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Update: Acute Heart Failure (VIII)

Multidisciplinary Approach for Patients Hospitalized With Heart Failure

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ABSTRACT

Acute heart failure describes the rapid deterioration, over minutes, days or hours, of symptoms and signs of heart failure. Its management is an interdisciplinary challenge that requires the cooperation of various specialists. While emergency providers, (interventional) cardiologists, heart surgeons, and intensive care specialists collaborate in the initial stabilization of acute heart failure patients, the involvement of nurses, discharge managers, and general practitioners in the heart failure team may facilitate the transition from inpatient care to the outpatient setting and improve acute heart failure readmission rates. This review highlights the importance of a multidisciplinary approach to acute heart failure with particular focus on the chain-of-care delivered by the various services within the healthcare system.

Abordaje multidisciplinario en pacientes hospitalizados por insuficiencia cardiaca

Palabras clave:
Insuficiencia cardiaca aguda
Tratamiento multidisciplinario
Transición

RESUMEN

La insuficiencia cardiaca aguda describe el deterioro rápido, en un plazo de minutos, días u horas, de los signos y síntomas de la insuficiencia cardiaca. Su tratamiento constituye un verdadero reto interdisciplinario que requiere la colaboración de diversos especialistas. Aunque los servicios de urgencias, los cardiólogos (intervencionistas), los cirujanos cardiacos y los especialistas en cuidados intensivos colaboran en la estabilización inicial de los pacientes con insuficiencia cardiaca aguda, la participación en el equipo de asistencia de enfermeras, encargados del alta y médicos generales puede facilitar la transición de la asistencia hospitalaria al contexto ambulatorio, y reducir las tasas de reingreso por insuficiencia cardiaca aguda. En esta revisión se señala la importancia de un abordaje multidisciplinario de la insuficiencia cardiaca aguda, con especial énfasis en la cadena de asistencia prestada por los diversos servicios dentro del contexto del sistema de asistencia sanitaria.

INTRODUCTION

Acute heart failure (AHF) describes the rapid onset or worsening of symptoms and signs of heart failure (HF),[1] usually leading to hospitalization. It is a life-threatening condition and the most common diagnosis among patients suffering from acute respiratory distress.[2,3] The term AHF is also often extended to patients with more gradual deterioration, with increasing exertional dyspnea and worsening peripheral edema and for this reason some people have coined the term "hospitalized HF" as a more accurate reflection of the clinical problem.[4] Although worsening peripheral edema may appear less alarming than pulmonary edema, it may carry a worse prognosis, perhaps because it reflects biventricular rather than only left ventricular failure.[5]

Heart failure is common[6] and there has been a steady rise in AHF admissions over the last decade.[7–9] An aging population and improved survival after the onset of cardiovascular disease is expected to further increase HF incidence and prevalence.[10] Most people who die of cardiovascular diseases will first develop HF.[11] The management of HF is an interdisciplinary challenge that requires the cooperation of various specialists (Figure).

EMERGENCY MEDICAL SERVICES

Patients suffering from AHF may contact emergency medical services (EMS) because of acute symptoms such as dyspnoea, syncope, palpitations, or thoracic pain. An analysis of 4083 consecutive EMS contacts in Denmark found HF to be the primary discharge diagnosis in 3.1% of these patients.[12] However, AHF may also be present in patients with other primary diagnoses such as acute coronary syndrome, arrhythmia, or valvular disease. Based on physical signs and symptoms alone, the prehospital diagnosis of AHF can be challenging.[13–15] Studies on the accuracy of EMS

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Abbreviations

AHF: acute heart failure
EMS: emergency medical services
HF: heart failure

diagnosis and treatment of AHF found rates of error ranging from 9%[14] to 23%.[15] While EMS treatment overall seems to improve the survival of AHF patients,[13,16] erroneous diagnosis and treatment may on the other hand result in increased mortality rates.[16] The organization and structure of EMS vary amongst geographical regions and may include paramedics, technicians, nurses, and physicians. Therefore, studies on the performance of EMS treatment in AHF are difficult to compare. However, the interdisciplinary cooperation of EMS teams as well as a structured handover to the hospital physician is likely to be important in the emergency care of AHF. Further research is warranted to improve the prehospital management of AHF patients.

EMERGENCY DEPARTMENTS

Emergency providers play an important role in the management of patients with AHF, as patients commonly present to the emergency departments of local hospitals (either self-directed or via EMS). Indeed, most cases of HF are first diagnosed in hospital rather than in primary care.[17] More than 80% of emergency department patients with AHF are admitted to hospital, a proportion that has remained largely unchanged over the past 5 years.[8] It is crucial that emergency providers recognize the clinical presentation of AHF, as correct diagnosis is a prerequisite for successful treatment.[1] Studies show that therapeutic and management decisions made by emergency providers have a direct impact on morbidity, mortality, and hospital length of stay, all of which affect health care costs.[18–20] The accuracy of the diagnosis of AHF in emergency departments is reported to vary between 71%[21] and 95%.[22] Patients with AHF seen in high-volume emergency departments seem to have better outcomes than patients who present to low-volume emergency departments.[18] On the other hand, patients with AHF may also present after admission to any hospital ward, either as a consequence of another cardiovascular problem (eg, acute coronary syndrome/arrhythmia) or because they have cardiac disease complicating a noncardiac problem (eg, patients with hip fractures are often elderly and have hypertension and/or coronary disease) or as an iatrogenic complication (eg, excessive fluid replacement on surgical wards).

HOSPITAL CARDIOLOGISTS

Heart failure outcomes are better for patients when they are admitted under specialist cardiology medical staff or have specialist HF input into their care.[23–26] The first days following hospital admission are a high-risk period for the patient, when the diagnosis must be clarified or revisited, reversible factors addressed, evidence-based therapies started, comorbidities treated, and the post-discharge management planned. The European Society of Cardiology Heart Failure Association Standards for delivering HF care guideline therefore advises that all tertiary/teaching/university hospital referral centers should have an individual with a specific interest and expertise in HF among their cardiology staff/faculty. Ideally, 25% of the cardiology staff in tertiary/teaching/university hospital referral centers should have a HF remit.[27]

OTHER SPECIALISTS

Depending on the clinical presentation of the patient and the cause for AHF, a variety of in-hospital specialists may be involved in the comprehensive care of the patient (Table).

IN-HOSPITAL TRANSITIONS

Several transitions of care, such as emergency department to intensive care unit, intensive care unit to ward, and ward to home, often occur subsequent to discharge. These transitions are often associated with changes in the patient's medication: guideline-mandated treatments may be stopped or initiated and/or their doses or their mode of administration may be changed.[28] Any breakdown in communication during these in-hospital transitions commonly reflects on medication regimens and may adversely impact patient care.[29,30] Cessation or dose-reduction of guideline-indicated treatments is often intended only as a temporary measure but poor organization of care may fail to reinstate life-saving therapies after the acute problem has been solved.

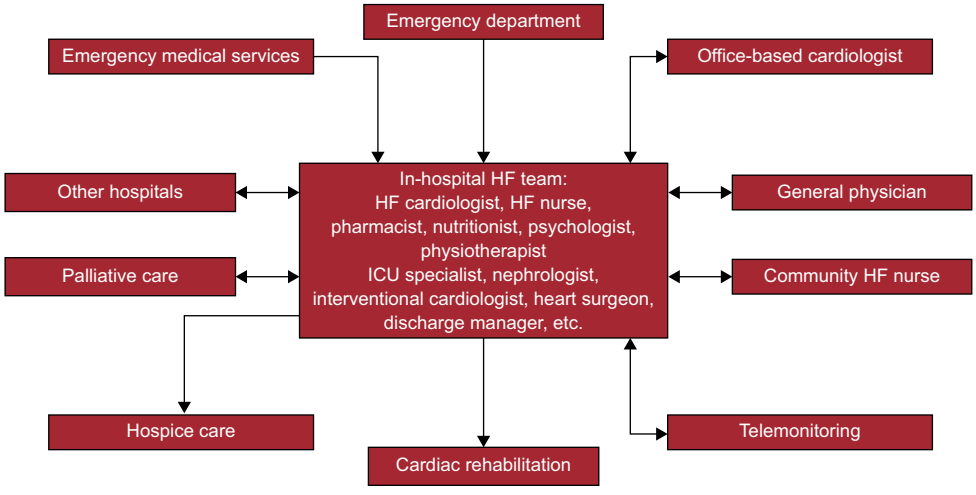

Figure. Multidisciplinary approach to heart failure. HF, heart failure; ICU, intensive care unit.

Table
In-hospital Specialists Involved in the Diagnosis and Treatment of Acute Heart Failure

Clinical finding	Expertise	Care
Hypotension/cardiogenic shock	Intensive medical care	Catecholamines, volume management, CPR
Respiratory insufficiency/gross peripheral edema (anasarca)		Forced diuresis, tap pleural effusion, (non)-invasive ventilation, hemo-/ultra-filtration, stop NSAID
Hemodynamic instability		Invasive monitoring
Arrhythmia		Cardioversion, pacing
	(Interventional) cardiology	Pacemaker/ICD
Acute myocardial infarction		Coronary reperfusion
Hypotension/cardiogenic shock		Mechanical circulatory support (IABP, Impella, ECMO, etc.)
Cardiac tamponade		Tap
Acute valvular disease		Valve replacement/repair
Acute myocardial infarction	Heart surgery	Coronary bypass
Acute ischemic ventricular rupture		Repair
Refractory heart failure		High urgent heart transplantation
		Assist device implantation (IABP, LVAD, BIVAD, etc.)
Acute renal failure (CRS type 1)	Nephrology	Pharmacotherapy, renal replacement therapy
Chronic kidney disease		
Severe hyper-/hypothyroidism	Endocrinology	Identification and treatment
Cachexia	Appropriate nutrition	Appropriate alimentation
Polypharmacy	Pharmacy	Medication reconciliation
Depression	Psychotherapy	Psychotherapy, medication
Weakness, immobilization, fatigue	Nursery, physiotherapy	Mobilization, physiotherapy, education
	Discharge management	Procurement of rehabilitation/home care/hospice care

BIVAD, biventricular assist device; CPR, cardiopulmonary resuscitation; CRS, cardiorenal syndrome; ECMO, extracorporal membrane oxygenation; IABP, intra-aortal balloon pump; ICD, implantable cardioverter defibrillator; LVAD, left ventricular assist device; NSAID, nonsteroidal anti-inflammatory drugs.

Transitioning between intravenous and oral diuretics also requires considerable experience. Prospective studies found that more than 50% of patients admitted to hospital had at least 1 unintended discrepancy between their chronic outpatient medication and their admission regimen.[29,31] Then again, medication reconciliation performed by clinical pharmacists may improve medication adherence.[32] In-hospital transitions contribute to longer lengths of stay and miscommunication. Care pathways should try to minimize the need for them. When in-hospital transitions occur, all staff involved need to communicate professionally to avoid unintentional erroneous treatment.

DISCHARGE MANAGEMENT

Once hospitalized for HF, the 30-day readmission rate approaches 25% to 50%.[33] Studies investigating the determinants of HF rehospitalizations have identified comorbidities and markers of HF severity as risk factors for HF readmissions.[34–36] In addition, patients with limited education and those with a foreign mother language are more likely to have poorer understanding of their condition and higher rates of 30-day readmissions.[37] Hospital-based disease management programs as well as nurse-led discharge planning reduce rehospitalization rates in HF patients. Unfortunately, interventions based primarily on patient education have been shown not to reduce readmission or mortality rates.[33,38–41] The National Heart Failure Audit for England and Wales enrolled more than 75 000 patients with a primary discharge diagnosis of HF. About half of patients were followed-up by a HF specialist team, which was associated with a substantially better outcome; 3-year mortality was 70% in those who did not receive specialist follow-up but only 50% in those who did.[42] An analysis of the Get With The Guidelines® program including 57 969 patients hospitalized with HF between 2005 and 2010 found that referral to a HF disease management program occurred in less than one-fifth of hospitalized HF patients. Paradoxically, patients with a worse prognosis were less likely to be referred.[43]

Thus, increasing the availability of HF disease management programs and optimizing selection for these programs might improve the quality and effectiveness of care. A well-orchestrated team of cardiologists, general practitioners, nurses, and ancillary support staff seems important for an integrated and seamless transition from inpatient care to the outpatient setting.[44]

NURSING STAFF

The role of the HF specialist nurse varies depending on the regional organization of medical care. It may involve home visits, telephone contact, facilitating telemonitoring, running nurse-led clinics, participating in cardiologist-led clinics, or a combination of these, as well as providing education for health professionals involved in the management of the patient.[45] The HF nursing service should function as a key link between secondary and primary care. Although the COACH study[46]—one of the largest randomized trials that compared disease management by a specialized HF nurse with standard follow-up by a cardiologist—did not show a reduction in the combined endpoints of death and HF hospitalization, other studies suggest that a HF nursing service may reduce morbidity and mortality.[47] In 2012, a systematic review performed by the Cochrane Collaboration concluded that there is good evidence that case management-type interventions led by a HF specialist nurse reduce HF-related 12-months readmissions, all-cause readmissions, and all-cause mortality in patients recently discharged after a hospital admission for HF.[47]

Geographical considerations and/or the needs of the patient population being cared for may make telephone-assisted

management or telemonitoring a useful method to improve the efficiency and effectiveness of the nursing team.[27] Although outcome data for remote monitoring are conflicting, the bulk of evidence points toward a benefit of home telemonitoring on mortality and a modest effect on hospitalization in patients with a recent HF hospitalization.[48,49] In contrast, well managed, stable chronic HF patients may not benefit from telemonitoring.[50–52] Another large randomized trial, the BEAT-HF study,[53] is ongoing. Its results may help to clarify the role of home telemonitoring in HF patients.

CARDIAC REHABILITATION

Bed-rest is appropriate for the patient with pulmonary or severe peripheral edema as it conserves blood flow to essential organs, reduces cardiac work, and improves diuresis. Once the patient has been stabilized, European guidelines advise early mobilization through an individualized exercise program after hospitalization for an exacerbation of HF to prevent further disability and lay good foundations for the formal exercise training plan.[54,55] In this early phase after decompensation, cardiac rehabilitation may include respiratory training, small muscle strength exercise, or simply increasing activities of daily living such as walking.[54,55] Cardiac rehabilitation may also include self-care counselling that targets improved education and skill development (eg, medication compliance, monitoring/management of body weight). When clinical stabilization is achieved, exercise-based rehabilitation reduces the risk of hospital admissions and confers important improvements in health-related quality of life.[56,57] As a universal agreement on exercise prescription in HF does not exist, an individualized approach is recommended, with careful clinical evaluation, including behavioral characteristics, personal goals, and preferences.[54]

PRIMARY CARE

A robust HF management program must include the primary care physician as an important member of the multiprofessional team. Primary care physicians are often the first port of call for patients who have new or worsening symptoms/signs potentially due to HF. They play an essential role in titrating and monitoring guideline-indicated therapy and a key role in terminal care at home.[27] In some countries, office-based cardiologists may also be involved in the HF team. The comanagement of HF patients by a primary care physician and a cardiologist has been shown to reduce both all-cause mortality and hospitalizations for AHF when compared with HF patients managed solely by primary care physicians.[58,59] This may be explained by more effective implementation of target doses of medication and timely device implantation.[60,61] Patients cared for by physicians that see only a few patients with HF may have worse outcomes,[62] although this might be partly explained by differences in the sorts of patients managed by general physicians rather than cardiologists.[63]

PALLIATIVE CARE

Heart failure guidelines indicate that palliative care should be integrated into the overall provision of care for patients with HF.[1] The American Center to Advance Palliative Care defines subspecialty palliative care as follows[64]: "Specialized medical care for people with serious illnesses. This type of care is focused on providing patients with relief from the symptoms, pain, and stress of a serious illness–whatever the diagnosis or prognosis. The goal is to improve quality of life for both the patient and the family. Palliative care is delivered by a team of doctors, nurses, and other specialists who work with the patient's doctors to provide an extra layer of support". Thus, palliative care is appropriate at any stage in a serious illness and can be provided together with curative treatment.[65] Although studies show that palliative care improves quality of life and morbidity of HF patients,[66–68] few patients with HF receive care from palliative care specialists.[69–71] A recently published study explored barriers to palliative care referrals in HF from cardiology and primary care providers.[72] Identified barriers included lack of knowledge about the field of palliative care, lack of appropriate triggers for referral, and discomfort with the term palliative care. Future work should seek to develop provider–and patient–centred interventions to reduce actionable barriers to palliative care uptake in HF.

HOSPICE CARE

A hospice uses an interdisciplinary approach to deliver medical, social, physical, emotional, and spiritual services through the use of a broad spectrum of caregivers within a defined time frame at the end of life.[73] The Centers for Medicare and Medicaid Services definition of hospice is: "Care that allows the terminally ill patient to remain at home as long as possible by providing support to the patient and family and keeping the patient as comfortable as possible while maintaining his or her dignity and quality of life".[73] While hospice care was initially geared only towards the care of patients with cancer, any terminal illness with less than 6-month predicted survival currently qualifies for its institution.

Although heart disease is the leading cause of death in Western countries, there is a lingering disparity between the use of hospice and palliative services in patients with advanced HF compared with cancer. Of 58 330 patients aged $\geq$ 65 years participating in the Get With The Guidelines® HF program, only 2.5% were discharged to a hospice.[74] In 2012, only 11.4% of United States hospice patients had a primary diagnosis of heart disease.[75] In addition, it was estimated that only between 11% and 39% of patients who died of advanced HF were enrolled in hospice programs.[76–78] Heart failure patients entering hospice care have multiple symptoms requiring management, many of which cause considerable distress.[79] Noteworthy is the finding that symptoms with the greatest reported severity were not necessarily those causing the greatest distress, as well as the relationship between symptom distress and depressive symptoms.[79] Clinicians in hospices may consider specifically focusing part of their assessment and management by first addressing symptom severity and distress.

PATIENTS

Treatment of HF is complex, requiring attention to diet, lifestyle, complex therapeutic regimens, and device therapy. In daily clinical life, many patients have difficulties adopting complex care regimens and adherence to evidence-based regimens remains low. Therefore, facilitating a more active role for patients in self-management of long-term medical conditions is an essential component of good clinical care. Patients may be considered the largest health care workforce available.[80] There is, however, conflicting evidence as to the potential benefits of patient education and self-management on hospitalization rates and mortality.[80–83] In the HART study,[82] self-management counselling plus HF education did not reduce the primary endpoint of death or HF hospitalization compared with HF education alone in 902 patients with mild to moderate HF. In contrast, formal education and support intervention was shown by others[81,83]

to reduce adverse clinical outcomes and costs for patients with HF, while it had positive effects on quality of life, exercise capacity, and plasma concentrations of cardiac peptides.

MULTIDISCIPLINARY APPROACH

Current HF guidelines recommend that HF patients are enrolled in a multidisciplinary-care management program to reduce the risk of HF hospitalization.[1] A multidisciplinary approach to HF may reduce costs,[84] decrease length of stay,[85–88] curtail readmissions,[86–95] improve compliance,[90,96,97] and reduce mortality.[91,92,94,96,98] An important limitation, however, is the substantial heterogeneity in both the terms of the models of care and the interventions offered, including: clinic or community-based systems of care, remote management, and enhanced patient self-care.[27]

A meta-analysis of 30 trials (7532 patients) on multidisciplinary interventions in HF found that all-cause hospital admission rates, HF admission rates and all-cause mortality were reduced by 14%, 30%, and 20%, respectively.[92] The positive effects, however, varied with respect to the intervention applied: provision of home visits reduced all-cause admissions but not all-cause mortality, whereas telephone follow-up did not influence hospital admissions but reduced all-cause mortality. Hospital/clinic interventions, in contrast, had no impact on either all-cause hospitalization or all-cause mortality. Another review of 29 randomized trials (5039 patients) on multiprofessional strategies for the management of HF patients reported that follow-up by a specialized multidisciplinary team (either in a clinic or a nonclinic setting) reduced mortality, HF hospitalizations, and all-cause hospitalizations, while programs that focused on enhancing patient self-care activities reduced HF hospitalizations and all-cause hospitalizations but had no effect on mortality.[94] Strategies that employed telephone contact and advised patients to attend their primary care physician in the event of deterioration reduced HF hospitalizations but not mortality or all-cause hospitalizations.

Thus, there remains considerable uncertainty about which components of multidisciplinary HF care are most important. For example, are beneficial effects mediated through more aggressive medication titration (as proposed by Mao et al[91]), or through enhanced surveillance? Conventional trials that randomize individual patients may not be the best way to test the effect of a service; novel approaches, such as the cluster randomized controlled trial, may be superior.[49]

It is unlikely that any one approach is optimal. The best form of care might seek to compensate for the weaknesses of each approach by exploiting their strengths. A strong HF cardiology lead, supported by primary care physicians, nurse specialists, and pharmacists in the hospital and community with the ability to offer patients remote support might offer the best service.

Key to the success of multidisciplinary HF programs may be the coordination of care along the spectrum of severity of HF and throughout the chain-of-care delivered by the various services within the healthcare system.[1] Further research is warranted to identify the most efficacious multidisciplinary approaches to AHF.

CONFLICTS OF INTEREST

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REFERENCES

1. McMurray JJ, Adamopoulos S, Anker SD, Auricchio A, Bohm M, Dickstein K, et al. ESC guidelines for the diagnosis and treatment of acute and chronic heart failure 2012: The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC. Eur J Heart Fail. 2012;14:803–69.
2. Prekker ME, Feemster LC, Hough CL, Carlbom D, Crothers K, Au DH, et al. The epidemiology and outcome of prehospital respiratory distress. Acad Emerg Med. 2014;21:543–50.
3. Burri E, Hochholzer K, Arenja N, Martin-Braschler H, Kaestner L, Gekeler H, et al. B-type natriuretic peptide in the evaluation and management of dyspnoea in primary care. J Intern Med. 2012;272:504–13.
4. Gheorghiade M, Shah A, Vaduganathan M, Butler J, Bonow RO, Taylor S, et al. Recognizing hospitalized heart failure as an entity and developing new therapies to improve outcomes: academics', clinicians', industry's, regulators', and payers' perspectives. Heart Fail Clin. 2013;9:285–90.
5. Shoaib A, Waleed M, Khan S, Raza A, Zuhair M, Kassianides X, et al. Breathlessness at rest is not the dominant presentation of patients admitted with heart failure. Eur J Heart Fail. 2014;16:1283–91.
6. De Giuli F, Khaw KT, Cowie MR, Sutton GC, Ferrari R, Poole-Wilson PA. Incidence and outcome of persons with a clinical diagnosis of heart failure in a general practice population of 696,884 in the United Kingdom. Eur J Heart Fail. 2005;7:295–302.
7. Hall MJ, DeFrances CJ, Williams SN, Golosinskiy A, Schwartzman A. National Hospital Discharge Survey: 2007 summary. Natl Health Stat Report. 2010; 1–20. 24.
8. Storrow AB, Jenkins CA, Self WH, Alexander PT, Barrett TW, Han JH, et al. The burden of acute heart failure on U.S. emergency departments. JACC Heart Fail. 2014;2:269–77.
9. Collins SP, Storrow AB, Levy PD, Albert N, Butler J, Ezekowitz JA, et al. Early management of patients with acute heart failure: state of the art and future directions-a consensus document from the SAEM/HFSA Acute Heart Failure Working Group. Acad Emerg Med. 2015;22:94–112.
10. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al. Heart disease and stroke statistics - 2014 update: a report from the American Heart Association. Circulation. 2014;129:e28–292.
11. Torabi A, Cleland JG, Khan NK, Loh PH, Clark AL, Alamgir F, et al. The timing of development and subsequent clinical course of heart failure after a myocardial infarction. Eur Heart J. 2008;29:859–70.
12. Schoos MM, Sejersten M, Baber U, Treschow PM, Madsen M, Hvelplund A, et al. Outcomes of patients calling emergency medical services for suspected acute cardiovascular disease. Am J Cardiol. 2015;115:13–20.
13. Shapiro SE. Evidence review: emergency medical services treatment of patients with congestive heart failure/acute pulmonary edema: do risks outweigh benefits? J Emerg Nurs. 2005;31:51–7. quiz 118-9..
14. Rottman SJ, Schriger DL, Charlop G, Salas JH, Lee S. On-line medical control versus protocol-based prehospital care. Ann Emerg Med. 1997;30:62–8.
15. Hoffman JR, Reynolds S. Comparison of nitroglycerin, morphine and furosemide in treatment of presumed pre-hospital pulmonary edema. Chest. 1987;92: 586–93.
16. Wuerz RC, Meador SA. Effects of prehospital medications on mortality and length of stay in congestive heart failure. Ann Emerg Med. 1992;21:669–74.
17. Cowie MR, Wood DA, Coats AJ, Thompson SG, Poole-Wilson PA, Suresh V, et al. Incidence and aetiology of heart failure: a population based study. Eur Heart J. 1999;20:421–8.
18. Brar S, McAlister FA, Youngson E, Rowe BH. Do outcomes for patients with heart failure vary by emergency department volume? Circ Heart Fail. 2013;6: 1147–54.
19. Rame JE, Sheffield MA, Dries DL, Gardner EB, Toto KH, Yancy CW, et al. Outcomes after emergency department discharge with a primary diagnosis of heart failure. Am Heart J. 2001;142:714–9.
20. Singer AJ, Birkhahn RH, Guss D, Chandra A, Miller CD, Tiffany B, et al. Rapid Emergency Department Heart Failure Outpatients Trial (REDHOT II): a randomized controlled trial of the effect of serial B-type natriuretic peptide testing on patient management. Circ Heart Fail. 2009;2:287–93.
21. Collins SP, Lindsell CJ, Yealy DM, Maron DJ, Naftilan AJ, McPherson JA, et al. A comparison of criterion standard methods to diagnose acute heart failure. Congest Heart Fail. 2012;18:262–71.
22. Seronde MF, Laribi S, Collins SP, Deye N, Logeart D, Plaisance P, et al. Heart failure diagnosis in acute conditions has high agreement with inpatient diagnosis. Eur J Emerg Med. 2015. http://dx.doi.org/10.1097/MEJ.0000000000000247..
23. Reis SE, Holubkov R, Edmundowicz D, McNamara DM, Zell KA, Detre KM, et al. Treatment of patients admitted to the hospital with congestive heart failure: specialty-related disparities in practice patterns and outcomes. J Am Coll Cardiol. 1997;30:733–8.
24. Uthamalingam S, Kandala J, Selvaraj V, Martin W, Daley M, Patvardhan E, et al. Outcomes of patients with acute decompensated heart failure managed by cardiologists versus noncardiologists. Am J Cardiol. 2015;115:466–71.
25. Foody JM, Rathore SS, Wang Y, Herrin J, Masoudi FA, Havranek EP, et al. Physician specialty and mortality among elderly patients hospitalized with heart failure. Am J Med. 2005;118:1120–5.

26. Jong P, Gong Y, Liu PP, Austin PC, Lee DS, Tu JV. Care and outcomes of patients newly hospitalized for heart failure in the community treated by cardiologists compared with other specialists. Circulation. 2003;108:184–91.
27. McDonagh TA, Blue L, Clark AL, Dahlstrom U, Ekman I, Lainscak M, et al. European Society of Cardiology Heart Failure Association Standards for delivering heart failure care. Eur J Heart Fail. 2011;13:235–41.
28. Kripalani S, Jackson AT, Schnipper JL, Coleman EA. Promoting effective transitions of care at hospital discharge: a review of key issues for hospitalists. J Hosp Med. 2007;2:314–23.
29. Cornish PL, Knowles SR, Marchesano R, Tam V, Shadowitz S, Juurlink DN, et al. Unintended medication discrepancies at the time of hospital admission. Arch Intern Med. 2005;165:424–9.
30. Gleason KM, Groszek JM, Sullivan C, Rooney D, Barnard C, Noskin GA. Reconciliation of discrepancies in medication histories and admission orders of newly hospitalized patients. Am J Health Syst Pharm. 2004;61:1689–95.
31. Armor BL, Wight AJ, Carter SM. Evaluation of adverse drug events and medication discrepancies in transitions of care between hospital discharge and primary care follow-up. J Pharm Pract. 2014. http://dx.doi.org/10.1177/0897190014549836.
32. Leguelinel-Blache G, Arnaud F, Bouvet S, Dubois F, Castelli C, Roux-Marson C, et al. Impact of admission medication reconciliation performed by clinical pharmacists on medication safety. Eur J Intern Med. 2014;25:808–14.
33. Adib-Hajbaghery M, Maghaminejad F, Abbasi A. The role of continuous care in reducing readmission for patients with heart failure. J Caring Sci. 2013;2:255–67.
34. Corrao G, Ghirardi A, Ibrahim B, Merlino L, Maggioni AP. Short- and long-term mortality and hospital readmissions among patients with new hospitalization for heart failure: a population-based investigation from Italy. Int J Cardiol. 2015;181. 81-7.
35. Setoguchi M, Hashimoto Y, Sasaoka T, Ashikaga T, Isobe M. Risk factors for rehospitalization in heart failure with preserved ejection fraction compared with reduced ejection fraction. Heart Vessels. 2014. http://dx.doi.org/10.1007/s00380-014-0532-5.
36. Anderson KM. Discharge clinical characteristics and 60-day readmission in patients hospitalized with heart failure. J Cardiovasc Nurs. 2014;29:232–41.
37. Regalbuto R, Maurer MS, Chapel D, Mendez J, Shaffer JA. Joint Commission requirements for discharge instructions in patients with heart failure: is understanding important for preventing readmissions? J Card Fail. 2014;20:641–9.
38. Berkowitz R, Blank LJ, Powell SK. Strategies to reduce hospitalization in the management of heart failure. Lippincotts Case Manag. 2005;10(6 Suppl):S1–15. quiz S16-7.
39. Lambrinou E, Kalogirou F, Lamnisos D, Sourtzi P. Effectiveness of heart failure management programmes with nurse-led discharge planning in reducing re-admissions: a systematic review and meta-analysis. Int J Nurs Stud. 2012;49:610–24.
40. White SM, Hill A. A heart failure initiative to reduce the length of stay and readmission rates. Prof Case Manag. 2014;19:276–84.
41. Feltner C, Jones CD, Cene CW, Zheng ZJ, Sueta CA, Coker-Schwimmer EJ, et al. Transitional care interventions to prevent readmissions for persons with heart failure: a systematic review and meta-analysis. Ann Intern Med. 2014;160:774–84.
42. Cleland J, Dargie H, Hardman S, McDonagh T, Mitchell P. National Heart Failure Audit: April 2012-March 2012. London: National Institute for Cardiovascular Outcomes Research; 2013. Available at: http://www.ucl.ac.uk/nicor/audits/heartfailure/documents/annualreports/hfannual12-13.pdf
43. Gharacholou SM, Hellkamp AS, Hernandez AF, Peterson ED, Bhatt DL, Yancy CW, et al. Use and predictors of heart failure disease management referral in patients hospitalized with heart failure: insights from the Get With the Guidelines Program. J Card Fail. 2011;17:431–9.
44. Amin A. Who is managing acute decompensated heart failure?.The need for a multidisciplinary approach. J Hosp Med. 2008;3(6 Suppl):S1–6.
45. Rasmusson K, Flattery M, Baas LS. American Association of Heart Failure Nurses position paper on educating patients with heart failure. Heart Lung. 2015;44:173–7.
46. Jaarsma T, Van der Wal MH, Lesman-Leegte I, Luttik ML, Hogenhuis J, Veeger NJ, et al. Effect of moderate or intensive disease management program on outcome in patients with heart failure: Coordinating Study Evaluating Outcomes of Advising and Counseling in Heart Failure (COACH). Arch Intern Med. 2008;168:316–24.
47. 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.
48. Dierckx R, Pellicori P, Cleland JG, Clark AL. Telemonitoring in heart failure: Big Brother watching over you. Heart Fail Rev. 2015;20:107–16.
49. Steventon A, Bardsley M, Billings J, Dixon J, Doll H, Hirani S, et al. Effect of telehealth on use of secondary care and mortality: findings from the Whole System Demonstrator cluster randomised trial. BMJ. 2012;344:e3874.
50. Vuorinen AL, Leppanen J, Kaijanranta H, Kulju M, Helio T, van Gils M, et al. Use of home telemonitoring to support multidisciplinary care of heart failure patients in Finland: randomized controlled trial. J Med Internet Res. 2014;16:e282.
51. Koehler F, Winkler S, Schieber M, Sechtem U, Stangl K, Bohm M, et al. Impact of remote telemedical management on mortality and hospitalizations in ambulatory patients with chronic heart failure: the telemedical interventional monitoring in heart failure study. Circulation. 2011;123:1873–80.
52. Blum K, Gottlieb SS. The effect of a randomized trial of home telemonitoring on medical costs, 30-day readmissions, mortality, and health-related quality of life in a cohort of community-dwelling heart failure patients. J Card Fail. 2014;20:513–21.
53. Black JT, Romano PS, Sadeghi B, Auerbach AD, Ganiats TG, Greenfield S, et al. A remote monitoring and telephone nurse coaching intervention to reduce readmissions among patients with heart failure: study protocol for the Better Effectiveness After Transition - Heart Failure (BEAT-HF) randomized controlled trial. Trials. 2014;15:124.
54. Piepoli MF, Conraads V, Corra U, Dickstein K, Francis DP, Jaarsma T, et al. Exercise training in heart failure: from theory to practice. A consensus document of the Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation. Eur J Heart Fail. 2011;13:347–57.
55. Achttien RJ, Staal JB, Van der Voort S, Kemps HM, Koers H, Jongert MW, et al. Exercise-based cardiac rehabilitation in patients with chronic heart failure: a Dutch practice guideline. Neth Heart J. 2015;23:6–17.
56. Taylor RS, Sagar VA, Davies EJ, Briscoe S, Coats AJ, Dalal H, et al. Exercise-based rehabilitation for heart failure. Cochrane Database Syst Rev. 2014;4:CD003331.
57. Lewinter C, Doherty P, Gale CP, Crouch S, Stirk L, Lewin RJ, et al. Exercise-based cardiac rehabilitation in patients with heart failure: a meta-analysis of randomised controlled trials between 1999 and. Eur J Prev Cardiol. 2014. http://dx.doi.org/10.1177/2047487314559853.
58. Diller PM, Smucker DR, David B. Comanagement of patients with congestive heart failure by family physicians and cardiologists: frequency, timing, and patient characteristics. J Fam Pract. 1999;48:188–95.
59. Ezekowitz JA, Van Walraven C, McAlister FA, Armstrong PW, Kaul P. Impact of specialist follow-up in outpatients with congestive heart failure. CMAJ. 2005;172:189–94.
60. Chou CY, Chen TJ, Chiang SC, Chen YC, Cheng MH, Yang YC, et al. Disparity of physician specialties in the management of chronic heart failure: trend analysis in Taiwan, 2000-2010. Int J Clin Pharmacol Ther. 2013;51:678–87.
61. Tebbe U, Tschope C, Wirtz JH, Lokies J, Turgonyi E, Bramlage P, et al. Registry in Germany focusing on level-specific and evidence-based decision finding in the treatment of heart failure: REFLECT-HF. Clin Res Cardiol. 2014;103:665–73.
62. Joynt KE, Orav EJ, Jha AK. Physician volume, specialty, and outcomes of care for patients with heart failure. Circ Heart Fail. 2013;6:890–7.
63. Román-Sánchez P, Conthe P, García-Alegría J, Forteza-Rey J, Montero M, Montoto C. Factors influencing medical treatment of heart failure patients in Spanish internal medicine departments: a national survey. QJM. 2005;98:127–38.
64. Center to Advance Palliative Care (CAPC). Available at: www.capc.org.
65. Lemond L, Allen LA. Palliative care and hospice in advanced heart failure. Prog Cardiovasc Dis. 2011;54:168–78.
66. Brannstrom M, Boman K. Effects of person-centred and integrated chronic heart failure and palliative home care. PREFER: a randomized controlled study. Eur J Heart Fail. 2014;16:1142–51.
67. Sidebottom AC, Jorgenson A, Richards H, Kirven J, Sillah A. Inpatient palliative care for patients with acute heart failure: outcomes from a randomized trial. J Palliat Med. 2015;18:134–42.
68. Pattenden JF, Mason AR, Lewin RJ. Collaborative palliative care for advanced heart failure: outcomes and costs from the 'Better Together' pilot study. BMJ Support Palliat Care. 2013;3:69–76.
69. Greener DT, Quill T, Amir O, Szydlowski J, Gramling RE. Palliative care referral among patients hospitalized with advanced heart failure. J Palliat Med. 2014;17:1115–20.
70. Cheang MH, Rose G, Cheung CC, Thomas M. Current challenges in palliative care provision for heart failure in the UK: a survey on the perspectives of palliative care professionals. Open Heart. 2015;2:e000188.
71. Gadoud A, Kane E, Macleod U, Ansell P, Oliver S, Johnson M. Palliative care among heart failure patients in primary care: a comparison to cancer patients using English family practice data. PLoS One. 2014;9:e113188.
72. Kavalieratos D, Mitchell EM, Carey TS, Dev S, Biddle AK, Reeve BB, et al. "Not the 'grim reaper service'": an assessment of provider knowledge, attitudes, and perceptions regarding palliative care referral barriers in heart failure. J Am Heart Assoc. 2014;3:e000544.
73. Centers for Medicare & Medicaid Services (CMS), HHS. Medicare and Medicaid programs: hospice conditions of participation. Final rule Fed Regist. 2008;73:32087–220.
74. Whellan DJ, Cox M, Hernandez AF, Heidenreich PA, Curtis LH, Peterson ED, et al. Utilization of hospice and predicted mortality risk among older patients hospitalized with heart failure: findings from GWTG-HF. J Card Fail. 2012;18:471–7.
75. NHPCO Facts and Figures: Hospice Care in America. Alexandria, Virginia: National Hospice and Palliative Care Organization; 2013.
76. Wingate SJ, Goodlin SJ. Where's the data: heart failure admissions to hospice. J Card Fail. 2006;12(6 Suppl):S124.
77. Blecker S, Anderson GF, Herbert R, Wang NY, Brancati FL. Hospice care and resource utilization in Medicare beneficiaries with heart failure. Med Care. 2011;49:985–91.
78. Unroe KT, Greiner MA, Hernandez AF, Whellan DJ, Kaul P, Schulman KA, et al. Resource use in the last 6 months of life among Medicare beneficiaries with heart failure, 2000-2007. Arch Intern Med. 2011;171:196–203.
79. Wilson J, McMillan S. Symptoms experienced by heart failure patients in hospice care. J Hosp Palliat Nurs. 2013;15:13–21.
80. Cleland JG, Ekman I. Enlisting the help of the largest health care workforce—patients. JAMA. 2010;304:1383–4.
81. Krumholz HM, Amatruda J, Smith GL, Mattera JA, Roumanis SA, Radford MJ, et al. Randomized trial of an education and support intervention to prevent readmission of patients with heart failure. J Am Coll Cardiol. 2002;39:83–9.

82. Powell LH, Calvin Jr JE, Richardson D, Janssen I, Mendes de Leon CF, Flynn KJ, et al.; HART Investigators. Self-management counseling in patients with heart failure: the heart failure adherence and retention randomized behavioral trial. JAMA. 2010;304:1331–8.
83. Lycholip E, Celutkiene J, Rudys A, Steponeniene R, Laucevicius A. Patient education significantly improves quality of life, exercise capacity and BNP level in stable heart failure patients. Acta Cardiol. 2010;65:549–56.
84. Wijeysundera HC, Machado M, Wang X, Van Der Velde G, Sikich N, Witteman W, et al. Cost-effectiveness of specialized multidisciplinary heart failure clinics in Ontario. Canada Value Health. 2010;13:915–21.
85. Dusemund F, Steiner M, Vuilliomenet A, Muller C, Bossart R, Regez K, et al. Multidisciplinary Assessment to Personalize Length of Stay in Acute Decompensated Heart Failure (OPTIMA II ADHF). J Clin Med Res. 2012;4:402–9.
86. Martineau P, Frenette M, Blais L, Sauve C. Multidisciplinary outpatient congestive heart failure clinic: impact on hospital admissions and emergency room visits. Can J Cardiol. 2004;20:1205–11.
87. Sochalski J, Jaarsma T, Krumholz HM, Laramee A, McMurray JJ, Naylor MD, et al. What works in chronic care management: the case of heart failure. Health Aff (Millwood). 2009;28:179–89.
88. Ducharme A, Doyon O, White M, Rouleau JL, Brophy JM. Impact of care at a multidisciplinary congestive heart failure clinic: a randomized trial. CMAJ. 2005;173:40–5.
89. Jain R, Evenson A, Jain R, Biddison E, Dalal D, Kelly KM, et al. Efficacy of multidisciplinary outpatient management (MOM) program in long term heart failure care. South Med J. 2010;103:131–7.
90. Smith CE, Piamjariyakul U, Wick JA, Spertus JA, Russell C, Dalton KM, et al. Multidisciplinary group clinic appointments: the Self-Management and Care of Heart Failure (SMAC-HF) trial. Circ Heart Fail. 2014;7:888–94.
91. Mao CT, Liu MH, Hsu KH, Fu TC, Wang JS, Huang YY, et al. Effect of multidisciplinary disease management for hospitalized heart failure under a national health insurance programme. J Cardiovasc Med (Hagerstown). 2014. http://dx.doi.org/10.2459/JCM.0000000000000089.
92. Holland R, Battersby J, Harvey I, Lenaghan E, Smith J, Hay L. Systematic review of multidisciplinary interventions in heart failure. Heart. 2005;91:899–906.
93. Gwadry-Sridhar FH, Flintoft V, Lee DS, Lee H, Guyatt GH. A systematic review and meta-analysis of studies comparing readmission rates and mortality rates in patients with heart failure. Arch Intern Med. 2004;164:2315–20.
94. McAlister FA, Stewart S, Ferrua S, McMurray JJ. Multidisciplinary strategies 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.
95. Knox D, Mischke L. Implementing a congestive heart failure disease management program to decrease length of stay and cost. J Cardiovasc Nurs. 1999;14:55–74.
96. Gattis WA, Hasselblad V, Whellan DJ, O'Connor CM. Reduction in heart failure events by the addition of a clinical pharmacist to the heart failure management team: results of the Pharmacist in Heart Failure Assessment Recommendation and Monitoring (PHARM) study. Arch Intern Med. 1999;159:1939–45.
97. Kasper EK, Gerstenblith G, Hefter G, Van Anden E, Brinker JA, Thiemann DR, et al. A randomized trial of the efficacy of multidisciplinary care in heart failure outpatients at high risk of hospital readmission. J Am Coll Cardiol. 2002;39:471–80.
98. Wijeysundera HC, Trubiani G, Wang X, Mitsakakis N, Austin PC, Ko DT, et al. A population-based study to evaluate the effectiveness of multidisciplinary heart failure clinics and identify important service components. Circ Heart Fail. 2013;6:68–75.