CARDIAC resynchronization therapy (CRT) can help reduce readmissions in patients with heart failure (HF). It uses an implanted cardiac device to boost the heart’s efficiency and improve blood flow. CRT is intended for HF patients with ejection fractions (EFs) of 35% or less. (See The failing heart.)

Generally, patients meet the criteria for CRT if they:

- are in normal sinus rhythm
- have current HF symptoms (New York Heart Association [NYHA] functional classes II to IV) despite receiving core HF medications
- have left bundle branch block (LBBB) QRS morphology.

Like pacemaker therapy, CRT entails placing lead wires in the right atrium and right ventricle, with a third lead wire placed in a cardiac vein of the left ventricle. The device sends small, undetectable electrical impulses to both ventricles to improve the synchrony of electrical stimulation, promoting a more synchronized ventricular contraction pattern. When the right and left ventricles contract uniformly, stroke volume increases and mitral regurgitation decreases. As a result, HF symptoms ease and quality of life improves.

No guidelines exist for specific medication-plan revisions before CRT placement, with or without an implantable cardioverter-defibrillator, for patients who meet CRT inclusion criteria. When CRT is the treatment of choice, device placement poses a cost, but patients benefit through early and long-term symptom improvement.

HF readmissions

Hospital readmissions are common in HF patients—and are linked to increased morbidity and deaths. From 2007 to 2009, about 25% of HF patients were readmitted within 30 days. More important, readmission occurred soon after discharge. In a large review of Medicare beneficiaries, 61% of readmissions occurred during the first 15 days after discharge.

When patients are readmitted, their diagnoses aren’t always HF. In one study of 30-day readmissions after HF discharge, nearly 20% of
patients were readmitted for worsening HF and 10% came in with acute myocardial infarctions. What’s more, 30-day mortality among patients readmitted for cardiovascular reasons exceeded that of patients readmitted for noncardiovascular reasons. Over a 3-year period, patients who weren’t readmitted had significantly lower death rates than those who were readmitted for either cardiovascular or noncardiovascular reasons. These findings highlight the complexity of HF.

When asked the reason for their HF readmission, patients’ rationales tended to reflect preventable causes. Data from medical records showed evidence of multiple medical conditions in patients who were readmitted. Patient interviews shed light on psychosocial factors, self-care adherence, and health-system failures and delays in treatment as rationales for increased readmissions.

The Centers for Medicare & Medicaid Services began public reporting of 30-day risk-standardized readmission rates for HF in an attempt to raise healthcare provider awareness and, ultimately, to lower rates. The National Quality Forum endorses the 30-day readmission measure as a way to improve quality of care and reduce preventable readmissions.

Evidence supporting CRT

Multiple prospective and retrospective research trials have shown that CRT reduces the risk of all-cause mortality and all-cause, cardiovascular, and HF readmissions.

CRT was applied in patients with an LBBB pattern and QRS durations of 150 ms or more, as well as in patients with a non-LBBB pattern and those with QRS durations between 120 and 150 ms. Patients in the first category had significant EF and functional status improvements as well as heart-size reduction (reduced left ventricular end-systolic and diastolic diameters) compared to the other groups. Surprisingly, though, CRT is underused in patients who meet the criteria. In fact, 60% of eligible patients don’t receive CRT despite known benefits.

Adaptive CRT

An improvement to CRT, called adaptive CRT (aCRT), is now available. This dynamic physiologic pacing algorithm enhances CRT by adjusting device parameters automatically with changes in patient activity levels and conduction status. Rather than using echocardiographic (echo) optimization, the technology automatically adjusts to patients’ minute-by-minute needs and creates customized therapy. Compared to echo optimization, aCRT reduced the odds of 30-day HF hospital readmission by 59% and the odds of all-cause 30-day hospitalization by 46%. It also reduced all-cause and HF readmissions beyond 30 days. Ultimately, aCRT enhanced optimization, and research participants had reduced short- and long-term hospitalizations.

Case study

Mr. R, a 79-year-old Caucasian male, has a history of HF and reduced EF, along with hypertension, obesity, and gout. He was diagnosed with dilated cardiomyopathy about 4 years ago after complaining of fatigue and shortness of breath that didn’t subside with rest. He was unable to complete activities of daily living (ADLs) without frequent breaks and rest periods. His primary care physician placed him on evidence-based medication therapies, including an angiotensin-converting enzyme (ACE) inhibitor, a beta blocker, a loop diuretic, and an aldosterone antagonist.

Initially, Mr. R’s signs and symptoms improved. But in the last 6 months, they’ve become progressive-

The failing heart

Chronic and progressive, heart failure (HF) prevents the heart from delivering enough blood to meet the body’s needs. It occurs in more than 5.5 million Americans, with more than 1 million hospitalized each year. With HF prevalence expected to rise 46% from 2012 to 2030, managing this serious medical condition is becoming a growing priority.

HF occurs in two main forms. Both reduce the heart’s ability to deliver adequate blood throughout the body.

• **HF with reduced ejection fraction (EF).** In this condition, muscles of the heart wall weaken and enlarge gradually. EF drops to 40% or lower, preventing adequate pumping during ventricular systole.

• **HF with preserved EF (also called diastolic dysfunction).** Muscles of the heart wall thicken and become fibrotic, preventing normal ventricular relaxation and filling during diastole.

About 36% of patients with HF have a left bundle branch block QRS pattern, defined as a QRS duration of more than 120 ms. This pattern leads to early right ventricular activation and ends with left ventricular lateral or posterolateral wall activation. Because the ventricles aren’t activated synchronously, muscular contraction and blood ejection are out of sync, resulting in reduced cardiac output, decreased EF, and increased mitral regurgitation.

**Hospital readmissions are common in HF patients—and are linked to increased morbidity and deaths.**
Assessing and managing HF patients

This table provides an overview of heart failure (HF), including management and patient education. It’s based on recommendations and practice guidelines from the American College of Cardiology, the American Heart Association (AHA), and the Heart Failure Society of America, as well as an AHA scientific statement on care transitions in HF patients.

<table>
<thead>
<tr>
<th>Area of focus</th>
<th>Specifics</th>
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<tbody>
<tr>
<td>Healthcare provider plans and</td>
<td>• Order serum laboratory tests; review for abnormalities.</td>
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<tr>
<td>communication</td>
<td>• Develop medication titration plans if patient isn’t receiving target doses.</td>
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<td></td>
<td>• Treat comorbid conditions, especially those whose symptoms mimic HF (for example, anemia, atrial fibrillation, renal insufficiency, and chronic lung disease).</td>
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<td></td>
<td>• Evaluate need for and scheduling of cardiac device use.</td>
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<td></td>
<td>• Plan for remote monitoring or internal cardiac monitoring via implantable cardioverter-defibrillator or other implantable device that monitors pulmonary artery pressure.</td>
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<td></td>
<td>• Conduct multidisciplinary team discussions with non-HF cardiologist or other physician providers, pharmacist, care coordinator, transition coach or navigator, social worker, dietitian, exercise physiologist or physical therapist, or home care, assisted living, rehabilitation, or skilled-nursing facility.</td>
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<tr>
<td></td>
<td>• Refer patient to palliative-care or hospice-care specialist as needed.</td>
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<tr>
<td>Core medical treatments</td>
<td><strong>Core pharmacologic management of HF and reduced ejection fraction (EF):</strong></td>
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<tr>
<td></td>
<td>• <strong>Neuroendocrine inhibitor:</strong> angiotensin-converting enzyme inhibitor, angiotensin receptor blocker, or angiotensin-receptor-neprilysin inhibitor.*,** Titrate dose upward to target dose or highest dose tolerated, based on guidelines.</td>
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<tr>
<td></td>
<td>• <strong>Beta blocker:</strong> reduces sympathetic nervous system activity to lower blood pressure and slow heart rate. Titrate dose upward to target dose or highest dose tolerated, based on guidelines.</td>
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<tr>
<td></td>
<td>• <strong>Hydralazine/nitrate combination</strong> (in patients self-described as African-Americans with moderate to severe symptoms): dilates arteries and veins to lower blood pressure</td>
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<tr>
<td></td>
<td>• <strong>Aldosterone antagonist</strong> (if mild to severe symptoms follow treatment with vasodilator and beta blocker, in patients with adequate renal function and normal potassium levels): reduces aldosterone release from adrenal cortex to reduce sodium and water retention. Use in doses recommended by national guidelines.</td>
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<td></td>
<td><strong>Add-on pharmacologic management of HF and reduced EF:</strong></td>
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<td></td>
<td>• <strong>Loop diuretic:</strong> promotes diuresis (water removal) and natriuresis (sodium removal)</td>
</tr>
<tr>
<td></td>
<td>• <strong>Sinus node pacemaker funny (If) channel inhibitor (ivabradine)</strong> in patients on core HF medications who have HF symptoms, resting heart rates above 70 beats/minute, and normal sinus rhythm, to slow heart rate. Titrate dose upward to target dose or highest dose tolerated, based on guidelines.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Digoxin:</strong> inhibits sympathetic out-flow and augments parasympathetic tone to increase cardiac output and slow heart rate. Use in low doses to maintain serum digoxin level of 0.7 to 0.9 ng/mL in patients who have HF symptoms despite core HF medications.</td>
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</tbody>
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(continued on next page)
R's suboptimal functional status, including deconditioning and lack of a physical activity routine, comorbid conditions, hidden dietary sodium indiscrination from restaurant food, and poor absorption of his loop diuretic. He requires further assessment to determine if his blood counts and thyroid function are normal and if he has critical (but asymptomatic) coronary artery disease, sleep-disordered breathing, or another medical condition that could account for his symptoms. He appears to meet the criteria for CRT with an implantable cardioverter-defibrillator and additional medications, if worsening symptoms stem from hypervolemia.

Mr. R’s nurse should be sure to discuss CRT as an option, if appropriate. Also, Mr. R may meet the criteria for newer HF medications that increase vasodilation or slow the heart rate; research suggests these agents improve both symptom burden and quality of life. His nurse also may need to discuss more advanced HF therapies, such as ventricular assist device support or palliative and end-of-life care. (See Assessing and managing HF patients.)

**Nurse’s role in managing HF**

As Mr. R’s scenario shows, nurses are uniquely positioned to identify ways to help reduce HF readmissions. Given the high risk of early readmission after discharge, multidisciplinary care is crucial. Nurses need to be assertive advocates to ensure patients’ needs are met during the transition from hospital to home, as well as after discharge. Patient and family caregiver education should include signs and symptoms that herald worsening of the patient’s condition, pharmacologic and nonpharmacologic plans of care, and new interventions and technologies.

To provide thorough education and patient care, nurses must remain current in their knowledge of HF management—including understanding and applying guideline-directed medical therapies consistent with the highest evidence-based practices. And we must consider social, cultural, fi-

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**Cardiac resynchronization therapy:** delivers electrical impulses to synchronize contractions of right and left ventricles and improve heart’s overall pumping efficiency

**Implantable cardioverter-defibrillator:** prevents sudden cardiac death from ventricular fibrillation and converts supraventricular tachycardia to normal sinus rhythm, as needed

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**Nonpharmacologic, non-device management**

- Dietary sodium restriction to less than 3,000 mg/day. Although exact amount of restriction isn’t well studied, overly tight restriction (for example, below 2,400 mg/day) may activate neuroendocrine hormones known to worsen HF.
- Fluid restriction to approximately 2 L/day if patient has advanced HF symptoms with hypervolemia and a history of multiple readmissions for hypervolemia
- Moderate physical activity (such as walking) for 30 minutes/day, 5 days/week
- Monitoring for new or worsening HF signs and symptoms
- Daily weight measurement and documentation; notify healthcare provider if weight is 4 lb (1.8 kg) more than dry weight, which reflects euvolemia
- Regularly scheduled outpatient office visits
- Yearly influenza vaccination

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**Patient education**

Assess patient’s:
- literacy and health literacy level
- cognitive status
- social support
- cultural and financial factors
- psychological status
- self-management ability, knowledge, skill, and confidence
- external factors and resources, such as transportation, drive time to grocery store, ability to read small print
- comorbid conditions with symptoms that mimic HF or prevent or limit adherence to HF self-care.

Perform medication reconciliation at each visit.

Use teachback method to gauge patient’s understanding of each HF therapy and when to contact healthcare provider.

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*Angiotensin-receptor-neprilysin inhibitors reduce activity of renin-angiotensin-aldosterone system, resulting in arterial vasodilation, blood pressure reduction, and decreased cardiac workload.

**Approved by Food and Drug Administration in 2015; however, national evidence-based practice guidelines haven’t been updated.
**Indications for CRT**

This table lists indications for cardiac resynchronization therapy (CRT), based on 2012 guidelines from the American College of Cardiology Foundation, the American Heart Association, and the Heart Rhythm Society.

Different levels of evidence apply to the indications below.

- **Level A**: Multiple populations were evaluated and data came from multiple randomized clinical trials or meta-analyses.
- **Level B**: Limited populations were evaluated and data came from a single randomized trial or from nonrandomized studies.
- **Level C**: Very limited populations were evaluated and data came from consensus opinion of experts, case studies, or standard of care.

### Class I recommendations

These recommendations have benefits that greatly outweigh risks. CRT **should** be used if the patient has the following indications, is on chronic optimal medical therapy, and has a reasonable expectation of survival with good functional status for more than 1 year:

- left ventricular ejection fraction (LVEF) of 35% or less
- sinus rhythm
- left bundle branch block (LBBB)
- QRS duration ≥ 150 ms
- New York Heart Association (NYHA) Class II, III, or ambulatory Class IV symptoms*
- guideline-directed medical therapy.

### Level A evidence

CRT can be useful for patients who have:

- LVEF of 35% or less
- sinus rhythm
- non-LBBB pattern
- QRS duration ≥ 150 ms
- NYHA Class III, or ambulatory Class IV symptoms
- guideline-directed medical therapy.

### Class IIa recommendations

These recommendations have benefits that outweigh risks, but additional studies are needed. CRT is reasonable for patients with the indications that follow. The recommendations are grouped by level of evidence, with two separate groups of indications for level B evidence.

### Level B evidence

CRT can be useful for patients who have:

- atrial fibrillation
- LVEF of 35% or less
- guideline-directed medical therapy if the patient requires ventricular pacing or otherwise meets CRT criteria, and atrioventricular nodal ablation or pharmacologic rate control allows nearly 100% ventricular pacing with CRT.

### Level C evidence

CRT can be useful for patients who have:

- LVEF of 35% or less
- guideline-directed medical therapy
- anticipated requirement for significant (> 40%) ventricular pacing.

*NYHA Class III or IV: level A evidence. NYHA Class II: level B evidence.

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Financial, and other factors that could pose barriers to care. In addition, we must learn about new or improved drug and device therapies known to further reduce HF readmissions. For example, two new medications approved by the Food and Drug Administration are available for HF patients with reduced EF—ivabradine and the combination agent sacubitril/valsartan. Although each has unique applications and inclusion criteria for use, they both reduced HF hospitalizations compared to placebo (ivabradine) and usual care (sacubitril/valsartan).

When appropriate, nurses also may need to discuss use of CRT or atrioventricular nodal ablation. Nurses who focus on care coordination, connecting patients to the right care provider is crucial to ensure the patient is assessed thoroughly to determine optimal next steps. At every encounter, evaluate the patient’s self-confidence, as well as level of knowledge and skills in carrying out HF recommendations. Teach patients about self-care expectations related to diet, physical activity, and self-assessment of worsening symptoms, as well as the importance of keeping appointments with healthcare providers, even if they feel fine. For patients with refractory symptoms despite optimal medical therapies, palliative care may be needed to improve quality of life.
1. In a review of Medicare beneficiaries, 61% of hospital readmissions in patients with heart failure (HF) occurred how many days after discharge?
   a. 15
   b. 25
   c. 30
   d. 45

2. Which statement about hospital readmissions for patients with HF is correct?
   a. Most patients are readmitted for HF.
   b. Most patients are readmitted for myocardial infarction.
   c. Patients’ readmission reasons tend to reflect preventable causes.
   d. Patients’ readmission reasons tend to reflect nonpreventable causes.

3. All of the following are themes identified as contributing to readmission in HF patients except:
   a. psychosocial factors.
   b. symptom distress.
   c. healthcare-system failures.
   d. excessive follow-up calls.

4. Which of the following is a criterion for cardiac resynchronization therapy (CRT)?
   a. Normal sinus rhythm
   b. Atrial fibrillation
   c. Right bundle branch block
   d. Ejection fraction of 50% or less

5. Which description of lead-wire placement for CRT is correct?
   a. One wire is placed in the left atrium and one is placed in a cardiac vein of the right ventricle.
   b. One wire is placed in the left atrium and one is placed in the left ventricle.
   c. One wire is placed in the right atrium, one is placed in the right ventricle, and one is placed in a cardiac artery of the left ventricle.
   d. One wire is placed in the right atrium, one is placed in the right ventricle, and one is placed in a cardiac vein of the left ventricle.

6. Which agent is a part of core pharmacologic management for patients with HF and a reduced ejection fraction?
   a. Beta blocker
   b. Alpha blocker
   c. Digoxin
   d. Loop diuretic

7. Mr. Cunningham, a 70-year-old patient with HF, is receiving core medications but normal sinus rhythm with a resting heart rate of 75 beats/minute. Which drug therapy do you anticipate will be added to his regimen?
   a. Angiotensin-receptor-neprilysin inhibitor
   b. Angiotensin-converting enzyme inhibitor
   c. Sinus node pacemaker funny (I) channel inhibitor
   d. Combination of a loop diuretic and digoxin

8. Mr. Cunningham will be receiving adaptive CRT (aCRT). Which of the following statements correctly describes aCRT?
   a. It uses an echocardiographic optimization algorithm to ensure patients receive customized therapy.
   b. It makes adjustments automatically with changes in patient activity levels and conduction status.
   c. It was found to have no effect on 30-day readmission.
   d. It was found to increase the odds of 30-day readmission.

9. You correctly advise Mr. Cunningham to restrict his sodium intake to less than:
   a. 5,000 mg/day.
   b. 4,000 mg/day.
   c. 3,000 mg/day.
   d. 2,000 mg/day.

10. Which finding would indicate that Mr. Cunningham has fluid overload?
    a. Jugular venous elevation
    b. Jugular arterial elevation
    c. Negative hepatojugular reflux
    d. Positive abdominal reflux

11. Mr. Cunningham develops advanced HF symptoms. He is hypervolemic and has been admitted for this problem several times. You suggest he limit his fluid intake to about:
    a. 4 L/day.
    b. 3 L/day.
    c. 2 L/day.
    d. 1 L/day.

12. Which of the following statements about palliative care for HF patients is accurate?
    a. A patient who requires continuous I.V. inotropic support (dobutamine or milrinone) is not a candidate for palliative care.
    b. If the patient has an implantable-cardioverter defibrillator in place, healthcare providers should discuss deactivation if it fires frequently.
    c. Palliative care is indicated for patients with persistent New York Heart Association functional class III.
    d. Palliative care is indicated for patients with stage C HF.