

NEIGHBORHOOD HEALTH PLAN OF RHODE ISLAND	
Section: Clinical Practice Guideline	Subject: Diagnosis and Management of Adult Heart Failure (HF)
Effective: November 13, 2008	Updated: 10/10

RATIONALE

Heart failure (HF) is a major and growing public health problem; it is the primary reason for 12-15 million office visits and 6.5 million hospital days each year. It is estimated that in 2005 the total direct and indirect cost of HF in the U.S. was \$27.9 billion. HF is primarily a condition of the elderly and is a syndrome characterized by high mortality, frequent hospitalization, reduced quality of life, and a complex therapeutic regimen. Knowledge about HF is accumulating so rapidly that individual clinicians may be unable to readily and adequately synthesize new information into effective strategies of care for patients with this syndrome. Trial data, though valuable, often do not give direction for individual patient management. These characteristics make heart failure an ideal candidate for practice guidelines. This guideline attempts to define practices that meet the needs of most patients in most circumstances. The ultimate judgment regarding care of a particular patient must be made by the healthcare provider and patient in light of all the circumstances presented by that patient.

DEFINITION

Heart failure is a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood. The cardinal manifestations of HF are

- dyspnea and fatigue, which may limit exercise tolerance, and
- fluid retention, which may lead to pulmonary congestion and peripheral edema.

Because not all patients have volume overload at the time of initial or subsequent evaluation, the term “heart failure” is preferred over the older term “congestive heart failure.”

The majority of patients with HF have symptoms due to an impairment of left ventricular (LV) myocardial function. LV dysfunction begins with some injury to, or stress on, the myocardium and is generally a progressive process, even in the absence of a new insult to the heart. Coronary artery disease, hypertension, dilated cardiomyopathy, and valvular heart disease are the common causes of HF; however, nearly any form of heart disease may ultimately lead to the HF syndrome. There is no single diagnostic test for HF because it is largely a clinical diagnosis that is based on a careful history and physical examination.

CLASSIFICATION OF HF Stages

This guideline identifies four stages in the development of the HF syndrome. The first two stages are clearly not HF but are an attempt to help healthcare providers identify patients early who are at risk for developing HF.

- Stage A – patients with risk factors that predispose toward the development of HF (e.g. coronary artery disease, hypertension, diabetes mellitus) with no HF symptoms or demonstrable impaired LV function or LV hypertrophy
- Stage B – asymptomatic patients with risk factors as above who demonstrate LV hypertrophy and/or impaired LV function.
- Stage C – patients with current or past symptoms of HF associated with underlying structural heart disease
- Stage D – patients with refractory HF

This classification recognizes that there are established risk factors and structural prerequisites for the development of HF and that **therapeutic interventions introduced even before the appearance of LV dysfunction or symptoms can reduce the population morbidity and mortality of HF.**

Functional (symptom) classification

The following classification¹ for patients with symptomatic (*i.e.* stage C or D) HF depends on the degree of effort needed by patients to elicit HF symptoms:

- Class I – asymptomatic symptoms only at levels of exertion that would limit normal individuals
- Class II – symptoms with ordinary moderate exertion
- Class III – symptoms with mild less-than-ordinary exertion
- Class IV – symptoms at rest

The severity of symptoms characteristically fluctuates even in the absence of changes in medications, and changes in medications and diet can have either favorable or adverse effects on functional capacity in the absence of measurable changes in ventricular function. **INITIAL ASSESSMENT OF**

PATIENTS WITH HF

Patients usually present in 1 of 3 ways:

- With a syndrome of decreased effort tolerance due to dyspnea and/or fatigue
- With a syndrome of fluid retention
- With no symptoms or symptoms of another disorder (*i.e.* evidence of HF an incidental finding).

A thorough history and physical examination should be obtained/performed in patients presenting with HF to identify cardiac and noncardiac disorders or behaviors that might cause or accelerate the development or progression of HF.

Medical History

An initial medical history should include:

- history of known HF risk factors (e.g. coronary artery disease, hypertension, diabetes mellitus)
- current and past use of alcohol, illicit drugs, current or past standard or “alternative therapies,” and chemotherapy drugs
- smoking history
- current ability to perform routine activities of daily living
- history of other heart disease (rheumatic, heart murmur or congenital heart disease, valvular disease, myopathy) or mediastinal irradiation
- family history of cardiac disease (e.g. MIs, strokes, cardiomyopathy)

Physical examination

A careful physical exam should include:

- specific signs of right or left HF (especially presence of elevated jugular venous pressure and a third heart sound)
- weight, height, calculation of body mass index (BMI)
- assessment of volume status and /or orthostatic blood pressure changes
- evidence of noncardiac diseases (collagen vascular disease, infection, obesity, thyroid disease, pheochromocytoma, amyloidosis)

Laboratory testing

Laboratory testing may reveal the presence of disorders or conditions that can lead to or exacerbate HF. The following tests are recommended at the initial evaluation:

- routine blood work (CBC, UA, serum electrolytes (including calcium and magnesium), FBS, lipid profile, BUN, creatinine, LFTs)
- chest radiograph
- 12-lead electrocardiogram
- Thyroid function tests, especially TSH

¹ New York Heart Association functional classification

- Other specific screening tests for diagnoses suspected by history and/or physical exam (hemochromatosis, sleep-disturbed breathing, HIV, rheumatologic diseases, amyloidosis, pheochromocytoma)
- Measurement of natriuretic peptides (B-type natriuretic peptide/BNP and N-terminal pro-B-type natriuretic peptide/NT-proBNP)
 - can be useful in evaluation of patients in the urgent care setting when clinical diagnosis of HF is uncertain.
 - can be useful in risk stratification of HF.

Other diagnostic testing

Although the history and physical examination may provide important clues about the nature of the underlying cardiac abnormality, identification of the structural abnormality leading to HF generally requires invasive or noninvasive imaging of the cardiac chambers or great vessels.

- **Two-dimensional echocardiography with Doppler (the single most useful diagnostic test)** should be performed during initial evaluation of patients presenting with HF to assess
 - LV Ejection Fraction/LVEF (preserved or reduced)
 - LV size (normal or abnormal)
 - wall thickness
 - valve function.
- **Radionuclide ventriculography** can be performed to assess LVEF and volumes. This older more expensive technique can be used for select patients in whom a diagnostic echo can not be obtained
- **Coronary arteriography** to evaluate the possibility of coronary artery disease (CAD) should be performed
 - in patients presenting with HF who have angina or significant ischemia unless the patient is not eligible for revascularization of any kind and is reasonable
 - in patients presenting with HF who have chest pain of unknown origin who have not had evaluation of their coronary anatomy and who have no contraindications to coronary revascularization and/or
 - in patients presenting with HF who have known or suspected CAD but do not have angina unless the patient is not eligible for revascularization of any kind.
- **Noninvasive imaging** to detect myocardial ischemia and viability is reasonable in patients who have known CAD and no angina unless the patient is not eligible for revascularization of any kind..
- **Maximal exercise testing**
 - with or without measurement of respiratory gas exchange and/or blood oxygen saturation is reasonable to help determine whether HF is the cause of exercise limitation when the contribution of HF is uncertain
 - with measurement of respiratory gas exchange is reasonable to identify high-risk patients who are candidates for cardiac transplantation or other advanced treatments.
- **Endomyocardial biopsy** can be useful in patients presenting with HF when a specific diagnosis is suspected that would influence therapy.

ONGOING ASSESSMENT OF PATIENTS WITH HF

Clinical assessment should be made at each visit of

- ability to perform routine and desired activities of daily living
- history of current
 - use of alcohol, tobacco, and illicit drugs
 - use of “alternative therapies”
 - use of chemotherapy drugs

- diet and sodium intake
- volume status, including
 - weight,
 - sitting and standing BP,
 - degree of jugular venous distension and its response to abdominal pressure
 - presence of pulmonary rales and/or hepatomegaly,
 - magnitude of peripheral edema (extremities, scrotum, presacral, and or abdomen including ascites)

Laboratory assessment should include

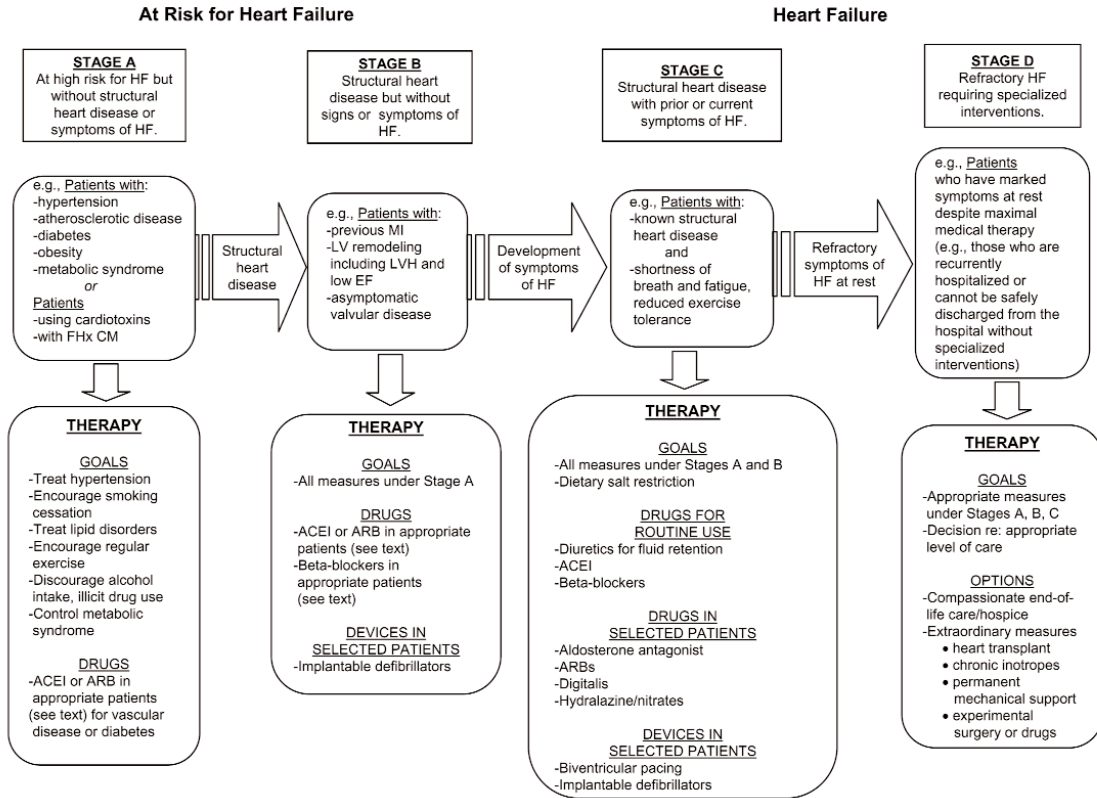
- routine monitoring of electrolytes, especially potassium, and renal function is important in patients who are receiving diuretics
- repeat measurement of EF and the severity of structural remodeling **only** when patient has demonstrated a major change in clinical status (either improvement or deterioration) or has experienced or recovered from a clinical event or treatment that might have had an effect on cardiac function.

Periodic invasive or noninvasive hemodynamic measurements **are not recommended** in the management of most patients with HF.

THERAPY FOR HF

Most drugs used for the treatment of HF are prescribed on the basis of their ability to improve symptoms or survival rather than their effect on hemodynamic variables. The initial and target doses of these drugs are selected on the basis of experience in controlled trials and are not based on the changes they may produce in hemodynamic measurements. The chart below summarizes the stages of HF and recommended therapy for each stage, followed by more specific recommendations for each therapy modality. A summary of specific cardiovascular medications useful for treatment of various stages of HF can be found in Appendix A.

Stages in the development of heart failure/recommended therapy by stage



FHx CM = family history of cardiomyopathy; ACEI= angiotensin converting enzyme inhibitors; ARB= angiotensin receptor blocker

Recommendations for patients at high risk for HF - Stages A & B

The symptoms and signs of HF are often difficult to identify because they are frequently confused with other disorders or are attributed to aging, obesity, or lack of conditioning.

Limitations of exercise tolerance can occur so gradually that patients may adapt their lifestyles (consciously or subconsciously) to minimize symptoms and thus fail to report them to healthcare providers. Healthcare providers should intensify their vigilance for the signs and symptoms of HF in these patients. Because early modification of HF risk factors can reduce the risk of HF, the recommendation of appropriate medical interventions to patients with these risk factors provides the earliest opportunity to reduce the impact of HF on individual health.

Stage A – patients at high risk for heart failure but without structural heart disease or HF symptoms

- Control systolic and diastolic hypertension in accordance with contemporary guidelines.
- Treat lipid disorders in accordance with contemporary guidelines.
- For patients with diabetes mellitus, control blood sugar in accordance with contemporary guidelines. (see *Neighborhood Guidelines for Diabetes Care*).
- Manage patients with metabolic syndrome in accordance with contemporary guidelines.
- Counsel patients to avoid behaviors that may increase HF risk (e.g. smoking, excessive alcohol consumption, illicit drug use)
- Control ventricular rate or restore sinus rhythm in patients with supraventricular tachyarrhythmias.
- Treat thyroid disorders, if present, in accordance with contemporary guidelines.
- Perform periodic evaluation for signs and symptoms of HF.

- In patients with known atherosclerotic vascular disease, follow current guidelines for secondary prevention.
- Angiotensin converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs) can be useful to prevent HF in Stage A patients who have a history of atherosclerotic vascular disease, diabetes mellitus, or hypertension with associated cardiovascular risk factors.
- Perform a noninvasive evaluation of LV function (i.e., LVEF) in patients with a strong family history of cardiomyopathy or in those receiving cardiotoxic interventions.

Stage B – patients with structural heart disease but without signs or symptoms of HF

Patients without HF symptoms but who have had an MI or who have evidence of LV remodeling are at considerable risk of developing HF. In such patients, the incidence of HF can be decreased by reducing the risk of additional injury and by retarding the evolution and progression of LV remodeling. All recommendations for Stage A should apply to these patients. In addition, appropriate measures include:

- Beta-blockers
 - should be used in all patients with a recent or remote history of MI regardless of EF or presence of HF
 - are indicated in all patients without a history of MI who have a reduced LVEF with no HF symptoms
- ACEIs
 - should be used in all patients with a recent or remote history of MI regardless of EF or presence of HF
 - should be used in patients with a reduced EF and no symptoms of HF, even if they have not experienced MI
 - can be beneficial in patients with hypertension and LVH and no symptoms of HF.
- An ARB
 - should be administered to post-MI patients without HF who are intolerant of ACEIs and have a low LVEF.
 - can be beneficial in patients with hypertension and LVH and no symptoms of HF.
 - can be beneficial in patients with low EF and no symptoms of HF who are intolerant of ACEIs.
- Patients who have not developed HF symptoms should be treated according to contemporary guidelines after an acute MI.
- Coronary revascularization should be recommended in appropriate patients without symptoms of HF in accordance with contemporary guidelines (see ACC/AHA Guidelines for the Management of Patients With Chronic Stable Angina).
- Valve replacement or repair should be recommended for patients with hemodynamically significant valvular stenosis or regurgitation and no symptoms of HF in accordance with contemporary guidelines.
- Placement of an implantable cardiac defibrillator (ICD) is reasonable to consider in patients with ischemic cardiomyopathy who are at least 40 days post-MI, have an LVEF of 30% or less, are NYHA functional class I) on chronic optimal medical therapy, and have reasonable expectation of survival with a good functional status for more than 1 year.

Stage C - patients with current or prior symptoms of HF

A. Patients with Stage C Heart Failure and reduced LVEF

Measures recommended for Class A and B patients are also appropriate for patients in this Stage C group. Additional measures for management of this group include the following:

General Measures

- **Most effective:** patient education and close supervision (by patient, family, and nurse/PA) to promote adherence to diet and medications regimen and to detect early changes in body weight or clinical status that call for changes in treatment to prevent clinical deterioration.

- Sodium restriction (3-4 gm/day) and daily weights to monitor fluid retention
- Immunization with influenza and pneumococcal vaccines
- Encourage physical activity
 - maximal exercise testing with or without measurement of respiratory gas exchange is reasonable to facilitate prescription of an appropriate exercise program and
 - exercise training is beneficial as an adjunctive approach to improve clinical status (lessen symptoms, increase exercise capacity, improve quality of life)
- It is reasonable to treat patient with atrial fibrillation and HF (10-30% of chronic HF patients) with a strategy to maintain sinus rhythm or with a strategy to control ventricular rate alone.

Routine Medications for HF – most patients with HF should be routinely managed with a combination of 3 types of drugs.

- Diuretics – are indicated in patients who have evidence of fluid retention. Optimal use is the cornerstone of any successful approach to treatment of HF. (See Appendix B for specific drugs/doses.)
 - Initiate at low dose, then increase dose until urine output increases and weight decreases; further increase dose if needed to maintain diuresis and sustain weight loss.
 - Taken until euvolemic state achieved in patients with fluid retention
 - Therapy then continued to prevent recurrence of fluid retention
 - Should not be used alone in the treatment of Stage C HF.
 - Patient must be monitored for electrolyte and fluid depletion, hypotension, and azotemia
- ACEI or ARB – favorably influence the long-term prognosis of HF. (See Appendix C for specific drugs/doses.)
 - ACEIs for all patients unless contraindicated
 - ARBs for those patients who are ACEI-intolerant
 - Initiate at low doses, increase dose gradually to target doses shown in clinical trials to reduce risk of cardiovascular events
 - Monitor for hypotension, worsening renal function, potassium retention, cough, angioedema
- Beta-blockers - favorably influence the long-term prognosis of HF. (See Appendix C for specific drugs/doses.)
 - use 1 of the 3 proven to reduce mortality (i.e. bisoprolol, sustained-release metoprolol, and carvedilol)
 - Use for all Stage C stable patients with reduced LVEF unless contraindicated
 - Initiate therapy in stable patients without volume overload as soon as LV dysfunction diagnosed; initiate at low dose and increase dose to clinical target doses, as with ACEIs
 - Monitor for fluid retention with worsening HF, fatigue, bradycardia and heart block, and hypotension
 - In patients with fluid retention, patient must also be on a diuretic.

Other medications used in HF

- Digoxin – can be beneficial as a fourth agent if needed for patients with persistent HF symptoms during therapy with above routine medications
 - may be initiated at any time to reduce symptoms, prevent hospitalization, control rhythm, and enhance exercise tolerance.
 - is not indicated as primary therapy for the stabilization of patients with an acute exacerbation of HF symptoms.

- Levels of < 0.7 seem to be associated with improved safety. Need to be monitored in setting of renal dysfunction as well as cocommitant medication use, especially amiodarone.
- Aldosterone antagonists – additional recommended medication in selected patients
 - With moderately severe to severe HF symptoms and recent decompensation
 - or with LV dysfunction early after MI with preserved renal function (creatinine ≤ 2.5 mg/dL men or ≤ 2.0 mg/dL women)
 - With normal potassium concentration (< 5 mEq/L)
 - Who can be carefully monitored for preserved renal function and potassium concentration.
- Hydralazine/nitrate combination –
 - is recommended to improve outcomes for patients self-described as African-Americans, with moderate-severe symptoms on optimal therapy with ACEIs, beta-blockers, and diuretics.
 - is a reasonable addition for patients who are already taking an ACEI and beta blocker for symptomatic HF and who have persistent symptoms.

Medications to avoid

- Drugs known to adversely affect the clinical status of patients in this group should be avoided or withdrawn whenever possible (e.g., nonsteroidal anti-inflammatory drugs, most antiarrhythmic drugs, and most calcium channel blocking drugs)
- Long-term use of an infusion of a positive inotropic drug may be harmful and is not recommended.

Implantable cardioverter-defibrillator (ICD) therapy is recommended

- as secondary prevention to prolong survival in patients with current or prior symptoms of HF and reduced LVEF who have a history of cardiac arrest, ventricular fibrillation, or hemodynamically destabilizing ventricular tachycardia.
- for primary prevention of sudden cardiac death to reduce total mortality in patients with non-ischemic dilated cardiomyopathy or ischemic heart disease at least 40 days post-MI, a LVEF $\leq 35\%$, and NYHA functional class II or III symptoms while receiving chronic optimal medical therapy, and who have reasonable expectation of survival with a good functional status for more than 1 year

Cardiac resynchronization therapy (CRT)

- is recommended unless contraindicated, with or without an ICD, for patients with LVEF $\leq 35\%$, sinus rhythm, and NYHA functional class III or ambulatory class IV symptoms despite recommended optimal medical therapy and who have cardiac dyssynchrony, which is currently defined as a QRS duration ≥ 0.12 sec. (Typically LBBB on surface ECG)
- is reasonable, with or without an ICD, for treatment of NYHA functional class III or ambulatory class IV HF symptoms on optimal recommended medical therapy
- for patients who have LVEF $\leq 35\%$, a QRS duration ≥ 0.12 sec., and atrial fibrillation (AF), is reasonable for patients with LVEF $\leq 35\%$ with NYHA functional class III or ambulatory class IV symptoms who are receiving optimal recommended medical therapy and who have frequent dependence on ventricular pacing.

B. Patients with Stage C Heart Failure and Normal LVEF

An estimated 20-60% of patients with HF and no valvular disease have relatively normal LVEF; these patients are believed to have reduced ventricular compliance as a major contributor to the clinical syndrome. It is most prevalent in elderly women who also have hypertension, diabetes or both; many also have CAD and atrial fibrillation. Management is based on the control of

physiological factors (BP, heart rate, blood volume, myocardial ischemia) that are known to exert important effects on ventricular relaxation.

Differential diagnosis includes:

- Incorrect diagnosis of HF
- Inaccurate measurement of LVEF
- Primary valvular disease
- Restrictive (infiltrative) cardiomyopathies
 - Amyloidosis, sarcoidosis, hemochromatosis
- Pericardial constriction
- Episodic or reversible LV systolic dysfunction
- Severe hypertension, myocardial ischemia
- HF associated with high metabolic demand (high-output states)
 - Anemia, thyrotoxicosis, arteriovenous fistulae
- Chronic pulmonary disease with right HF
- Pulmonary hypertension associated with pulmonary vascular disorders
- Atrial myxoma
- Diastolic dysfunction of uncertain origin
- Obesity

Recommendations for treatment:

- Control systolic and diastolic hypertension in accordance with published guidelines.
- Control ventricular rate in patients with atrial fibrillation.
- Use diuretics to control pulmonary congestion and peripheral edema.
- Coronary revascularization is reasonable in patients with coronary artery disease in whom symptomatic or demonstrable myocardial ischemia is judged to be having an adverse effect on cardiac function.
-

Stage D - Patients with Refractory End-Stage Heart Failure

Some patients with HF do not improve or experience rapid recurrence of symptoms despite optimal medical therapy. Such patients characteristically

- have symptoms at rest or on minimal exertion, including profound fatigue;
- cannot perform most activities of daily living;
- frequently have evidence of cardiac cachexia; and
- typically require repeated and/or prolonged hospitalizations for intensive management.

Recommendations include:

- Appropriate measures as outlined for Stages A, B, and C; ensure that all conventional medical strategies have been optimally employed.
- Meticulous identification and control of fluid retention
- Referral of patients with refractory end-stage HF to a HF program with expertise in the management of refractory HF
- Referral for cardiac transplantation in potentially eligible patients. (See Appendix D for indications for cardiac transplantation.)
- Discussion with patient and family of options for end-of-life care when severe symptoms persist despite application of all recommended therapies
- Giving patients with refractory end-stage HF and implantable defibrillators information about the option to inactivate defibrillation.
- Consideration of an LV assist device as permanent or “destination” therapy is reasonable in highly selected non-transplant-eligible patients with an estimated 1-year mortality over 50% with medical therapy.

THE HOSPITALIZED PATIENT

Patients with HF may develop a change in HF signs and symptoms resulting in a need for urgent therapy. In general, there are 3 clinical profiles that describe the hospitalized patient with HF:

- patient with volume overload (pulmonary and/or systemic congestion), frequently precipitated by an acute increase in chronic hypertension
- patient with profound depression of cardiac output manifested by hypotension, renal insufficiency, and/or shock syndrome
- patient with signs and symptoms of both fluid overload and shock.

Whether the diagnosis of HF is new or chronic, patients who present with rapid decompensation and hypoperfusion associated with decreasing urine output and other manifestations of shock are critically ill and need rapid intervention to improve systemic perfusion.

Hospitalization is recommended for patients with

- evidence of severely decompensated HF, including:
 - hypotension
 - worsening renal function
 - altered mentation
- dyspnea at rest (resting tachypnea and/or oxygen saturation < 90%)
- hemodynamically significant arrhythmia, including new onset rapid atrial fibrillation
- acute coronary syndromes

Hospitalization should be considered for patients with

- worsened congestion, even without dyspnea, reflected by weight gain of ≥ 5 kg.
- signs and symptoms of pulmonary or systemic congestion, even in absence of weight gain
- major electrolyte disturbance
- associated comorbid conditions, *e.g.* pneumonia, pulmonary embolus, diabetic ketoacidosis, symptoms suggestive of transient ischemic accident or stroke
- repeated ICD firings
- previously undiagnosed HF with signs and symptoms of systemic or pulmonary congestion

Common Factors Precipitating Hospitalization

- Noncompliance with medical regimen, sodium and/or fluid restriction
- Acute myocardial ischemia
- Uncorrected high blood pressure
- Atrial fibrillation and other atrial and ventricular arrhythmias
- Recent addition of negative inotropic drugs (*e.g.* verapamil, nifedipine, diltiazem, beta blockers)
- Pulmonary embolus/emboli
- Renal failure
- Nonsteroidal anti-inflammatory drugs
- Excessive alcohol or illicit drug use
- Endocrine abnormalities (*e.g.* diabetes mellitus, hyperthyroidism, hypothyroidism)
- Concurrent infections (*e.g.* pneumonia, viral illnesses)

Prognosis after an index hospitalization for HF is poor, with a 50% rate of readmission at 6 months and a 25-35% incidence of death at 12 months. The following section outlines what should occur in the hospital for the HF patient requiring urgent therapy.

Initial Evaluation

- Diagnosis of HF based on signs and symptoms derived from thorough history and physical exam. Determine:
 - Adequacy of systemic perfusion

- Volume status
- Contribution of precipitating factors and/or comorbidities
- If HF is new onset or exacerbation of chronic disease
- Whether LVEF is preserved or reduced.
- Chest x-ray, ECG, and echocardiography to aid in assessment
- Measurement of concentrations of BNP or NT-proBNP in patients being evaluated for dyspnea in which the contribution of HF is not known. Interpretation of results in the context of all available clinical data, not as a stand-alone test.
- Prompt identification by ECG and cardiac troponin testing of acute coronary syndrome (ACS) precipitating HF; treatment as appropriate to overall condition and prognosis of patient. Urgent cardiac catheterization and revascularization (especially when there are signs and symptoms of inadequate systemic perfusion) where it is likely to prolong meaningful survival.
- Identification of other common precipitating factors for HF (see above) to guide therapy

Treatment Goals of Therapy

- Improve symptoms, especially congestion and low-output symptoms
- Optimize volume status
- Identify etiology
- Identify precipitating factors
- Optimize chronic oral therapy
- Minimize side effects
- Identify patients who might benefit from revascularization
- Educate patients concerning medications and self assessment of HF
- Consider and, where possible, initiate a disease management program

Management

- **Oxygen therapy** to relieve symptoms related to hypoxemia
- **Low-sodium diet** (2 g. daily)
- **Medications** – general guidelines
 - Reassess medications on admission and adjust their administration in light of worsening HF.
 - Reconcile and adjust medications as appropriate on discharge from the hospital; assure that evidence-based medications are instituted prior to patient discharge.
 - Monitor patient for supine and upright hypotension, worsening renal function and HF signs/symptoms with all medication changes.
- **Diuretics** – **IV loop diuretics** for patients with evidence of significant fluid overload (see Appendix B)
 - Begin therapy in emergency department or outpatient clinic
 - If patients are already receiving loop diuretic therapy, initial IV dose should be \geq chronic oral daily dose.
 - Titrate diuretic dose according to serial assessment of urine output and signs and symptoms of congestion.
 - Intensify diuretic regimen when diuresis is inadequate to relieve congestion, by:
 - Higher doses of loop diuretics
 - Addition of a second diuretic (*e.g.* metolazone, spironolactone or IV chlorothiazide), or
 - Continuous infusion of a loop diuretic
 - Transition from IV to oral diuretic therapy with careful attention to oral diuretic dosing and monitoring of electrolytes in all patients hospitalized with HF, both with preserved and low EF. ,
- **IV inotropic or vasopressor drugs** -

- Administer to patients with clinical evidence of hypotension associated with hypoperfusion and evidence of elevated cardiac filling pressures (*e.g.* elevated jugular venous pressure, elevated pulmonary artery wedge pressure) to maintain systemic perfusion and preserve end-organ performance while more definitive therapy is considered.
- **Not recommended** in normotensive patients without evidence of decreased organ perfusion.
- **Vasodilators (*e.g.* IV nitroglycerin, nitroprusside, nesiritide)**
 - Can be beneficial in patients with evidence of severely symptomatic fluid overload in the absence of systemic hypotension when added to diuretics and/or in those who do not respond to diuretics alone.
- **ACEIs or ARBs and beta-blockers**
 - Continue these therapies in the absence of hemodynamic instability or contraindications in most patients with reduced EF who experience exacerbation of HF requiring hospitalization during chronic maintenance treatment with these medications
 - Continuation of beta blockers for most patients is well tolerated and results in better outcomes; withhold or reduce only in patients hospitalized after recent initiation or increase in beta-blocker therapy or patients with marked volume overload.
 - Consider reduction or temporary discontinuation of ACEIs, ARBs, and/or aldosterone antagonists in patients with worsening azotemia until renal function improves.
 - Initiate these therapies in stable patients prior to discharge for patients hospitalized with HF with reduced EF who were not treated with these medications prior to admission
 - Initiate beta-blocker therapy at a low dose in stable patients after optimization of volume status and successful discontinuation of IV diuretics, vasodilators, and inotropic agents. Use particular caution when initiating beta blockers in patients who have required inotropes during hospital course.
- **Ultrafiltration** – reasonable for patients with refractory congestion not responding to medical therapy.
- **Anticoagulation** to prevent thromboembolic complications and deep venous thrombosis
 - Prophylactic anticoagulation with either IV unfractionated heparin or subcutaneous preparations of unfractionated or low-molecular-weight heparin, unless contraindicated.
- **Monitor effect of HF treatment** with
 - Careful measurement of fluid intake and output
 - Vital signs
 - Body weight, determined at the same time each day
 - Clinical signs (supine and standing) and symptoms of systemic perfusion and congestion
 - Measurement of daily serum electrolytes, urea nitrogen, and creatinine concentrations during use of IV diuretics or active titration of HF medications.
- **Invasive hemodynamic monitoring**
 - Perform to guide therapy in patients in respiratory distress or with clinical evidence of impaired perfusion in whom the adequacy or excess of intracardiac filling pressures cannot be determined from clinical assessment.
 - Use for selected patients with acute HF who have persistent symptoms despite empiric adjustment of standard therapies and

- Whose fluid status, perfusion, or systemic or pulmonary vascular resistances are uncertain
- Whose systolic pressure remains low, or is associated with symptoms, despite initial therapy
- Whose renal function is worsening with therapy
- Who require parenteral vasoactive agents or
- Who may need consideration for advanced device therapy or transplantation.

Not recommended for normotensive patients with acute decompensated HF and congestion who have symptomatic response to diuretics and vasodilators.

Hospital Discharge

- **Comprehensive written discharge instructions and education** for patients and caregivers, including
 - diet
 - discharge medications, with a special focus on adherence, persistence, and up-titration to recommended doses of ACEI/ARB and beta-blocker medication
 - activity level
 - follow-up appointments
 - daily weight monitoring
 - what to do if HF symptoms worsen.
- **Reassess overall prognosis** once current functional status and precipitating causes of the hospitalization have been determined. The appropriateness of discussion about advanced therapy or end-of-life preferences should also be considered.
- **Post-discharge systems of care** should be used if available to facilitate transition to effective outpatient care.

TREATMENT OF HF PATIENTS WHO HAVE CONCOMITANT DISORDERS

Hypertension, Hyperlipidemia, and Diabetes Mellitus

Approximately two thirds of patients with HF have a past or current history of hypertension, and approximately one third have diabetes mellitus. It is prudent to manage hypertension, hypercholesterolemia, and diabetes mellitus in patients with HF as if the patients did not have HF. This may be particularly true in patients with HF and preserved LVEF.

- Drugs that can both control blood pressure and treat HF should be preferred in patients with both conditions; this includes the use of diuretics, ACEIs, and beta-blockers.
- Consider renal artery stenosis in patients with hypertension and HF, because renal artery stenting can treat both conditions.
- The drugs routinely used in the management of HF in nondiabetic patients should be administered to those with diabetes mellitus (*e.g.* ACEIs and beta blockers to prevent the progression of HF).
- Long-term treatment of both hypertension and hyperlipidemia decrease the risk of developing HF.

Coronary Artery Disease

Approximately two thirds of patients with HF have underlying coronary artery disease (CAD), which may limit exercise tolerance by causing angina pectoris or may lead to further myocardial injury by causing an MI. CAD is now the most common cause of chronic HF. Therefore, physicians should manage both the symptomatic and prognostic consequences of the patient's underlying coronary artery disease in accordance with contemporary guidelines.

- In general, patients who have both angina pectoris and HF should be given drugs that relieve angina along with drugs that are appropriate in the management of HF (*e.g.* nitrates and beta blockers).

- The combination of the 2 drugs may produce little improvement in anginal pain unless fluid retention is adequately controlled with diuretics.
- In patients with both HF and angina pectoris, strong consideration should be given to the use of coronary revascularization.

Supraventricular Tachycardias

The most common treatable atrial arrhythmia is atrial fibrillation, which affects 10% to 30% of patients with chronic HF. The control of ventricular rate and the prevention of thromboembolic events are essential elements of the treatment of HF in patients with an underlying supraventricular arrhythmia.

- Beta-blockers are more effective than digoxin during exercise and are preferred because of their favorable effects on the natural history of HF.
- The combination of digoxin and beta-blockers may be more effective than betablockers alone for rate control.
- The question of whether patients with HF and atrial fibrillation should be converted to and maintained in sinus rhythm remains under study.

Prevention of Thromboembolic events

The risk of thromboembolism in clinically stable patients with HF has been low (1% to 3% per year), even in those with very depressed EFs and echocardiographic evidence of intracardiac thrombi. These rates are sufficiently low to limit the detectable benefit of anticoagulation in these patients.

- Anticoagulation with warfarin is most justified in patients with HF who have experienced a previous embolic event or who have paroxysmal or persistent atrial fibrillation.
- Anticoagulation should also be considered in patients with underlying disorders that may be associated with an increased thromboembolic risk (e.g., amyloidosis or LV noncompaction) and in patients with familial dilated cardiomyopathy and a history of thromboembolism in first-degree relatives and in patients with LV apical aneurysm or ECHO evidence of thrombus

Patients With Renal Insufficiency

Patients with HF frequently have impaired renal function as a result of poor renal perfusion, intrinsic renal disease, or drugs used to treat HF. Most patients with HF tolerate mild to moderate degrees of functional renal impairment without difficulty. In these individuals, changes in blood urea nitrogen and serum creatinine are generally clinically insignificant and can usually be managed without the withdrawal of drugs needed to slow the progression of HF.

- If the serum creatinine increases to more than 3 mg per dL, the presence of renal insufficiency can severely limit the efficacy and enhance the toxicity of established treatments.
- In patients with a serum creatinine greater than 5 mg per dL, hemofiltration or dialysis may be needed to control fluid retention, minimize the risk of uremia, and allow the patient to respond to and tolerate the drugs routinely used for the management of HF.

Patients with Pulmonary Disease

Because dyspnea is the key symptom in both HF and pulmonary disease, it is important to distinguish the 2 diseases and to quantify the relative contribution of cardiac and pulmonary components to the disability of the patient when these disorders coexist.

- Exercise testing with simultaneous gas exchange or blood gas measurements may be helpful in this regard, particularly when used in conjunction with right heart catheterization.
- ACEIs can cause a persistent nonproductive cough that can be confused with a respiratory infection, and conversely, ACEIs may be inappropriately stopped in patients with pulmonary causes of cough. Therefore, physicians should seek a pulmonary cause in all patients with HF who complain of cough, whether or not they are taking an ACEI.
- Beta-blockers can aggravate bronchospastic symptoms in patients with asthma; however, many patients with asymptomatic or mild reactive airways disease tolerate beta-blockers well.

Patients with Cancer

Patients with cancer are particularly predisposed to the development of HF as a result of the cardiotoxic effects of many cancer chemotherapeutic agents.

- Patients undergoing potentially cardiotoxic treatments for cancer should be monitored closely for the development of cardiac dysfunction.
- Heart failure due to chemotherapeutic agents is managed similarly to HF due to other causes, although it is not clear whether patients with cancer respond similarly to patients with other causes of HF
- HF related to chemotherapy often improves in response to therapy, even when HF appears late after exposure.

Patients With Thyroid Disease

Patients with both hyperthyroidism and hypothyroidism are prone to develop HF.

- Special vigilance is required for patients who are taking amiodarone, who may develop either hyperthyroidism or hypothyroidism.
- New atrial fibrillation or exacerbation of ventricular arrhythmias should trigger reevaluation of thyroid status.

Patients With Anemia

Anemia is seldom the cause of HF in the absence of underlying cardiac disease.

REFERENCES

1. Sharon Ann Hunt, MD, Chair, *et al* 2009 Focused Update Incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Chronic Heart Failure in the Adult: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines; *J. Am. Coll. Cardiol.* 2009;53:e1-e90; information current as of May 26, 2010,
2. Mariell Jessup, MD, Chair, *et al* writing on behalf of the 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult Writing Committee; “2009 Focused update: ACCF/AHA Guidelines for the Diagnosis and Management of Heart Failure in Adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines”; *J Am Coll Cardiol* 2009;53:1343-82
3. “2006 HFSA (Heart Failure Society of America) Comprehensive Heart Failure Practice Guidelines”; *Journal of Cardiac Failure* Vol. 12 No. 1 2006

APPENDIX A

Cardiovascular Medications Useful for Treatment of Various Stages of Heart Failure

Drug	Stage A	Stage B		Stage C
Ace Inhibitors				
Benazepril	H	—	—	
Captopril	H, DN	Post MI		HF
Enalapril	H, DN	Asymptomatic LVSD	HF	
Fosinopril	H	—	HF	
Lisinopril	H, DN	Post MI		HF
Moexipril	H	—	—	
Perindopril	H, CV Risk	—	—	
Quinapril	H	—	HF	
Ramipril	H, CV Risk	Post MI		Post MI
Trandolapril	H	Post MI		Post MI
Angiotensin Receptor Blockers				
Candesartan	H	—	HF	
Eprosartan	H	—	—	
Irbesartan	H, DN	—	—	
Losartan	H, DN	CV Risk		—
Olmesartan	H	—	—	
Telmisartan	H	—	—	
Valsartan	H, DN	Post MI		Post MI, HF
Aldosterone Blockers				
Eplerenone	H	Post MI		Post MI
Spirolactone	H	—		HF
Beta Blockers				
Acebutolol	H	—	—	
Atenolol	H	Post MI		—
Betaxolol	H	—	—	
Bisoprolol	H	—	HF	
Carteolol	H	—	—	
Carvedilol	H	Post MI		HF, Post MI
Labetalol	H	—	—	
Metoprolol succinate	H	—	HF	
Metoprolol tartrate	H	Post MI		—
Nadolol	H	—	—	
Penbutolol	H	—	—	
Pindolol	H	—	—	
Propranolol	H	Post MI	—	
Timolol	H	Post MI		—
Digoxin	—	—		HF

Asymptomatic LVSD indicates asymptomatic left ventricular systolic dysfunction; CV Risk, reduction in future cardiovascular events; DN, diabetic nephropathy; H, hypertension; HF, heart failure; Post MI, reduction in heart failure or other cardiac events following myocardial infarction

APPENDIX B

Oral Diuretics Recommended for Use in the Treatment of Chronic Heart Failure

Drug	Initial Daily Dose(s)	Maximum Total Daily Dose	Duration of Action
Loop diuretics			
Bumetanide	0.5 to 1.0 mg once or twice	10 mg	4 to 6 hours
Furosemide	20 to 40 mg once or twice	600 mg	6 to 8 hours
Torsemide	10 to 20 mg once	200 mg	12 to 16 hours
Thiazide diuretics			
Chlorothiazide	250 to 500 mg once or twice	1000 mg	6 to 12 hours
Chlorthalidone	12.5 to 25 mg once	100 mg	24 to 72 hours
Hydrochlorothiazide	25 mg once or twice	200 mg	6 to 12 hours
Indapamide	2.5 once	5 mg	36 hours
Metolazone	2.5 mg once	20 mg	12 to 24 hours
Potassium-sparing diuretics†			
Amiloride	5 mg once	20 mg	24 hours
Spironolactone	12.5 to 25 mg once	50 mg*	2 to 3 days
Triamterene	50 to 75 mg twice	200 mg	7 to 9 hours
Sequential nephron blockade			
Metolazone	2.5 to 10 mg once plus loop diuretic		
Hydrochlorothiazide	25 to 100 mg once or twice plus loop diuretic		
Chlorothiazide (IV)	500 to 1000 mg once plus loop diuretic		

Intravenous Diuretic Medications Useful for the Treatment of Severe Heart Failure

Drug	Initial Dose	Maximum Single Dose
Loop diuretics		
Bumetanide	1.0 mg	4-8 mg.
Furosemide	40 mg	160-200 mg
Torsemide	10 mg.	100-200 mg.
Thiazide Diuretics		
Chlorothiazide	500 mg	1000 mg
Sequential Nephron Blockade		
Chlorothiazide	500-1000 mg (IV) once or twice plus loop diuretics once; multiple doses per day	
Metozalone	2.5-5 mg PO once or twice daily with loop diuretic	
IV infusions		
Bumetanide	1-mg IV load then 0.5-2 mg./hr infusion	
Furosemide	40 mg IV load then 10-40 mg/hr infusion	
Torsemide	20 mg IV load then 5-20 mg/hr infusion	

APPENDIX C

Inhibitors of the Renin-Angiotensin-Aldosterone System and Beta-Blockers Commonly Used for the Treatment of Patients With Heart Failure With Low Ejection Fraction

Drug	Initial Daily Dose(s)	Maximum Dose(s)
ACE inhibitors		
Captopril	6.25 mg 3 times	50 mg 3 times
Enalapril	2.5 mg twice	10 to 20 mg twice
Fosinopril	5 to 10 mg once	40 mg once
Lisinopril	2.5 to 5 mg once	20 to 40 mg once
Perindopril	2 mg once	8 to 16 mg once
Quinapril	5 mg twice	20 mg twice
Ramipril	1.25 to 2.5 mg once	10 mg once
Trandolapril	1 mg once	4 mg once
Angiotensin receptor blockers		
Candesartan	4 to 8 mg once	32 mg once
Losartan	25 to 50 mg once	50 to 100 mg once
Valsartan	20 to 40 mg twice	160 mg twice
Aldosterone antagonists		
Spironolactone	12.5 to 25 mg once	25 mg once or twice
Eplerenone	25 mg once	50 mg once
Beta-blockers		
Bisoprolol	1.25 mg once	10 mg once
Carvedilol	3.125 mg twice	25 mg twice (50 mg twice for patients over 85 kg)
Metoprolol succinate extended release (metoprolol CR/XL)	12.5 to 25 mg once	200 mg once

ACE indicates angiotensin converting enzyme; mg, milligrams; and kg, kilograms.

APPENDIX D

Indications for Cardiac Transplantation

Absolute indications in appropriate patients

- For hemodynamic compromise due to HF
 - Refractory cardiogenic shock
 - Documented dependence on IV inotropic support to maintain adequate organ perfusion
 - Peak VO₂ less than 10 mL per kg per min with achievement of anaerobic metabolism
- Severe symptoms of ischemia that consistently limit routine activity and are not amenable to coronary artery bypass surgery or percutaneous coronary intervention
- Recurrent symptomatic ventricular arrhythmias refractory to all therapeutic modalities

Relative indications

- Peak VO₂ 11 to 14 mL per kg per min (or 55% of predicted) and major limitation of the patient's daily activities
- Recurrent unstable ischemia not amenable to other intervention
- Recurrent instability of fluid balance/renal function not due to patient noncompliance with medical regimen

Insufficient indications

- Low left ventricular ejection fraction
- History of functional class III or IV symptoms of HF
- Peak VO₂ greater than 15 mL per kg per min (and greater than 55% of predicted) without other indications

HF indicates heart failure; IV, intravenous; and VO₂, oxygen consumption per unit time.