



A management programme for suspected heart failure in primary care in cooperation with specialists in cardiology

Märit Mejhert & Thomas Kahan

To cite this article: Märit Mejhert & Thomas Kahan (2015) A management programme for suspected heart failure in primary care in cooperation with specialists in cardiology, The European Journal of General Practice, 21:1, 26-32, DOI: [10.3109/13814788.2014.908282](https://doi.org/10.3109/13814788.2014.908282)

To link to this article: <https://doi.org/10.3109/13814788.2014.908282>



Published online: 24 Oct 2014.



Submit your article to this journal [↗](#)



Article views: 1356



View related articles [↗](#)



View Crossmark data [↗](#)

Original Article

A management programme for suspected heart failure in primary care in cooperation with specialists in cardiology

Märil Mejhert^{1,2} & Thomas Kahan^{1,3}

¹Karolinska Institutet, Department of Clinical Sciences, Danderyd Hospital, Division of Cardiovascular Medicine, Stockholm, Sweden, ²Ersta Hospital, Stockholm, Sweden, and ³Department of Cardiology, Danderyd University Hospital Corp, Stockholm, Sweden

KEY MESSAGE:

- The implementation of an easily accessible hospital management programme for suspected heart failure in primary care is described.
- NT-proBNP levels < 300 ng/l had a 73% negative predictive value for heart failure; most of those patients had respiratory diseases.
- Drug treatment and NYHA class improved after one year, compared to baseline.

ABSTRACT

Background: The diagnosis of new onset congestive heart failure (CHF) is often difficult as symptoms and signs are non-specific. Proper diagnostic investigations and treatments are underused in primary care.

Objective: To describe a management programme for patients with suspected CHF in primary care in cooperation with specialists in cardiology.

Methods: Prospective study of 102 consecutive primary care patients with suspected new onset CHF referred to an easily accessible hospital-based cardiology outpatient clinic management programme. Following clinical examination, ECG, echocardiography, blood chemistry including NT-proBNP, and assessment of NYHA class and quality of life (EQ5D), patients with a confirmed diagnosis of CHF were prescribed medication with advice on titration and target doses. Trained CHF nurses gave information on CHF and provided follow up.

Results: Half (47%) of the referred patients had the diagnosis of CHF confirmed. Low NT-proBNP values (< 300 ng/l) provided a negative predictive value of 73%. Respiratory tract diseases were common differential diagnoses. At one year of follow-up, medication in the CHF group was 86% ACE-inhibitors/angiotensin receptor blockers, 61% β -blocking agents, and 81% diuretics ($P < 0.001$ for the increase in ACE-inhibitors/angiotensin receptor blockers from baseline). NYHA class improved from baseline (median 2, range: 1–3) to one year ($P < 0.05$), whereas NT-proBNP (1491–1261 ng/l), and quality of life (EQ5D; 67–67) were unchanged.

Conclusion: A management programme to optimize quality of care for patients with suspected new onset CHF in primary care, with referral to a hospital-based specialist team, can be applied successfully.

Keywords: Heart failure, primary health care, management programme, natriuretic peptides

INTRODUCTION

Most patients with congestive heart failure (CHF) are old, multi-diseased, and have an impaired quality of life (1,2). Health care costs for CHF are high, the main driver being hospital care (3,4). A diagnosis of CHF requires typical symptoms and signs, and evidence of abnormal cardiac structure or function (5). Symptoms and signs may be difficult to evaluate in obese individuals, in the elderly,

and in patients with respiratory tract disease. A diagnosis based solely on symptoms and signs may be wrong in half of the cases (6). An electrocardiogram (ECG), echocardiography, and natriuretic peptides often add to the diagnostic accuracy. However, the diagnosis of new onset CHF often remains difficult as symptoms and signs are non-specific, and values of natriuretic peptides and echocardiography findings are sometimes inconclusive.

An early diagnosis and treatment of CHF will reduce cardiovascular hospitalizations and mortality (7,8). Thus, CHF management programmes have been established improving treatment and avoiding hospital admissions (9). In Sweden, 90% of all hospitals have a CHF management programme (10), but few such programmes are established in primary care. Only 31% of Swedish primary care patients with CHF were referred to echocardiography, and just 42% received appropriate drug treatment (11). Quality registers have been instituted to ensure coherence to guidelines. The Swedish Heart Failure Registry (S-HFR) was started in 2003 and comprises information on demography, aetiology, ECG, left ventricular ejection fraction (by echocardiography), blood chemistry and natriuretic peptides, New York Heart Association (NYHA) classification, quality of life (by EQ5D), medication, investigational procedures, and follow-up (12). Participating physicians and centres have immediate internet access to information on all their previously registered patients, and to reports, lists and statistical analyses of selected patient groups in comparison to other participating units. The S-HFR currently contains more than 50 000 patient reports and is linked to the National Registry on Health and Welfare to provide data on morbidity and mortality (12).

Although patients with suspected CHF represent a diagnostic challenge in everyday primary care practice, management programmes and participation in registries such as the S-HFR remain underused in this setting. This

study describes the implementation of an easily accessible hospital management programme for suspected CHF in primary care. The aim was to improve the cooperation between primary care and hospital specialists to optimize quality of care.

METHODS

Study design and patients

Four senior cardiologists and two specialized CHF nurses at Ersta Hospital, situated in southern central Stockholm, Sweden formed the hospital-based part of the CHF management programme. All 13 primary care centres within the southern central greater Stockholm area (approximately 140 000 inhabitants) were invited to participate. They were sent written information by mail and were invited to meetings on current CHF guidelines and the use N-terminal pro brain natriuretic peptide (NT-proBNP) and the S-HFR. The cooperation between specialists in general practice and cardiology was emphasized, and a direct telephone access for the primary care centres with a cardiologist was provided. Throughout the project, from 1 June 2008 to 31 March 2010, seven newsletters were distributed to all primary care centres.

All patients with new onset suspected CHF according to prevailing Swedish recommendations (13) and based on European guidelines (14) (see Figure 1)

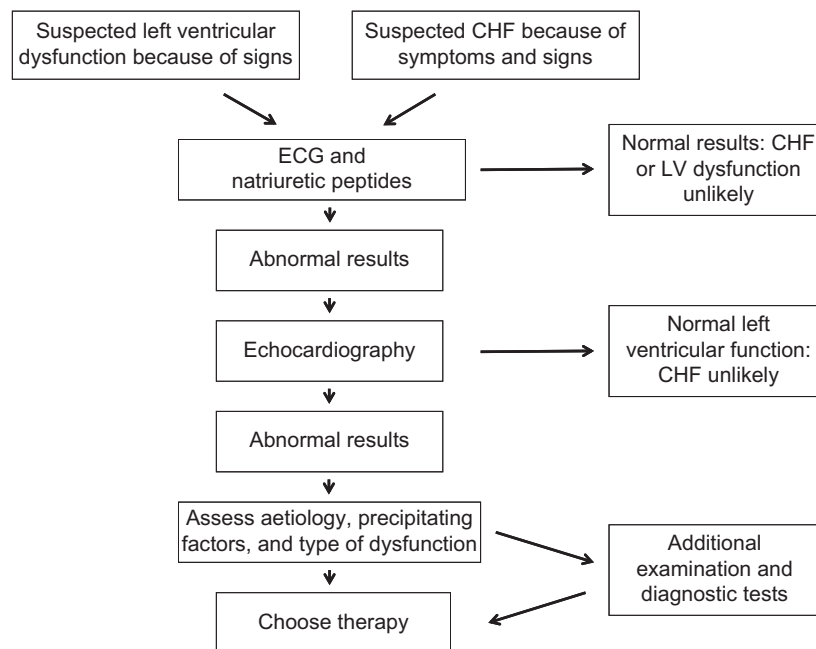


Figure 1. The algorithm for diagnosing congestive heart failure. The algorithm for diagnosing CHF according to prevailing Swedish recommendations, and based on European guidelines (13,14). Symptoms suggestive of CHF include dyspnoea at rest or during effort, tiredness, nocturnal dyspnoea or cough, nocturia, loss of appetite, nausea, depression, abdominal pain, and difficulty concentrating. Signs suggestive of CHF include pulmonary rales, peripheral oedema, tachycardia, jugular vein distension, hepatomegaly, tachypnoea, S3 or S4 gallop rhythm, pleural effusion, and ascites. Patients with suspected CHF because of symptoms and signs, or signs suggestive of left ventricular dysfunction; together with an abnormal ECG and/or elevated value of NT-proBNP were eligible for inclusion.

Table 1. Values of NT-pro BNP to facilitate decision making in primary care according to prevailing Swedish recommendations on the management of CHF.

Age, years	NT-pro BNP, ng/l		
< 50	< 300	300–450	> 450
50–75	< 300	300–900	> 900
> 75	< 300	300–1800	> 1800
Interpretation	Heart failure unlikely	Heart failure possible	Heart failure probable

Assessment of natriuretic peptides can add to the diagnostic accuracy of defining CHF but is not to be used alone to make a diagnosis. NT-pro BNP was measured by an electrochemiluminescence immunoassay (Cobas 232, Roche Diagnostics, Mannheim, Germany) (17). The cut-off values of NT-pro BNP values in this study were according to Swedish recommendations at the time of the study, and were adapted from van Kimmenade et al. (13,15).

visiting a primary care centre were eligible for inclusion. Table 1 gives the cut-off values of NT-proBNP recommended at the time of the study (15). There were no exclusion criteria. Consecutive patients referred to the hospital were scheduled for a first visit at the hospital outpatient clinic within four weeks. This visit included a clinical examination, ECG, echocardiography, blood chemistry including NT-proBNP, and assessment of NYHA class and quality of life (by EQ5D). Data was entered into the S-HFR (shown in Table 2) to facilitate monitoring of the patients and improvement of the quality of care of the primary care centre. If needed to establish a diagnosis, the cardiologist scheduled further investigations and follow up visits. A defi-

nite diagnosis of CHF was made by a senior cardiologist and according to the prevailing guidelines (14).

Patients with a confirmed diagnosis of CHF were prescribed and started on the appropriate medication (ACE-inhibitors or angiotensin receptor blockers, β -blocking agents, and diuretics) by the cardiologist. At the index visit, patients and their spouses were invited to meet with the hospital based CHF nurses. Information on CHF in general, medication including a flexible diuretic regimen, and advice on lifestyle changes were given, and typically lasted 30–60 min. The nurses had permission to titrate doses of ACE-inhibitors or angiotensin receptor blockers, β -blocking agents, and diuretics, and provided follow-up visits for dose titration and further information if this was not readily available at the primary care centre. The hospital outpatient clinic provided the referring physician copies of full medical records of the patient evaluation, follow-up, and information given by the CHF nurses, laboratory tests and the echocardiographic examination, together with advice on follow-up, including drug titration, target doses, and suggestions in case of worsening of CHF. After three months, the CHF nurses made telephone calls to monitor compliance with medication. All CHF patients were scheduled for a follow-up visit at Ersta Hospital after one year, including clinical examination, quality of life (by EQ5D), NYHA class, ECG, echocardiography, blood chemistry and NT-proBNP, and medication; data were again reported to the S-HFR. Additional visits, if needed, were either at the primary care centre or Ersta Hospital, at the discretion of the patient and their primary care physician.

Table 2. Baseline demographics and findings of patients with suspected new onset CHF on referral, according to a confirmed diagnosis of CHF or not. Data are presented as mean values $\pm$ SD or proportions, as appropriate.

	CHF	Non-CHF	P
<i>n</i>	46	52	ns
Age, years	76.3 $\pm$ 9.5	75.0 $\pm$ 9.3	ns
Gender, % men	62	36	ns
Blood pressure, systolic, mm Hg	137 $\pm$ 33	137 $\pm$ 19	ns
Blood pressure, diastolic, mm Hg	81 $\pm$ 18	80 $\pm$ 10	ns
Heart rate, beats/min	73 $\pm$ 14	75 $\pm$ 15	ns
QRS width, ms	107 $\pm$ 25	93 $\pm$ 18	< 0.05
Hypertension, %	67	51	ns
Ischaemic heart disease, %	39	20	< 0.05
Atrial fibrillation, %	30	18	< 0.001
Diabetes mellitus, %	24	10	< 0.001
Respiratory diseases, %	16	35	< 0.001
Previous and current smokers, %	28	27	ns
Haemoglobin, g/l	139 $\pm$ 16	143 $\pm$ 48	ns
Serum creatinine, μ mol/l	107 $\pm$ 42	82 $\pm$ 20	< 0.001
NT-pro-brain natriuretic peptide, ng/l	1491 $\pm$ 1446	521 $\pm$ 407	< 0.001
Quality of life by EQ5D	67 $\pm$ 18	67 $\pm$ 61	ns
ACE-inhibitors or angiotensin receptor blockers, %	42	24	ns
β -blocking agents, %	67	54	ns
Diuretics, %	72	52	ns

ACE, angiotensin converting enzyme; CHF, congestive heart failure; ns, not significant; P, probability.

Patients in the non-CHF group were re-admitted to the primary care centre, with differential diagnostic suggestions. For this study only, patient records from the primary care centres were collected for follow-up after one year to ascertain a final diagnosis.

All patients gave their informed consent to participate. Approval from the Regional Ethics Committee in Stockholm was provided.

Examinations

Blood pressure and a resting 12-lead ECG were obtained in the supine position. Echocardiography (Vivid 7, Vingmed General Electrics, Horten, Norway) was performed and fully evaluated according to current guidelines (16). A left ventricular ejection fraction value below 50% was considered abnormal. Other echocardiographic abnormalities were not collected in this study population.

Laboratory tests (haemoglobin, creatinine, potassium, glucose, total cholesterol) were done by standard procedures. NT-proBNP was measured by electrochemiluminescence immunoassay (Cobas 232, Roche Diagnostics, Mannheim, Germany) (17) in the primary care centre before referral and at Ersta Hospital.

Quality of life in S-HFR is assessed by the EQ5D. This widely used simple generic measure of health provides a descriptive profile and a single index value for health status (where 100 is highest and 0 lowest perceived quality) (18).

Statistics

This study aimed to include 100 consecutive patients, which was considered sufficient to describe the introduction of the management programme. Student's *t*-test was used for continuous normally distributed variables, and the Mann-Whitney U-test or the Wilcoxon signed rank test for discrete or skewed variables. The Chi-square test was used for comparison of proportions. A probability (*P*) < 0.05 was considered significant.

RESULTS

Baseline

From 1 June 2008 to 31 March 2010, 52 primary care physicians in 13 primary care centres referred 102 patients. Four referral notes were not accepted as both ECG and NT-proBNP values were normal. Table 2 presents baseline demographics and findings of the 98 included patients on referral. Male gender, concomitant cardiovascular disease and medications, increased QRS width on ECG, and elevated serum creatinine and NT-proBNP levels were more common in the 46 CHF patients, whereas diseases of the respiratory tract were more

common in the 52 non-CHF patients. Left ventricular ejection fraction in the CHF group was considered normal in 6 patients, and the reduction was mild, moderate, and marked in 26, 6, and 6 patients, respectively. NYHA class I, II, III, and IV was present in 2, 38, 6, and 0 patients (5, 62, 12, and 0%, respectively).

Figure 2 presents the relationship between NT-proBNP values obtained initially in the primary care centre and on in the hospital outpatient clinic.

In the CHF group, all patients except 6 had NT-proBNP values above the recommended age-related cut-off value for probable CHF. Of note, 2 of the 6 patients with normal NT-proBNP values had a reduced left ventricular ejection fraction. In the non-CHF group 16 of the 52 patients (included based on clinically suspected CHF and pathological ECG findings) had NT-proBNP values below 300 ng/l, and no one had an NT-proBNP above 1800 ng/l. Based on 98 included patients, the calculated negative and positive predictive values, sensitivity, and specificity (with 95% confidence intervals), using a cut-off value for CHF below 300 ng/l (see Table 2), were 73 (50; 88), 53 (41; 64), 87 (73; 94), and 31 (19; 45)%, respectively.

NT-proBNP values were higher in men than in women with CHF (1885 versus 967 ng/l, *P* < 0.05). Women tended to be older than men in the CHF group (79.6 versus 74.2 years, *P* = 0.06).

Follow-up at one year

In the CHF group, 5 patients (11%) underwent further investigations such as exercise testing, spirometry, or coronary angiography. During follow-up, 2 patients were diagnosed with dilated cardiomyopathy, 1 with severe hypertension was diagnosed with primary aldosteronism, and 2 suffered from a stroke. Ten patients were missing at follow-up (3 were dead, 2 hospitalized, 2 did not wish to participate, 2 were not reached, and 1 settled elsewhere). The CHF nurses met with 37 (80%) of

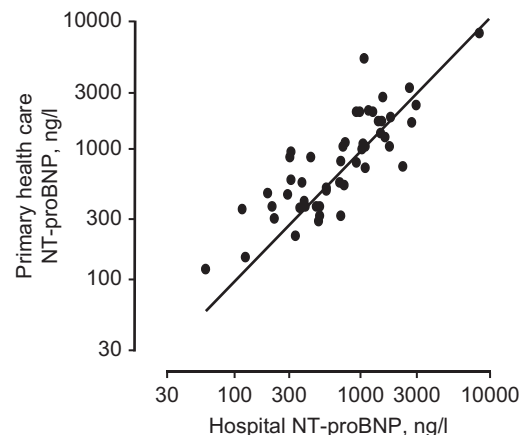


Figure 2. NT-proBNP values obtained at the primary care centre and the hospital outpatient clinic. The solid line represents the line of identity.

the CHF patients at 103 visits (mean 2.9; range: 1–8). The number of primary care centre visits was not available.

Medication in the CHF group at one year was 86% ACE-inhibitors or angiotensin receptor blockers, 61% β -blocking agents, and 8% diuretics; 58% were prescribed both ACE-inhibitors or angiotensin receptor blockers and β -blocking agents. Compared to the medication on referral (42, 67, and 72%, respectively; Table 2) the use of ACE-inhibitors or angiotensin receptor blockers increased ($P < 0.001$). Medication with ACE-inhibitors or angiotensin receptor blockers and diuretics tended to increase from three months to one year (data not shown).

In the CHF group, NYHA class at one year improved (i.e. NYHA class I, II, III, and IV was present in 24, 68, 4, and 4%, respectively; $P < 0.05$), whereas NT-proBNP (from 1491 to 1261 ng/l), serum creatinine (from 107 to 102 μ mol/l), haemoglobin (from 138 to 137 g/l), and quality of life (by EQ5D; from 67 to 67) did not change significantly. No patient had been hospitalized with CHF.

In the non-CHF group, 14 (27%) had not visited the primary care centre, or no patient record was obtained. Two were deceased. Common diagnoses were chronic obstructive lung disease, lung fibrosis, lung cancer, asthma, and peripheral venous insufficiency; diseases of the respiratory tract were present in 18 (35%). One patient was diagnosed with (right ventricular) heart failure during follow-up.

DISCUSSION

Main findings

This study describes a management programme in cooperation between specialists in general practice and cardiology for patients with suspected new onset CHF in primary care, with referral to an easily accessible hospital-based specialist team. One major finding was that only half of the referred patients presenting with suspected CHF had this diagnosis confirmed. Second, a low value of NT-proBNP provided a fairly high (73%) negative predictive value for CHF. Third, diseases of the respiratory tract were common differential diagnoses in patients where CHF could not be confirmed. Finally, patients with CHF included in the management programme showed improved CHF medication and improved NYHA class at one year of follow-up.

Study results in relation to existing findings

Open access echocardiography service and structured advice by a cardiologist could have an important impact on the management of patients with suspected CHF, including faster and more accurate diagnostic procedures, improved medication, and less need for unnecessary referrals to cardiologists (19–21). Furthermore, studies by us and others suggest a nurse-based CHF

management programme to be more effective than usual care in optimizing medication and improving self-care behaviour for patients in primary care (22–25). Thus, case management type interventions led by trained CHF nurses reduce CHF related cardiovascular complications (26). The current management programme support these observations and could help to improve the recognition, correct diagnosis and treatment of CHF, supporting recent recommendations for primary care (27).

The improved medication in the CHF group was expected as patients were newly diagnosed with CHF and followed a management programme where specialized CHF nurses met most patients on several visits. Medication was well maintained at one year of follow-up. This is important as persistence to cardiovascular medication generally is inversely related to the duration of treatment (28). Thus, the CHF group seemed to respond well to the proposed management programme as also suggested by an improvement in NYHA class.

As expected, NT-proBNP values were higher in the CHF group than in the non-CHF group. Values obtained in the primary care centre, and hospital outpatient clinic were closely related. This new observation suggests that NT-proBNP values remain fairly stable for weeks in this primary care setting. Our results confirm findings for sensitivity, specificity and positive predictive values for NT-proBNP to define the clinical syndrome of CHF in primary care (29–31). More importantly, we found a fairly high (73%) negative predictive value of NT-proBNP for CHF, in agreement with findings in primary care and in hospitalized patients (29,30,32). Thus, the value of NT-proBNP as a rule-out test for CHF in primary care seems strong.

Only half of the referred patients presenting with suspected CHF had a diagnosis of CHF confirmed. In the non-CHF group, diseases of the respiratory tract were the most common diagnoses. Respiratory tract diseases may be difficult to differentiate from CHF, and are also common in CHF (33,34). Physicians should pay more attention to the possibility that patients with symptoms suggestive of new onset CHF may suffer from respiratory disease instead of, or in combination with CHF.

Patients with CHF report impaired quality of life (22). This was confirmed by the present study, where the CHF group reported a lower index value for quality of life according to EQ5D (i.e. 67) as compared to a general population of similar age in Stockholm (35). Some studies on management programmes have shown improved quality of life, whereas others have reported equivocal results (22). This may relate to the different settings of studies.

Strengths and limitations

Patient characteristics in this study were similar to those patients in primary care reported to the S-HFR

(36). This suggests our study representative of CHF patients in Swedish primary care. However, this study has important limitations. We encouraged referral of all subjects with suspected new onset CHF, but detailed information on how many patients were eligible for referral is unavailable. The incidence of CHF in the Stockholm region in 2010 was 3.1/1000 person-years (2). Few patients with CHF attend primary care only, and most patients with new onset CHF will initially be treated in hospital (2). Thus, the number of referrals in this study may respond to a majority of patients with new onset CHF treated ambulatory in primary care. More important, the study did not involve a control group and does not allow us to assess improved clinical outcome related to the management programme.

Conclusion

This study supports recent recommendations on the management of CHF patients, and shows that a management programme for patients with suspected new onset CHF in primary care followed by referral to a structured assessment by a hospital-based specialist team can be applied. The fairly high negative predictive value of natriuretic peptides is useful and might reduce the need for echocardiography.

FUNDING

Supported by the Regional agreement on medical training and clinical research (ALF) between Stockholm County Council and Karolinska Institutet; the Tornspiran Foundation; the Swedish Association of Local Authorities and Regions; and Karolinska Institutet Research Foundations. AstraZeneca, Mölndal, Sweden, and Roche Diagnostics Scandinavia, Stockholm, Sweden, supported part of the costs for analyses of NT-proBNP.

ACKNOWLEDGEMENT

The authors acknowledge the expert advice and support from Dr Björn Eriksson, Gustavsberg primary care centre, and all collaborating primary care physicians.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

REFERENCES

- Mosterd A, Hoes A, De Bruyne M. Prevalence of heart failure and left ventricular dysfunction in the general population. *Eur Heart J*. 1999;20:447–55.
- Zarrinkoub R, Wettermark B, Wändell P, Mejhert M, Kahan T. The epidemiology of heart failure, based on patient data for 2.1 million inhabitants in Sweden. *Eur J Heart Fail*. 2013;15:995–1002.
- Liao L, Allen LA, Whellan DJ. Economic burden of heart failure in the elderly. *Pharmacoeconomics* 2008;26:447–62.
- Mejhert M, Lindgren P, Schill O, Edner M, Persson H, Kahan T. Health care consumption and cost expenditure in chronic systolic heart failure during an 8–12 year prospective follow up. *Eur J Intern Med*. 2013;24:260–5.
- McMurray JJ, Adamopoulos S, Anker SD, Auricchio A, Böhm M, Dickstein K, et al. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012. *Eur Heart J*. 2012;33:1787–847.
- Remes J, Miettinen H, Reunanen A, Pyörälä K. Validity of clinical diagnosis of heart failure in primary health care. *Eur Heart J*. 1991;12:315–21.
- Jong P, Yusuf S, Rousseau MF, Ahn SA, Bangdiwala SI. Effect of enalapril on 12-year survival and life expectancy in patients with left ventricular systolic dysfunction: A follow-up study. *Lancet* 2003;361:1843–8.
- Ahn SA, Jong P, Yusuf S, Bangdiwala SI, Pouleur HG, Rousseau MF. Early versus delayed enalapril in patients with left ventricular systolic dysfunction: Impact on morbidity and mortality 15 years after the SOLVD trial. *J Am Coll Cardiol*. 2006;47:1904–5.
- McAlister F, Stewart S, Ferrua S, McMurray J. Multidisciplinary strategy for the management of heart failure patients at high risk for admission: A systematic review of randomized trials. *J Am Coll Cardiol*. 2004;44:810–9.
- Strömberg A, Mårtensson J, Fridlund B, Dahlström U. Nurse-led heart failure clinics in Sweden. *Eur J Heart Fail*. 2001;3:139–44.
- Dahlström U, Håkansson J, Swedberg K, Waldenström A. Adequacy of diagnosis and treatment of chronic heart failure in primary health care in Sweden. *Eur J Heart Fail*. 2009;11:92–8.
- Jonsson Å, Edner M, Alehagen U, Dahlström U. Heart failure registry: A valuable tool for improving the management of patients with heart failure. *Eur J Heart Fail*. 2010;12:25–31.
- Diagnostic procedures and treatment of chronic heart failure. Information from the Medical Products Agency—Sweden (in Swedish). 2006;1:7–15.
- Swedberg K, Cleland J, Dargie H, Drexler H, Follath F, Komajda M, et al. Guidelines for the diagnosis and treatment of chronic heart failure: Executive summary (update 2005): The task force for the diagnosis and treatment of chronic heart failure of the European Society of Cardiology. *Eur Heart J*. 2005;26:1115–40.
- van Kimmenade RR, Pinto YM, Januzzi JL Jr. Importance and interpretation of intermediate (gray zone) amino-terminal pro-B-type natriuretic peptide concentrations. *Am J Cardiol*. 2008;101:39–42.
- Lang RM, Bierig M, Devereux RB, Flachskampf FA, Foster E, Pellikka PA, et al. Recommendations for chamber quantification: A report from the American Society of Echocardiography's guidelines and standards committee and the chamber quantification writing group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. *J Am Soc Echocardiogr*. 2005;18:1440–63.
- Alehagen U, Janzon M. A clinician's experience of using the cardiac reader NT-proBNP point-of-care assay in a clinical setting. *Eur J Heart Fail*. 2008;10:260–6.
- EuroQol Group. EuroQol—a new facility for the measurement of health related quality of life. *Health Policy* 1990;16:199–208.
- Francis CM, Caruana L, Kearney P, Love M, Sutherland GR, Starkey IR, et al. Open access echocardiography in management of heart failure in the community. *Br Med J*. 1995;310:634–6.
- van Heur LM, Baur LH, Tent M, Lodewijks-van der Bolt CL, Strepel M, Winkens RA, et al. Evaluation of an open access echocardiography service in the Netherlands: A mixed methods study of

- indications, outcomes, patient management and trends. *BMC Health Serv Res.* 2010;10:37.
21. van Gorp N, Boonman-De Winter LJ, Meijer Timmerman Thijssen DW, Stoffers HE. Benefits of an open access echocardiography service: A Dutch prospective cohort study. *Neth Heart J.* 2013;21:399–405.
 22. Mejhert M, Kahan T, Persson H, Edner M. Limited long term effects of a management programme for heart failure. *Heart* 2004;90:1010–5.
 23. Strömberg A, Mårtensson J, Fridlund B, Levin LA, Karlsson JE, Dahlström U. Nurse-led heart failure clinics improve survival and self-care behaviour in patients with heart failure: Results from a prospective, randomised trial. *Eur Heart J.* 2003;24:1014–23.
 24. Andryukhin A, Frolova E, Vaes B, Degryse J. The impact of a nurse-led care programme on events and physical and psychosocial parameters in patients with heart failure with preserved ejection fraction: A randomized clinical trial in primary care in Russia. *Eur J Gen Pract.* 2010;16:205–14.
 25. Smeulders ES, van Haastregt JC, Ambergen T, Uszko-Lencer NH, Janssen-Boyne JJ, Gorgels AP, et al. Nurse-led self-management group programme for patients with congestive heart failure: Randomized controlled trial. *J Adv Nurs.* 2010;66:1487–99.
 26. Takeda A, Taylor SJ, Taylor RS, Khan F, Krum H, Underwood M. Clinical service organisation for heart failure. *Cochrane Database Syst Rev.* 2012;9:CD002752.
 27. Mant J, Doust J, Roalfe A, Barton P, Cowie MR, Glasziou P, et al. Systematic review and individual patient data meta-analysis of diagnosis of heart failure, with modelling of implications of different diagnostic strategies in primary care. *Health Technol Assess.* 2009;13:1–207.
 28. Cramer JA, Benedict A, Muszbek N, Keskinaslan A, Khan ZM. The significance of compliance and persistence in the treatment of diabetes, hypertension and dyslipidaemia: A review. *Int J Clin Pract.* 2008;62:76–87.
 29. Zaphiriou A, Robb S, Murray-Thomas T, Mendez G, Fox K, McDonagh T, et al. The diagnostic accuracy of plasma BNP and NTproBNP in patients referred from primary care with suspected heart failure: Results of the UK natriuretic peptide study. *Eur J Heart Fail.* 2005;7:537–41.
 30. Boman K, Olofsson M. Usefulness of natriuretic peptides in primary health care; an exploratory study in elderly patients. *Scand J Prim Health Care* 2010;1:29–35.
 31. Kelder JC, Cowie MR, McDonagh TA, Hardman SM, Grobbee DE, Cost B, et al. Quantifying the added value of BNP in suspected heart failure in general practice; an individual patient data meta-analysis. *Heart* 2011;97:959–63.
 32. McCullough, Nowak RM, McCord J. B-type natriuretic peptide and clinical judgment in emergency diagnosis of heart failure. Analysis from breathing not properly multinational study. *Circulation* 2002;106:416–22.
 33. Dahlström U. Frequent non-cardiac comorbidities in patients with chronic heart failure. *Eur J Heart Fail.* 2005;7:309–16.
 34. Rutten FH, Moons KG, Cramer MJ, Grobbee DE, Zuithoff NP, Lammers JW, et al. Recognising heart failure in elderly patients with stable chronic obstructive pulmonary disease in primary care: Cross sectional diagnostic study. *Br Med J.* 2005;331:1379.
 35. Burström K, Johannesson M, Rehnberg C. Deteriorating health status in Stockholm 1998–2002: Results from repeated population surveys using the EQ-5D. *Qual Life Res.* 2007;16:1547–53.
 36. Swedish Heart Failure Registry. Annual Report 2012 (in Swedish). Available at <http://www.ucl.ac.uk/uk-riksvikt-en/> (accessed 1 June 2013).