social Research, the Swedish Association of Health Professionals, Göteborg and Southern Bohus County, the Göteborg Medical Society, the Cardiology Research Foundation of the Department of Medicine, Sahlgrenska University Hospital/Östra and the Heart and Lung Foundation of Blekinge.

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