LOUISIANA BLUE

Biventricular Pacemakers (Cardiac Resynchronization Therapy) for the Treatment of Heart Failure

Policy # 00009
Original Effective Date: 06/05/2002
Current Effective Date: 06/01/2025

Applies to all products administered or underwritten by Blue Cross and Blue Shield of Louisiana and its subsidiary, HMO Louisiana, Inc. (collectively referred to as the "Company"), unless otherwise provided in the applicable contract. Medical technology is constantly evolving, and we reserve the right to review and update Medical Policy periodically.

Note: Automatic Implantable Cardioverter Defibrillator (AIDC) is addressed separately in medical policy 00008.

Note: Cardiac Hemodynamic Monitoring for the Management of Heart Failure in the Outpatient Setting is addressed separately in medical policy 00287.

When Services May Be Eligible for Coverage

Coverage for eligible medical treatments or procedures, drugs, devices or biological products may be provided only if:

- *Benefits are available in the member's contract/certificate, and*
- *Medical necessity criteria and guidelines are met.*

Based on review of available data, the Company may consider biventricular pacemakers with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus cardiac defibrillator]) as a treatment of heart failure symptoms to be **eligible for coverage.****

Patient Selection Criteria

Coverage eligibility for biventricular pacemakers with or without an accompanying ICD (i.e., a combined biventricular pacemaker plus cardiac defibrillator) as a treatment of heart failure symptoms will be considered in individuals who meet **ALL** of the following criteria:

- Sinus rhythm; **AND**
- New York Heart Association (NYHA) class II, III or ambulatory IV; **AND**
- Left ventricular ejection fraction (LVEF) ≤35%; **AND**
- Individuals treated with an adequate trial of guideline-directed medical therapy before implant, such as an angiotensin-converting enzyme (ACE) inhibitor (or an angiotensin receptor-neprilysin inhibitor (ARNi), or angiotensin receptor blocker) and a beta blocker, mineralocorticoid receptor antagonist, sodium-glucose cotransporter 2 inhibitor, and/or diuretics as needed; **AND**
- Prolonged QRS duration 130-149 milliseconds with left bundle branch block (LBBB) morphology **OR** QRS duration ≥150 ms.

Based on review of available data, the Company may consider biventricular pacemakers with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus cardiac defibrillator]) as a treatment of heart failure symptoms to be **eligible for coverage.****

Patient Selection Criteria

Coverage eligibility for biventricular pacemakers with or without an accompanying ICD (i.e., a combined biventricular pacemaker plus cardiac defibrillator) as a treatment of heart failure symptoms will be considered in individuals who meet **ALL** of the following criteria:

- Atrial fibrillation; **AND**
- New York Heart Association (NYHA) class III or ambulatory IV; **AND**
- Left ventricular ejection fraction (LVEF) ≤35%; **AND**
- Individuals treated with an adequate trial of guideline-directed medical therapy before implant, such as an angiotensin-converting enzyme (ACE) inhibitor (or an angiotensin receptor-neprilysin inhibitor (ARNi), or angiotensin receptor blocker) and a beta blocker, mineralocorticoid receptor antagonist, sodium-glucose cotransporter 2 inhibitor, and/or diuretics as needed; **AND**
- Prolonged QRS duration ≥130 ms; **AND**
- Expected to have high degree of ventricular pacing (close to 100%) with cardiac resynchronization therapy (CRT), e.g., presence of high-degree or complete atrioventricular (AV) block, planning AV node ablation, or pharmacologic rate control (See Policy Guidelines).

Note: In this context, an adequate trial of guideline-directed medical therapy means either 3 months of therapy following diagnosis or 40 days of therapy following the most recent myocardial infarction.

Based on review of available data, the Company may consider biventricular pacemakers with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus ICD]) as an alternative to a right ventricular pacemaker for individuals who do not meet the criteria outlined above, but who have an indication for a ventricular pacemaker to be **eligible for coverage.****

Patient Selection Criteria

Coverage eligibility for biventricular pacemakers with or without an accompanying ICD (i.e., a combined biventricular pacemaker plus ICD) as an alternative to a right ventricular pacemaker for individuals who do not meet the criteria outlined above, but who have an indication for a ventricular pacemaker will be considered when **ALL** of the following criteria are met:

- Sinus rhythm or atrial fibrillation; **AND**
- NYHA class I, II, III, or IV heart failure; **AND**
- Left ventricular ejection fraction (LVEF) ≤50%; **AND**
- Expected to have high degree of ventricular pacing (close to 100%).

Based on review of available data, the Company may consider replacement of biventricular pacemaker with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus ICD]) to be **eligible for coverage.****

Patient Selection Criteria
Coverage eligibility for replacement of biventricular pacemakers with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus ICD]) will be considered when **ANY** of the following criteria are met:

- Generator end-of-life criteria are present; **OR**
- The generator pocket needs to be opened for another reason (e.g., lead revision) and the device is within 3 years of reaching end-of-life criteria.

When Services Are Considered Investigational

Coverage is not available for investigational medical treatments or procedures, drugs, devices or biological products.

Based on review of available data, the Company considers the use of biventricular pacemakers, with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus ICD]) in all other situations when patient selection criteria are not met to be **investigational.***

Based on review of available data, the Company considers triple-site (triventricular) cardiac resynchronization therapy (CRT), using an additional pacing lead, to be **investigational.***

Based on review of available data, the Company considers an intrathoracic fluid monitoring sensor to be **investigational*** as a component of a biventricular pacemaker.

Based on review of available data, the Company considers cardiac resynchronization therapy (CRT) with wireless left ventricular (LV) endocardial pacing to be **investigational*.**

Policy Guidelines

Atrioventricular block with a requirement for a high percentage of ventricular pacing is considered to be present when there is either:

- Third-degree atrioventricular block; or
- Second-degree atrioventricular block or a PR interval of ≥300 ms when paced at 100 beats per minute.

Guideline-directed medical therapy for heart failure is outlined in the 2022 American Heart Association, American College of Cardiology, and Heart Failure Society of America guidelines for the management of heart failure (Heidenreich et al [2022]).

Table 1. NYHA Functional Classification

NYHA Class	Patients with Cardiac Disease(Description of HF Related Symptoms)
Class I (Mild)	Patients with cardiac disease but without resulting in limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation (rapid or pounding heart beat), dyspnea (shortness of breath), or anginal pain (chest pain).
Class II (Mild)	Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain
Class III (Moderate)	Patients with cardiac disease resulting in marked limitation of physical activity. They are comfortable at rest. Less than ordinary activity causes fatigue, palpitation, dyspnea, or anginal pain.
Class IV (Severe)	Patients with cardiac disease resulting in the inability to carry on any physical activity without discomfort. Symptoms of heart failure or the anginal syndrome may be present even at rest. If any physical activity is undertaken, discomfort is increased.

The Criteria Committee of the New York Heart Association. *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels*. 9th ed. Boston, Mass: Little, Brown & Co; 1994:253-256.

Table 2. Classification of HF by LVEF

Type of HF According to LVEF	Criteria
HFrEF (HF with reduced EF)	• LVEF ≤40%
HFimpEF (HF with improved EF)	• Previous LVEF ≤40% and a follow-up measurement of LVEF >40%
HFmrEF (HF with mildly reduced EF)	• LVEF 41%–49% • Evidence of spontaneous or provokable increased LV filling pressures (e.g., elevated natriuretic peptide, noninvasive and invasive hemodynamic measurement)
HFpEF (HF with preserved EF)	• LVEF ≥50% • Evidence of spontaneous or provokable increased LV filling pressures (e.g., elevated natriuretic peptide, noninvasive and invasive hemodynamic measurement)

Guideline-directed medical therapy (GDMT) for individuals with established diagnosis of HFrEF (LVEF 40% or lower); following drug classes have class 1 recommendation:

- Angiotensin receptor-neprilysin inhibitor (ARNi) in New York Heart Association (NYHA) II-III; or angiotensin-converting enzyme inhibitor (ACEi) or angiotensin receptor blocker (ARB) in NYHA II-IV

- Beta blocker (i.e., bisoprolol, carvedilol, or sustained-release metoprolol succinate)
- Mineralocorticoid receptor antagonist (MRA; spironolactone or eplerenone)
- Sodium-glucose cotransporter 2 inhibitor (SGLT2 inhibitor)
- Diuretics as needed

GDMT for individuals with established diagnosis of HFmrEF (LVEF 41-49%); following drug classes have been noted with class 1-2b recommendations:

- Diuretics, as needed (1)
- SGLT2i (2a)
- ACEi, ARB, ARNi (2b)
- MRA (2b)
- Evidence-based beta blockers for HFrEF (2b)

Background/Overview

Heart Failure

An estimated 6.7 million adults in the United States 20 years of age and older had heart failure between 2017 to 2020. The prevalence continues to increase over time with the aging of the population. Prevalence of disease is higher in women than men 80 years of age and older. Overall prevalence is especially high in Black individuals. A 2008 study demonstrated that Black individuals had the highest risk of developing heart failure, followed by Hispanic, White, and Chinese individuals in the United States. Higher risk reflected differential prevalence of hypertension, diabetes, and lower socioeconomic status. Black individuals also had the highest proportion of incident heart failure not preceded by myocardial infarction (75%). Additionally, Black individuals have a greater 5-year case fatality rate associated with heart failure compared to White individuals. It is estimated that 20% to 30% of patients with heart failure have intraventricular conduction disorders resulting in a contraction pattern that is not coordinated and a wide QRS interval on the electrocardiogram. This abnormality appears to be associated with increased morbidity and mortality.

Treatment

Biventricular pacemakers using 3 leads (1 in the right atrium, 1 endocardial in the right ventricle, 1 epicardial for the left ventricle), also known as cardiac resynchronization therapy (CRT), have been investigated as a technique to coordinate the contraction of the ventricles, thus improving patients' hemodynamic status. Originally developed CRT devices typically used 2 ventricular leads for biventricular pacing. Devices and implantation techniques have been developed to allow for multisite pacing, with the goal of improving CRT response. This may be accomplished in 1 of 2 ways: through the use of multiple leads within the coronary sinus (triventricular pacing) or through the use of multipolar left ventricular pacing leads, which can deliver pacing stimuli at multiple sites. Wireless left ventricular endocardial pacing is also being evaluated for patients who are not candidates for or do not respond to standard epicardial pacing leads.

FDA or Other Governmental Regulatory Approval

U.S. Food and Drug Administration (FDA)

There are numerous CRT devices, combined implantable cardioverter-defibrillator (ICD) plus CRT devices (CRT-D), and combined CRT plus fluid monitoring devices. Some devices are discussed here. For example, in 2001, the InSync®‡ Biventricular Pacing System (Medtronic), a stand-alone biventricular pacemaker, was approved by the U.S. Food and Drug Administration (FDA) through the premarket approval process for the treatment of patients with New York Heart Association (NYHA) class III or IV heart failure, on a stable pharmacologic regimen, who also have a QRS duration of 130 ms or longer and a left ventricular ejection fraction (LVEF) of 35% or less. Devices by Guidant (CONTAK-CD®‡ CRT-D System) and Medtronic (InSync®‡ ICD Model 7272) have been approved by the FDA through the premarket approval process for combined CRT defibrillators for patients at high risk of sudden cardiac death due to ventricular arrhythmias and who have NYHA class III or IV heart failure with a LVEF of 35% or less, QRS interval 130 ms or longer (≥120 ms for the Guidant device), and remain symptomatic despite a stable, optimal heart failure drug therapy. In 2006, Biotronik Inc. received premarket approval from the FDA for its combined CRT-D device with ventricular pacing leads (Tupos LV/ATx CRT-D/Kronos LV-T CRT-D systems'); in 2013, the company received the FDA approval for updated CRT-D devices (Ilesto/Iforia series). On the basis of the Multicenter Automatic Defibrillator Implantation Trial with Cardiac Resynchronization Therapy (MADIT-CRT) study, indications for 3 Guidant CRT-D (Cognis®‡, Livian®‡, and Contak Renewal; Boston Scientific) devices were expanded to include patients with heart failure who receive stable optimal pharmacologic therapy for heart failure and who meet any of the following classifications:

- Moderate-to-severe heart failure (NYHA class III or IV) with an ejection fraction less than 35% and QRS interval greater than 120 ms.
- Left bundle branch block with a QRS interval greater than or equal to 130 ms, ejection fraction less than 30%, and mild (NYHA class II) ischemic or nonischemic heart failure or asymptomatic (NYHA class I) ischemic heart failure.

In April 2014, the FDA further expanded indications for multiple Medtronic CRT devices to include patients with NYHA class I, II, or III heart failure, who have an LVEF of 50% or less on stable, optimal heart failure medical therapy, if indicated, and have atrioventricular block that is expected to require a high percentage of ventricular pacing that cannot be managed with algorithms to minimize right ventricular pacing. The expanded indication was based on data from the Biventricular versus Right Ventricular Pacing in Heart Failure Patients with Atrioventricular Block (BLOCK HF) study, a Medtronic-sponsored randomized controlled trial that evaluated the use of CRT in patients with NYHA class I, II, or III heart failure, LVEF of 50% or less, and atrioventricular block.

Several CRT devices have incorporated a fourth lead, providing quadripolar pacing. The Medtronic Viva™‡ Quad XT and the Viva Quad S have a fourth lead, and the Medtronic Attain Performa®‡ has a left ventricular lead, which received clearance for marketing from the FDA in August 2014. The Dynagen™‡ X4 and Inogen™‡ X4 devices (Boston Scientific) also incorporate a fourth lead. Other

CRT devices with quadripolar leads have been approved for use outside of the U.S. (eg, St. Jude Quartet™‡ left ventricular lead).

Multiple devices manufactured by Medtronic combine a CRT with the OptiVol™‡ monitoring system. For example, in 2005, the InSync Sentry®‡ system was approved by the FDA through the supplemental premarket approval process. This combined biventricular pacemaker plus ICD is also equipped to monitor intrathoracic fluid levels using bioimpedance technology, referred to as OptiVol™‡ Fluid Status Monitoring. Bioimpedance measures, defined as the electrical resistance of tissue to flow of current, are performed many times a day using a vector from the right ventricular coil on the lead in the right side of the heart to the implanted pacemaker devices; changes in bioimpedance reflect intrathoracic fluid status and are evaluated using a computer algorithm. For example, changes in a patient's daily average of intrathoracic bioimpedance can be monitored; differences in the daily average are compared with a baseline and reported as the OptiVol™‡ Fluid Index. It has been proposed that these data may be used as an early warning system of cardiac decompensation or may provide feedback that enables a physician to tailor medical therapy. Medical policy 00287 addresses the use of external bioimpedance devices as stand-alone devices to assess cardiac output noninvasively.

The WiSE-CRT (EBR Systems) provides CRT with a small wireless electrode that is implanted within the left ventricle and controlled by ultrasound. It has European CE approval and is being studied in a multicenter pivotal trial.

FDA product code: NIK.

Rationale/Source

This medical policy was developed through consideration of peer-reviewed medical literature generally recognized by the relevant medical community, U.S. Food and Drug Administration approval status, nationally accepted standards of medical practice and accepted standards of medical practice in this community, technology evaluation centers, reference to regulations, other plan medical policies, and accredited national guidelines.

Description

Cardiac resynchronization therapy (CRT), which consists of synchronized pacing of the left and right ventricles, is intended to treat patients with heart failure and dyssynchronous ventricular contractions. Treatment involves placement of a device that paces both ventricles and coordinates ventricular pacing to maximize cardiac pumping function and left ventricular ejection fraction (LVEF).

Summary of Evidence

For individuals who have New York Heart Association (NYHA) class III or IV heart failure with an LVEF of 35% or less who are in sinus rhythm, treated with guideline-directed medical therapy, and have either left bundle branch block (LBBB) or a QRS interval of 150 ms or more who receive CRT with or without defibrillator, the evidence includes randomized controlled trials (RCTs) and

systematic reviews of RCTs. Relevant outcomes are overall survival (OS), symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. There is a large body of clinical trial evidence supporting the use of CRT in patients with NYHA class III or IV heart failure. The RCTs have consistently reported that CRT reduces mortality, improves functional status, and improves quality of life for patients with NYHA class III or IV heart failure. Multiple subgroup analyses of RCTs have demonstrated that the benefit of CRT is mainly restricted to patients with LBBB or QRS interval greater than 150 ms. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have NYHA class II heart failure with an LVEF of 30% or less who are in sinus rhythm, treated with guideline-directed medical therapy, and have either LBBB or a QRS interval of 150 ms or more who receive CRT with or without defibrillator, the evidence includes RCTs and systematic reviews of RCTs. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. For patients with NYHA class II heart failure, at least 4 RCTs assessing CRT have been published. A mortality benefit was reported in 1 of the 4 trials, the Resynchronization-Defibrillation for Ambulatory Heart Failure Trial (RAFT). None of the other 3 RCTs reported a mortality difference, but a subgroup analysis of the Multicenter Automatic Defibrillator Implantation Trial with Cardiac Resynchronization Therapy (MADIT-CRT) trial reported a mortality benefit for patients with LBBB. Among other outcome measures, hospitalizations for heart failure showed consistent reductions, but quality of life and functional status did not improve. Multiple subgroup analyses of RCTs have demonstrated that the benefit of CRT is mainly restricted to patients with LBBB or a QRS interval greater than 150 ms. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have NYHA class I heart failure who receive CRT with or without defibrillator, the evidence includes RCTs and systematic reviews of RCTs. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. Few patients with NYHA class I heart failure have been included in RCTs. The MADIT-CRT trial included 265 patients with class I heart failure. While the treatment effect on death and hospitalization favored combined implantable cardioverter-defibrillator plus CRT devices versus implantable cardioverter-defibrillator alone for class I patients, the confidence interval was large and included a 25% to 30% increase in events. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have NYHA class I, II, III or IV heart failure with LVEF of 50% or less and atrioventricular nodal block with requirement for a high percentage of ventricular pacing, treated with guideline-directed medical therapy, who receive CRT with or without defibrillator, the evidence includes RCTs. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. For patients who have atrioventricular nodal block, some degree of left ventricular dysfunction, and who would not necessarily meet conventional criteria for CRT but would require ventricular pacing, a large RCT has demonstrated improvements in heart failure-related hospitalizations and urgent care visits among patients treated with CRT instead of right ventricular pacing alone. For patients who require ventricular pacing but have no left

ventricular dysfunction, results of a small RCT have suggested that biventricular pacing is associated with improved measures of cardiac function, but the trial was small and underpowered to detect differences in clinical outcomes. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have heart failure and atrial fibrillation who receive CRT with or without defibrillator, the evidence includes 6 RCTs and a registry study. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. Results from RCTs have been conflicting, with 3 reporting improvements for patients with atrial fibrillation, including an all-cause mortality benefit, and others reporting no significant improvements. A registry study reported significant improvements in mortality and hospitalizations for patients with heart failure and atrial fibrillation treated with CRT plus defibrillator compared with implantable cardioverter-defibrillator alone. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have heart failure and AV nodal block who receive CRT, the evidence includes RCTs. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. One large RCT demonstrated that CRT led to reductions in heart failure-related hospitalizations and urgent care visits among patients with heart failure and AV block who would not necessarily meet conventional criteria for CRT. For patients who require ventricular pacing but have no LV dysfunction, results of a small RCT have suggested that biventricular pacing is associated with improvement in cardiac function, but the trial was small and underpowered to detect differences in clinical outcomes. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have heart failure who receive triple-site CRT, the evidence includes small RCTs and a meta-analysis that included nonrandomized studies. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. The available RCTs have reported improved outcomes on at least 1 measure of functional status or quality of life with triple-site CRT compared with conventional CRT. However, the trials were small and had methodologic limitations. Also, outcomes reported differed across studies. Triple-site CRT was also associated with higher radiation exposure and a greater number of additional procedures postimplantation. Larger, high-quality RCTs are needed to better define the benefit-risk ratio for triple-site CRT compared with conventional CRT. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have heart failure who receive CRT combined with remote fluid monitoring, the evidence includes 3 RCTs. Relevant outcomes are OS, symptoms, functional outcomes, quality of life, hospitalizations, and treatment-related morbidity. Three RCTs have reported no improvement in outcomes associated with remote fluid monitoring for patients with heart failure. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Supplemental Information

Clinical Input From Physician Specialty Societies and Academic Medical Centers

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

2012 Input

In response to requests, input was received from 1 physician specialty society and 8 academic medical centers while this policy was under review in 2012. There was consensus with the medically necessary statements. For patients with class I heart failure, there was mixed input as to whether cardiac resynchronization therapy (CRT) should be medically necessary. Regarding the duration of the QRS complex, commentators acknowledged that the literature supported use mainly in patients with a QRS interval greater than 150 ms, but most reviewers disagreed with restricting CRT use to patients in that group because that duration was not currently the accepted standard of care. For patients with atrial fibrillation, the input was mixed on whether biventricular pacing improves outcomes.

Practice Guidelines and Position Statements

Guidelines or position statements will be considered for inclusion in 'Supplemental Information' if they were issued by, or jointly by, a US professional society, an international society with US representation, or National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

American College of Cardiology et al

The American College of Cardiology (ACC), American Heart Association, and Heart Rhythm Society (2019) published joint guidelines on the evaluation and management of patients with bradycardia and cardiac conduction delay. These guidelines included the following recommendations on CRT (see Table 3).

Table 3. Joint Guidelines on Treatment of Patients with Bradycardia and Cardiac Conduction Delay

Recommendation	COR	LOE
"In patients with atrioventricular block who have an indication for permanent pacing with a LVEF between 36% and 50% and are expected to require ventricular pacing more than 40% of the time, it is reasonable to choose pacing methods that maintain physiologic ventricular activation (e.g., cardiac resynchronization therapy [CRT] or His bundle pacing) over right ventricular pacing."	IIa	B-R^{SR}
"In patients with atrioventricular block who have an indication for permanent pacing with a LVEF between 36% and 50% and are expected to require ventricular pacing less than 40% of the time, it is reasonable to choose right ventricular pacing	IIa	B-R

Recommendation	COR	LOE
over pacing methods that maintain physiologic ventricular activation (e.g., CRT or His bundle pacing)."		

COR: class of recommendation; CRT: cardiac resynchronization therapy; LOE: level of evidence; LVEF: left ventricular ejection fraction; SR: systematic review.

A focused update to 2008 guidelines for device-based treatment of cardiac rhythm abnormalities was published jointly by ACC Foundation, American Heart Association, and Heart Rhythm Society in 2012. The ACC and American Heart Association (2013) subsequently published guidelines for the management of heart failure. These guidelines made recommendations on CRT for heart failure that are in line with those made by the ACC, American Heart Association, and Heart Rhythm Society related to CRT for heart failure in 2012. The ACC, American Heart Association, and Heart Failure Society of America published guidelines on the management of heart failure (2022) to replace the 2013 guidelines. The most recent recommendations on CRT for heart failure from the guidelines are included in Table 4.

Table 4. 2022 Joint Guidelines on Device-Based Treatment of Cardiac Rhythm Abnormalities

Recommendation	COR	LOE
CRT is indicated for patients who have LVEF less than or equal to 35%, sinus rhythm, LBBB with a QRS duration greater than or equal to 150 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT	I	B[a]
CRT can be useful for patients who have LVEF less than or equal to 35%, sinus rhythm, LBBB with a QRS duration 120 to 149 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT	IIa	B[b]
CRT can be useful for patients who have LVEF less than or equal to 35%, sinus rhythm, a non-LBBB pattern with a QRS duration greater than or equal to 150 ms, and NYHA class II, III, or ambulatory class IV symptoms on GDMT	IIa	B[a]
CRT is reasonable in patients with high-degree or complete heart block and LVEF of 36% to 50%	IIa	B[a]
CRT can be useful in patients with atrial fibrillation and LVEF less than or equal to 35% on GDMT if a) the patient requires ventricular pacing or otherwise meets CRT criteria and b) AV nodal ablation or pharmacologic rate control will allow near 100% ventricular pacing with CRT	IIa	B[b]
CRT can be useful for patients on GDMT who have LVEF less than or equal to 35% and are undergoing new or replacement device placement with anticipated requirement for significant (>40%) ventricular pacing	IIa	B[b]

Recommendation	COR	LOE
CRT may be considered for patients who have LVEF less than or equal to 30%, ischemic etiology of heart failure, sinus rhythm, LBBB with a QRS duration of greater than or equal to 150 ms, and NYHA class I symptoms on GDMT	IIb	B[b]
CRT may be considered for patients who have LVEF less than or equal to 35%, sinus rhythm, a non-LBBB pattern with QRS duration 120 to 149 ms, and NYHA class III/ambulatory class IV on GDMT	IIb	B[b]
CRT is not recommended in patients with QRS duration less than 120 ms	III[c]	B[a]
CRT is not recommended for patients with NYHA class I or II symptoms and non-LBBB pattern with QRS duration less than 150 ms	III[c]	B[b]
CRT-D is not indicated for patients whose comorbidities and/or frailty limit survival with good functional capacity to less than 1 year	III[c]	C[d]

AV: atrioventricular; COR: class of recommendation; CRT: cardiac resynchronization therapy; CRT-D: cardiac resynchronization therapy with defibrillation; GDMT: guideline-directed medical therapy; LBBB: left bundle branch block; LOE: level of evidence; LVEF: left ventricular ejection fraction; NYHA: New York Heart Association; RCT: randomized controlled trial.
[a]Moderate quality evidence from 1 or more RCTs.
[b]Moderate-quality evidence from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies.
[c]No benefit.
[d]Limited data.

Heart Failure Society of America
The Heart Failure Society of America (2010) released comprehensive guidelines on the management of heart failure. The guidelines were updated in conjunction with the ACC and American Heart Association in 2022; updated recommendations can be found above, in Table 4.

Heart Rhythm Society, et al
In 2024, the Heart Rhythm Society, European Heart Rhythm Association, Asia Pacific Heart Rhythm Society, and the Latin American Heart Rhythm Society published a guideline on cardiac physiologic pacing, which includes both CRT with biventricular pacing and conduction system pacing (ie, His bundle pacing or left bundle branch area pacing). In patients with heart failure, the authors stated that there is more evidence supporting the use of CRT than conduction system pacing, and that ongoing studies will address this question. The following patients should receive CRT: left ventricular ejection fraction (LVEF) ≤35%, left bundle branch block, QRS duration ≥150 ms, and New York Heart Association class II to IV symptoms despite guideline-directed therapy. Patients who meet all of the above criteria but have an LVEF ≤30%, or patients who meet all of the above criteria but have a QRS duration of 120 to 149 ms, can also be considered for CRT. Symptom control/functional class and LVEF may improve with CRT in patients with LVEF ≤35%, sinus

rhythm, QRS duration ≥150 ms, and New York Heart Association class III or ambulatory class IV symptoms despite guideline-directed therapy.
The following patients with cardiovascular implanted electrical devices are appropriate candidates for CRT: decline in left ventricular function or worsening symptoms due to substantial ventricular pacing. Another option for the same patients is switching to a conduction system pacing device.

In the setting of atrial fibrillation, CRT is recommended in patients undergoing ablation who have LVEF ≤50% or who are otherwise eligible for CRT implantation.

National Institute for Health and Care Excellence
The NICE (2014) guidance provided recommendations on CRT for heart failure. The recommendations for patients with LVEF of 35% or less are listed in Table 5.

Table 5. Guidelines on Management of Cardiac Resynchronization Therapy for Heart Failure

Indication	Recommendation
NYHA class I to IV with QRS interval <120 ms	CRT not recommended
NYHA class IV with QRS interval 120 to 149 ms and without LBBB	CRT-P recommended
NYHA class II to III with QRS interval 120 to 149 ms and with LBBB	CRT-D recommended
NYHA class III to IV with QRS interval 120 to 149 ms and with LBBB	CRT-P recommended
NYHA class I to III with QRS interval ≥150 ms (with or without LBBB)	CRT-D recommended
NYHA class III to IV with QRS interval ≥150 ms (with or without LBBB)	CRT-P recommended

CRT: cardiac resynchronization therapy; CRT-D: cardiac resynchronization therapy with implantable cardioverter-defibrillator; CRT-P: cardiac resynchronization therapy with pacemaker; LBBB: left bundle branch block; NYHA: New York Heart Association.

U.S. Preventive Services Task Force Recommendations
Not applicable.

Medicare National Coverage
There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

Ongoing and Unpublished Clinical Trials
Some currently ongoing and unpublished trials that might influence this review are listed in Table 6.

Table 6. Summary of Key Trials

NCT No.	Trial Name	Planned Enrollment	Completion Date
Ongoing			
NCT06105580	Conduction System Pacing vs Biventricular Resynchronization Therapy in Systolic Dysfunction and Wide QRS: Mortality, Heart Failure Hospitalization or Cardiac Transplant	320	Nov 2027
NCT05467163	CONDUCTion System Pacing Versus Biventricular Pacing After Atrioventricular Node Ablation in Heart Failure Patients With Symptomatic Atrial Fibrillation and Narrow QRS (CONDUCT-AF Trial)	82	Dec 2026
NCT05187611	Conduction System Pacing vs Biventricular Resynchronization Therapy in Systolic Dysfunction and Wide QRS: CONSYST-CRT Randomized Clinical Trial.	130	Oct 2024
NCT05572736	Conduction System Pacing Versus Biventricular Resynchronization in Patients With Chronic Heart Failure (PhysioSync-HF)	179	Dec 2024
NCT01994252	Resynchronization/Defibrillation for Ambulatory Heart Failure Trial in Patients With Permanent Atrial Fibrillation (RAFT-PermAF)	200	Feb 2024
NCT04225520	Assessment of Mechanical Dyssynchrony as Selection Criterion for Cardiac Resynchronization Therapy	700	Dec 2023
NCT02454439	Assessment of Cardiac Resynchronization Therapy in Patients With Wide QRS and Non-specific Intraventricular Conduction Delay: a Randomized Trial	200	July 2024
NCT03366545[a]	Observation of Clinical Routine Care for Heart Failure Patients Implanted With BIOTRONIK CRT Devices	3000	June 2025
NCT02922036[a]	Stimulation Of the Left Ventricular Endocardium for Cardiac Resynchronization Therapy in Non-Responders, Previously Untreatable and High Risk Upgrade Patients (SOLVE CRT)	300	Apr 2024

NCT No.	Trial Name	Planned Enrollment	Completion Date
NCT05451797	A Feasibility Study Into the Implant of the WiSE CRT System With an Intracardiac Pacemaker to Achieve Totally Leadless CRT	40	Jan 2025

NCT: national clinical trial.
[a]Denotes industry sponsored or co-sponsored trials

References

1. Carelon Medical Benefits Management, Inc., Clinical Appropriateness Guidelines for Cardiovascular Appropriate Use Criteria: Cardiac Resynchronization Therapy, October 20, 2024.
2. The Criteria Committee of the New York Heart Association. *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels*. 9th ed. Boston, Mass: Little, Brown & Co; 1994:253-256.
3. Canadian Cardiovascular Society Guidelines on the Use of Cardiac Resynchronization Therapy: Evidence and Patient Selection. Exner, Derek V. et al. Canadian Journal of Cardiology, Volume 29, Issue 2, 182 – 195.
4. Martin SS, Aday AW, Almarzooq ZI, et al. 2024 Heart Disease and Stroke Statistics: A Report of US and Global Data From the American Heart Association. Circulation. Feb 20 2024; 149(8): e347-e913. PMID 38264914
5. Bahrami H, Kronmal R, Bluemke DA, et al. Differences in the incidence of congestive heart failure by ethnicity: the multi-ethnic study of atherosclerosis. Arch Intern Med. Oct 27 2008; 168(19): 2138-45. PMID 18955644
6. Loehr LR, Rosamond WD, Chang PP, et al. Heart failure incidence and survival (from the Atherosclerosis Risk in Communities study). Am J Cardiol. Apr 01 2008; 101(7): 1016-22. PMID 18359324
7. Food and Drug Administration. Summary of Safety and Effectiveness Data (SSED): Cardiac Resynchronization Therapy Defibrillator (CRT-D). 2010; https://www.accessdata.fda.gov/cdrh_docs/pdf/P010012S230b.pdf.
8. Food and Drug Administration. Approval Order: Biotronic PMA P050023. 2013; https://www.accessdata.fda.gov/cdrh_docs/pdf5/P050023S058A.pdf.
9. Al-Majed NS, McAlister FA, Bakal JA, et al. Meta-analysis: cardiac resynchronization therapy for patients with less symptomatic heart failure. Ann Intern Med. Mar 15 2011; 154(6): 401-12. PMID 21320922
10. Ezekowitz JA, Rowe BH, Dryden DM, et al. Systematic review: implantable cardioverter defibrillators for adults with left ventricular systolic dysfunction. Ann Intern Med. Aug 21 2007; 147(4): 251-62. PMID 17709759
11. McAlister FA, Ezekowitz JA, Wiebe N, et al. Systematic review: cardiac resynchronization in patients with symptomatic heart failure. Ann Intern Med. Sep 07 2004; 141(5): 381-90. PMID 15353430

12. Adabag S, Roukoz H, Anand IS, et al. Cardiac resynchronization therapy in patients with minimal heart failure: a systematic review and meta-analysis. J Am Coll Cardiol. Aug 23 2011; 58(9): 935-41. PMID 21851882
13. Bertoldi EG, Polanczyk CA, Cunha V, et al. Mortality reduction of cardiac resynchronization and implantable cardioverter-defibrillator therapy in heart failure: an updated meta-analysis. Does recent evidence change the standard of care?. J Card Fail. Oct 2011; 17(10): 860-6. PMID 21962425
14. Nery PB, Ha AC, Keren A, et al. Cardiac resynchronization therapy in patients with left ventricular systolic dysfunction and right bundle branch block: a systematic review. Heart Rhythm. Jul 2011; 8(7): 1083-7. PMID 21300176
15. Tu R, Zhong G, Zeng Z, et al. Cardiac resynchronization therapy in patients with mild heart failure: a systematic review and meta-analysis of randomized controlled trials. Cardiovasc Drugs Ther. Aug 2011; 25(4): 331-40. PMID 21750900
16. Santangeli P, Di Biase L, Pelargonio G, et al. Cardiac resynchronization therapy in patients with mild heart failure: a systematic review and meta-analysis. J Interv Card Electrophysiol. Nov 2011; 32(2): 125-35. PMID 21594629
17. Wells G, Parkash R, Healey JS, et al. Cardiac resynchronization therapy: a meta-analysis of randomized controlled trials. CMAJ. Mar 08 2011; 183(4): 421-9. PMID 21282316
18. Chen S, Ling Z, Kiuchi MG, et al. The efficacy and safety of cardiac resynchronization therapy combined with implantable cardioverter defibrillator for heart failure: a meta-analysis of 5674 patients. Europace. Jul 2013; 15(7): 992-1001. PMID 23419662
19. Woods B, Hawkins N, Mealing S, et al. Individual patient data network meta-analysis of mortality effects of implantable cardiac devices. Heart. Nov 2015; 101(22): 1800-6. PMID 26269413
20. Sun WP, Li CL, Guo JC, et al. Long-term efficacy of implantable cardiac resynchronization therapy plus defibrillator for primary prevention of sudden cardiac death in patients with mild heart failure: an updated meta-analysis. Heart Fail Rev. Jul 2016; 21(4): 447-53. PMID 27043219
21. Ali-Hassan-Al-Saegh S, Mirhosseini SJ, Karimi-Bondarabadi AA, et al. Cardiac resynchronization therapy in patients with mild heart failure is a reversal therapy. Indian Heart J. 2017; 69(1): 112-118. PMID 28228294
22. Lozano I, Bocchiardo M, Achtelik M, et al. Impact of biventricular pacing on mortality in a randomized crossover study of patients with heart failure and ventricular arrhythmias. Pacing Clin Electrophysiol. Nov 2000; 23(11 Pt 2): 1711-2. PMID 11139906
23. Cazeau S, Leclercq C, Lavergne T, et al. Effects of multisite biventricular pacing in patients with heart failure and intraventricular conduction delay. N Engl J Med. Mar 22 2001; 344(12): 873-80. PMID 11259720
24. Garrigue S, Bordachar P, Reuter S, et al. Comparison of permanent left ventricular and biventricular pacing in patients with heart failure and chronic atrial fibrillation: prospective haemodynamic study. Heart. Jun 2002; 87(6): 529-34. PMID 12010933
25. Leclercq C, Walker S, Linde C, et al. Comparative effects of permanent biventricular and right-univentricular pacing in heart failure patients with chronic atrial fibrillation. Eur Heart J. Nov 2002; 23(22): 1780-7. PMID 12419298

26. Abraham WT, Fisher WG, Smith AL, et al. Cardiac resynchronization in chronic heart failure. N Engl J Med. Jun 13 2002; 346(24): 1845-53. PMID 12063368
27. Auricchio A, Stellbrink C, Sack S, et al. Long-term clinical effect of hemodynamically optimized cardiac resynchronization therapy in patients with heart failure and ventricular conduction delay. J Am Coll Cardiol. Jun 19 2002; 39(12): 2026-33. PMID 12084604
28. Auricchio A, Stellbrink C, Butter C, et al. Clinical efficacy of cardiac resynchronization therapy using left ventricular pacing in heart failure patients stratified by severity of ventricular conduction delay. J Am Coll Cardiol. Dec 17 2003; 42(12): 2109-16. PMID 14680736
29. Higgins SL, Hummel JD, Niazi IK, et al. Cardiac resynchronization therapy for the treatment of heart failure in patients with intraventricular conduction delay and malignant ventricular tachyarrhythmias. J Am Coll Cardiol. Oct 15 2003; 42(8): 1454-9. PMID 14563591
30. Young JB, Abraham WT, Smith AL, et al. Combined cardiac resynchronization and implantable cardioversion defibrillation in advanced chronic heart failure: the MIRACLE ICD Trial. JAMA. May 28 2003; 289(20): 2685-94. PMID 12771115
31. Bristow MR, Saxon LA, Boehmer J, et al. Cardiac-resynchronization therapy with or without an implantable defibrillator in advanced chronic heart failure. N Engl J Med. May 20 2004; 350(21): 2140-50. PMID 15152059
32. Abraham WT, Young JB, León AR, et al. Effects of cardiac resynchronization on disease progression in patients with left ventricular systolic dysfunction, an indication for an implantable cardioverter-defibrillator, and mildly symptomatic chronic heart failure. Circulation. Nov 02 2004; 110(18): 2864-8. PMID 15505095
33. Cleland JG, Daubert JC, Erdmann E, et al. The effect of cardiac resynchronization on morbidity and mortality in heart failure. N Engl J Med. Apr 14 2005; 352(15): 1539-49. PMID 15753115
34. Gasparini M, Bocchiardo M, Lunati M, et al. Comparison of 1-year effects of left ventricular and biventricular pacing in patients with heart failure who have ventricular arrhythmias and left bundle-branch block: the Bi vs Left Ventricular Pacing: an International Pilot Evaluation on Heart Failure Patients with Ventricular Arrhythmias (BELIEVE) multicenter prospective randomized pilot study. Am Heart J. Jul 2006; 152(1): 155.e1-7. PMID 16824846
35. Kindermann M, Hennen B, Jung J, et al. Biventricular versus conventional right ventricular stimulation for patients with standard pacing indication and left ventricular dysfunction: the Homburg Biventricular Pacing Evaluation (HOBIPACE). J Am Coll Cardiol. May 16 2006; 47(10): 1927-37. PMID 16697307
36. Piccirillo G, Magrì D, di Carlo S, et al. Influence of cardiac-resynchronization therapy on heart rate and blood pressure variability: 1-year follow-up. Eur J Heart Fail. Nov 2006; 8(7): 716-22. PMID 16513420
37. Rao RK, Kumar UN, Schafer J, et al. Reduced ventricular volumes and improved systolic function with cardiac resynchronization therapy: a randomized trial comparing simultaneous biventricular pacing, sequential biventricular pacing, and left ventricular pacing. Circulation. Apr 24 2007; 115(16): 2136-44. PMID 17420340
38. Leclercq C, Cazeau S, Lellouche D, et al. Upgrading from single chamber right ventricular to biventricular pacing in permanently paced patients with worsening heart failure: The RD-CHF Study. Pacing Clin Electrophysiol. Jan 2007; 30 Suppl 1: S23-30. PMID 17302711

39. Beshai JF, Grimm RA, Nagueh SF, et al. Cardiac-resynchronization therapy in heart failure with narrow QRS complexes. N Engl J Med. Dec 13 2007; 357(24): 2461-71. PMID 17986493
40. Brignole M, Auricchio A, Baron-Esquivias G, et al. 2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy: the Task Force on cardiac pacing and resynchronization therapy of the European Society of Cardiology (ESC). Developed in collaboration with the European Heart Rhythm Association (EHRA). Eur Heart J. Aug 2013; 34(29): 2281-329. PMID 23801822
41. Linde C, Abraham WT, Gold MR, et al. Randomized trial of cardiac resynchronization in mildly symptomatic heart failure patients and in asymptomatic patients with left ventricular dysfunction and previous heart failure symptoms. J Am Coll Cardiol. Dec 02 2008; 52(23): 1834-1843. PMID 19038680
42. Moss AJ, Hall WJ, Cannom DS, et al. Cardiac-resynchronization therapy for the prevention of heart-failure events. N Engl J Med. Oct 01 2009; 361(14): 1329-38. PMID 19723701
43. Pinter A, Mangat I, Korley V, et al. Assessment of resynchronization therapy on functional status and quality of life in patients requiring an implantable defibrillator. Pacing Clin Electrophysiol. Dec 2009; 32(12): 1509-19. PMID 19765233
44. Boriani G, Kranig W, Donal E, et al. A randomized double-blind comparison of biventricular versus left ventricular stimulation for cardiac resynchronization therapy: the Biventricular versus Left Univentricular Pacing with ICD Back-up in Heart Failure Patients (B-LEFT HF) trial. Am Heart J. Jun 2010; 159(6): 1052-1058.e1. PMID 20569719
45. Martinelli Filho M, de Siqueira SF, Costa R, et al. Conventional versus biventricular pacing in heart failure and bradyarrhythmia: the COMBAT study. J Card Fail. Apr 2010; 16(4): 293-300. PMID 20350695
46. Tang AS, Wells GA, Talajic M, et al. Cardiac-resynchronization therapy for mild-to-moderate heart failure. N Engl J Med. Dec 16 2010; 363(25): 2385-95. PMID 21073365
47. Thibault B, Ducharme A, Harel F, et al. Left ventricular versus simultaneous biventricular pacing in patients with heart failure and a QRS complex ≥120 milliseconds. Circulation. Dec 20 2011; 124(25): 2874-81. PMID 22104549
48. van Geldorp IE, Vernooy K, Delhaas T, et al. Beneficial effects of biventricular pacing in chronically right ventricular paced patients with mild cardiomyopathy. Europace. Feb 2010; 12(2): 223-9. PMID 19966323
49. Foley PW, Patel K, Irwin N, et al. Cardiac resynchronisation therapy in patients with heart failure and a normal QRS duration: the RESPOND study. Heart. Jul 2011; 97(13): 1041-7. PMID 21339317
50. Gillis AM, Kerr CR, Philippon F, et al. Impact of cardiac resynchronization therapy on hospitalizations in the Resynchronization-Defibrillation for Ambulatory Heart Failure trial. Circulation. May 20 2014; 129(20): 2021-30. PMID 24610807
51. Sapp JL, Sivakumaran S, Redpath CJ, et al. Long-Term Outcomes of Resynchronization-Defibrillation for Heart Failure. N Engl J Med. Jan 18 2024; 390(3): 212-220. PMID 38231622
52. Goldenberg I, Hall WJ, Beck CA, et al. Reduction of the risk of recurring heart failure events with cardiac resynchronization therapy: MADIT-CRT (Multicenter Automatic Defibrillator Implantation Trial With Cardiac Resynchronization Therapy). J Am Coll Cardiol. Aug 09 2011; 58(7): 729-37. PMID 21816309

53. Goldenberg I, Kutyifa V, Klein HU, et al. Survival with cardiac-resynchronization therapy in mild heart failure. N Engl J Med. May 01 2014; 370(18): 1694-701. PMID 24678999
54. Hosseini SM, Moazzami K, Rozen G, et al. Utilization and in-hospital complications of cardiac resynchronization therapy: trends in the United States from 2003 to 2013. Eur Heart J. Jul 14 2017; 38(27): 2122-2128. PMID 28329322
55. Yu CM, Abraham WT, Bax J, et al. Predictors of response to cardiac resynchronization therapy (PROSPECT)--study design. Am Heart J. Apr 2005; 149(4): 600-5. PMID 15990740
56. Chung ES, Leon AR, Tavazzi L, et al. Results of the Predictors of Response to CRT (PROSPECT) trial. Circulation. May 20 2008; 117(20): 2608-16. PMID 18458170
57. Thibault B, Harel F, Ducharme A, et al. Cardiac resynchronization therapy in patients with heart failure and a QRS complex 120 milliseconds: the Evaluation of Resynchronization Therapy for Heart Failure (LESSER-EARTH) trial. Circulation. Feb 26 2013; 127(8): 873-81. PMID 23388213
58. Sipahi I, Carrigan TP, Rowland DY, et al. Impact of QRS duration on clinical event reduction with cardiac resynchronization therapy: meta-analysis of randomized controlled trials. Arch Intern Med. Sep 12 2011; 171(16): 1454-62. PMID 21670335
59. Bryant AR, Wilton SB, Lai MP, et al. Association between QRS duration and outcome with cardiac resynchronization therapy: a systematic review and meta-analysis. J Electrocardiol. 2013; 46(2): 147-55. PMID 23394690
60. Stavrakis S, Lazzara R, Thadani U. The benefit of cardiac resynchronization therapy and QRS duration: a meta-analysis. J Cardiovasc Electrophysiol. Feb 2012; 23(2): 163-8. PMID 21815961
61. Sipahi I, Chou JC, Hyden M, et al. Effect of QRS morphology on clinical event reduction with cardiac resynchronization therapy: meta-analysis of randomized controlled trials. Am Heart J. Feb 2012; 163(2): 260-7.e3. PMID 22305845
62. Kang SH, Oh IY, Kang DY, et al. Cardiac resynchronization therapy and QRS duration: systematic review, meta-analysis, and meta-regression. J Korean Med Sci. Jan 2015; 30(1): 24-33. PMID 25552880
63. Shah RM, Patel D, Molnar J, et al. Cardiac-resynchronization therapy in patients with systolic heart failure and QRS interval ≤130 ms: insights from a meta-analysis. Europace. Feb 2015; 17(2): 267-73. PMID 25164431
64. Friedman DJ, Al-Khatib SM, Dalgaard F, et al. Cardiac Resynchronization Therapy Improves Outcomes in Patients With Intraventricular Conduction Delay But Not Right Bundle Branch Block: A Patient-Level Meta-Analysis of Randomized Controlled Trials. Circulation. Mar 07 2023; 147(10): 812-823. PMID 36700426
65. Peterson PN, Greiner MA, Qualls LG, et al. QRS duration, bundle-branch block morphology, and outcomes among older patients with heart failure receiving cardiac resynchronization therapy. JAMA. Aug 14 2013; 310(6): 617-26. PMID 23942680
66. Kutyifa V, Stockburger M, Daubert JP, et al. PR interval identifies clinical response in patients with non-left bundle branch block: a Multicenter Automatic Defibrillator Implantation Trial-Cardiac Resynchronization Therapy substudy. Circ Arrhythm Electrophysiol. Aug 2014; 7(4): 645-51. PMID 24963007

67. Stockburger M, Moss AJ, Klein HU, et al. Sustained clinical benefit of cardiac resynchronization therapy in non-LBBB patients with prolonged PR-interval: MADIT-CRT long-term follow-up. Clin Res Cardiol. Nov 2016; 105(11): 944-952. PMID 27318807
68. Friedman DJ, Bao H, Spatz ES, et al. Association Between a Prolonged PR Interval and Outcomes of Cardiac Resynchronization Therapy: A Report From the National Cardiovascular Data Registry. Circulation. Nov 22 2016; 134(21): 1617-1628. PMID 27760795
69. Hawkins NM, Petrie MC, MacDonald MR, et al. Selecting patients for cardiac resynchronization therapy: electrical or mechanical dyssynchrony?. Eur Heart J. Jun 2006; 27(11): 1270-81. PMID 16527827
70. Muto C, Solimene F, Gallo P, et al. A randomized study of cardiac resynchronization therapy defibrillator versus dual-chamber implantable cardioverter-defibrillator in ischemic cardiomyopathy with narrow QRS: the NARROW-CRT study. Circ Arrhythm Electrophysiol. Jun 2013; 6(3): 538-45. PMID 23592833
71. Ruschitzka F, Abraham WT, Singh JP, et al. Cardiac-resynchronization therapy in heart failure with a narrow QRS complex. N Engl J Med. Oct 10 2013; 369(15): 1395-405. PMID 23998714
72. Brignole M, Pokushalov E, Pentimalli F, et al. A randomized controlled trial of atrioventricular junction ablation and cardiac resynchronization therapy in patients with permanent atrial fibrillation and narrow QRS. Eur Heart J. Dec 01 2018; 39(45): 3999-4008. PMID 30165479
73. Brignole M, Pentimalli F, Palmisano P, et al. AV junction ablation and cardiac resynchronization for patients with permanent atrial fibrillation and narrow QRS: the APAF-CRT mortality trial. Eur Heart J. Dec 07 2021; 42(46): 4731-4739. PMID 34453840
74. Brignole M, Botto G, Mont L, et al. Cardiac resynchronization therapy in patients undergoing atrioventricular junction ablation for permanent atrial fibrillation: a randomized trial. Eur Heart J. Oct 2011; 32(19): 2420-9. PMID 21606084
75. Kalscheur MM, Saxon LA, Lee BK, et al. Outcomes of cardiac resynchronization therapy in patients with intermittent atrial fibrillation or atrial flutter in the COMPANION trial. Heart Rhythm. Jun 2017; 14(6): 858-865. PMID 28323173
76. Dalgaard F, Fudim M, Al-Khatib SM, et al. Cardiac resynchronization therapy in patients with a prior history of atrial fibrillation: Insights from four major clinical trials. J Cardiovasc Electrophysiol. Sep 2023; 34(9): 1914-1924. PMID 37522254
77. Healey JS, Hohnloser SH, Exner DV, et al. Cardiac resynchronization therapy in patients with permanent atrial fibrillation: results from the Resynchronization for Ambulatory Heart Failure Trial (RAFT). Circ Heart Fail. Sep 01 2012; 5(5): 566-70. PMID 22896584
78. Khazanie P, Greiner MA, Al-Khatib SM, et al. Comparative Effectiveness of Cardiac Resynchronization Therapy Among Patients With Heart Failure and Atrial Fibrillation: Findings From the National Cardiovascular Data Registry's Implantable Cardioverter-Defibrillator Registry. Circ Heart Fail. Jun 2016; 9(6). PMID 27296396
79. Curtis AB, Worley SJ, Adamson PB, et al. Biventricular pacing for atrioventricular block and systolic dysfunction. N Engl J Med. Apr 25 2013; 368(17): 1585-93. PMID 23614585
80. Curtis AB, Worley SJ, Chung ES, et al. Improvement in Clinical Outcomes With Biventricular Versus Right Ventricular Pacing: The BLOCK HF Study. J Am Coll Cardiol. May 10 2016; 67(18): 2148-2157. PMID 27151347

81. Yu CM, Chan JY, Zhang Q, et al. Biventricular pacing in patients with bradycardia and normal ejection fraction. N Engl J Med. Nov 26 2009; 361(22): 2123-34. PMID 19915220
82. Chan JY, Fang F, Zhang Q, et al. Biventricular pacing is superior to right ventricular pacing in bradycardia patients with preserved systolic function: 2-year results of the PACE trial. Eur Heart J. Oct 2011; 32(20): 2533-40. PMID 21875860
83. Yu CM, Fang F, Luo XX, et al. Long-term follow-up results of the pacing to avoid cardiac enlargement (PACE) trial. Eur J Heart Fail. Sep 2014; 16(9): 1016-25. PMID 25179592
84. Doshi RN, Daoud EG, Fellows C, et al. Left ventricular-based cardiac stimulation post AV nodal ablation evaluation (the PAVE study). J Cardiovasc Electrophysiol. Nov 2005; 16(11): 1160-5. PMID 16302897
85. Anselme F, Bordachar P, Pasquié JL, et al. Safety, feasibility, and outcome results of cardiac resynchronization with triple-site ventricular stimulation compared to conventional cardiac resynchronization. Heart Rhythm. Jan 2016; 13(1): 183-9. PMID 26325531
86. Bencardino G, Di Monaco A, Russo E, et al. Outcome of Patients Treated by Cardiac Resynchronization Therapy Using a Quadripolar Left Ventricular Lead. Circ J. 2016; 80(3): 613-8. PMID 26821688
87. Lenarczyk R, Kowalski O, Sredniawa B, et al. Implantation feasibility, procedure-related adverse events and lead performance during 1-year follow-up in patients undergoing triple-site cardiac resynchronization therapy: a substudy of TRUST CRT randomized trial. J Cardiovasc Electrophysiol. Nov 2012; 23(11): 1228-36. PMID 22651239
88. Pappone C, Ćalović Ž, Vicedomini G, et al. Improving cardiac resynchronization therapy response with multipoint left ventricular pacing: Twelve-month follow-up study. Heart Rhythm. Jun 2015; 12(6): 1250-8. PMID 25678057
89. Rogers DP, Lambiase PD, Lowe MD, et al. A randomized double-blind crossover trial of triventricular versus biventricular pacing in heart failure. Eur J Heart Fail. May 2012; 14(5): 495-505. PMID 22312038
90. Gould J, Claridge S, Jackson T, et al. Standard care vs. TRIVEntricular pacing in Heart Failure (STRIVE HF): a prospective multicentre randomized controlled trial of triventricular pacing vs. conventional biventricular pacing in patients with heart failure and intermediate QRS left bundle branch block. Europace. May 03 2022; 24(5): 796-806. PMID 35079787
91. Zhang B, Guo J, Zhang G. Comparison of triple-site ventricular pacing versus conventional cardiac resynchronization therapy in patients with systolic heart failure: A meta-analysis of randomized and observational studies. J Arrythmia. 2018;34:55-64. PMID
92. Domenichini G, Rahneva T, Diab IG, et al. The lung impedance monitoring in treatment of chronic heart failure (the LIMIT-CHF study). Europace. Mar 2016; 18(3): 428-35. PMID 26683599
93. Lüthje L, Vollmann D, Seegers J, et al. A randomized study of remote monitoring and fluid monitoring for the management of patients with implanted cardiac arrhythmia devices. Europace. Aug 2015; 17(8): 1276-81. PMID 25983310
94. Böhm M, Drexler H, Oswald H, et al. Fluid status telemedicine alerts for heart failure: a randomized controlled trial. Eur Heart J. Nov 01 2016; 37(41): 3154-3163. PMID 26984864
95. Kusumoto FM, Schoenfeld MH, Barrett C, et al. 2018 ACC/AHA/HRS Guideline on the Evaluation and Management of Patients With Bradycardia and Cardiac Conduction Delay:

Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines, and the Heart Rhythm Society. J Am Coll Cardiol. Aug 20 2019; 74(7): 932-987. PMID 30412710

96. Epstein AE, DiMarco JP, Ellenbogen KA, et al. ACC/AHA/HRS 2008 Guidelines for Device-Based Therapy of Cardiac Rhythm Abnormalities: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the ACC/AHA/NASPE 2002 Guideline Update for Implantation of Cardiac Pacemakers and Antiarrhythmia Devices): developed in collaboration with the American Association for Thoracic Surgery and Society of Thoracic Surgeons. Circulation. May 27 2008; 117(21): e350-408. PMID 18483207
97. Tracy CM, Epstein AE, Darbar D, et al. 2012 ACCF/AHA/HRS focused update of the 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. [corrected]. Circulation. Oct 02 2012; 126(14): 1784-800. PMID 22965336
98. Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA guideline for the management of heart failure: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on practice guidelines. Circulation. Oct 15 2013; 128(16): 1810-52. PMID 23741057
99. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol. May 03 2022; 79(17): e263-e421. PMID 35379503
100. Lindenfeld J, Albert NM, Boehmer JP, et al. HFSA 2010 Comprehensive Heart Failure Practice Guideline. J Card Fail. Jun 2010; 16(6): e1-194. PMID 20610207
101. Chung MK, Patton KK, Lau CP, et al. 2023 HRS/APHRS/LAHRS guideline on cardiac physiologic pacing for the avoidance and mitigation of heart failure. Heart Rhythm. Sep 2023; 20(9): e17-e91. PMID 37283271
102. National Institute for Health and Care Excellence (NICE). Implantable cardioverter defibrillators and cardiac resynchronisation therapy for arrhythmias and heart failure [TA314]. 2014; https://www.nice.org.uk/guidance/ta314.

Policy History

Original Effective Date: 06/05/2002
Current Effective Date: 06/01/2025

04/18/2002	Medical Policy Committee review
06/05/2002	Managed Care Advisory Council approval
06/24/2002	Format revision. No substance change to policy.
06/01/2004	Medical Director review. Format revision. Clinical criteria revision.
06/15/2004	Medical Policy Committee review
06/28/2004	Managed Care Advisory Council approval
11/02/2004	Medical Director review. Clinical criteria revision
11/16/2004	Medical Policy Committee review

11/29/2004	Managed Care Advisory Council approval
04/05/2005	Medical Director review
04/18/2005	Medical Director review
04/22/2005	Medical Director review
04/27/2005	Medical Policy Committee review. Clinical criteria revision. Combination automatic implantable cardiac defibrillators (AICD) and biventricular pacemakers criteria further defined; "patients with New York Heart Association (NYHA) Class III or IV CHF, with a QRS duration of >120-130 msec". FDA labeled indication for the InSync device and CONTAK CD® CRT-D System added. Investigational statement added to address cases not meeting clinical criteria.
04/04/2007	Medical Director review
04/18/2007	Medical Policy Committee approval. Policy statements revised indicating that intrathoracic bioimpedance is considered investigational as a component of a biventricular pacemaker; patient selection criteria for combined biventricular pacemaker/ACID revised to indicate that a combined device would be considered medically necessary in patients who meet the criteria for a biventricular pacemaker alone. Rationale /Source and Background/Overview updated.
04/02/2008	Medical Director review
04/16/2008	Medical Policy Committee approval. No changes to policy statement.
04/02/2009	Medical Director review
04/15/2009	Medical Policy Committee approval. No changes to policy statement.
04/08/2010	Medical Policy Committee approval
04/21/2010	Medical Policy Implementation Committee approval. Added statement "Based on review of available data, the Company considers biventricular pacemakers with or without an accompanying implantable cardiac defibrillator as a treatment of NYHA class I or II heart failure to be investigational to the policy.
04/07/2011	Medical Policy Committee approval
04/13/2011	Medical Policy Implementation Committee approval. Sinus rhythm added to the list of patient selection criteria.
04/12/2012	Medical Policy Committee review
04/25/2012	Medical Policy Implementation Committee approval. Cardiac resynchronization therapy use in patients with NYHA class II heart failure meeting specific criteria now may be considered eligible for coverage; all other uses in mild heart failure (e.g., class I) considered investigational. The term "congestive" was removed from the title and text.
02/04/2013	Coding revised
04/03/2014	Medical Policy Committee review
04/23/2014	Medical Policy Implementation Committee approval. Additional investigational statement added for triple-site (triventricular) CRT.
04/02/2015	Medical Policy Committee review
04/20/2015	Medical Policy Implementation Committee approval. Updated rationale/source and references. Coverage eligibility unchanged.

08/03/2015	Coding update: ICD10 Diagnosis code section added; ICD9 Procedure code section removed.
04/07/2016	Medical Policy Committee review
04/20/2016	Medical Policy Implementation Committee approval. Coverage statement with criteria added for CRT in patients with heart failure and AV block. Existing coverage criteria changed to include presence of LBBB (and QRS >120-130 ms) OR QRS >150 ms.
01/01/2017	Coding update: Removing ICD-9 Diagnosis Codes
04/06/2017	Medical Policy Committee review
04/19/2017	Medical Policy Committee approval. Coverage eligibility unchanged.
05/03/2018	Medical Policy Committee review
05/16/2018	Medical Policy Implementation Committee approval. Changed "a combined biventricular pacemaker/implantable cardiac defibrillator" to "a combined biventricular pacemaker plus implantable cardiac defibrillator" where it appears in the coverage section. Replaced "a stable pharmacologic medical regimen" with "guideline-directed medical therapy" for patients treated before implant in the Patient Selection Criteria. Coverage eligibility unchanged.
07/05/2018	Medical Policy Committee review
07/11/2018	Medical Policy Implementation Committee approval. Policy statement added that cardiac resynchronization therapy with wireless left ventricular endocardial pacing is considered investigational.
07/03/2019	Medical Policy Committee review
07/18/2019	Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
03/05/2020	Medical Policy Committee review
03/11/2020	Medical Policy Implementation Committee approval. Added New York Heart Association (NYHA) class II to coverage with criteria to Classes III and IV coverage for biventricular pacemakers with or without an accompanying ICD as a treatment of heart failure. Removed previous coverage with criteria for New York Heart Association (NYHA) class II. Added the NYHA Functional Classification table to the Policy Guidelines section.
10/12/2020	Coding update
03/04/2021	Medical Policy Committee review
03/10/2021	Medical Policy Implementation Committee approval. Combined the first two investigational statements to include NYHA class I, II, III or IV heart failure.
09/30/2021	Coding update
03/03/2022	Medical Policy Committee review
03/09/2022	Medical Policy Implementation Committee approval. Revisions made to the second.set of Patient Selection Criteria by adding a new first bullet and revising the forth bullet, respectively as follows: • Sinus rhythm or atrial fibrillation: AND

- Expected to have high degree of ventricular pacing (close to 100%) with CRT, e.g., presence of atrioventricular (AV) block, planning AV node ablation, or pharmacologic rate control (See Policy Guidelines); AND

12/07/2022 Coding update
03/02/2023 Medical Policy Committee review
03/08/2023 Medical Policy Implementation Committee approval. Replaced "patients" with "individuals". Clarified guideline-directed medical therapy in the coverage criteria and Policy Guidelines section. Coverage eligibility unchanged.
03/07/2024 Medical Policy Committee review
03/13/2024 Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
03/06/2025 Medical Policy Committee review
03/12/2025 Medical Policy Implementation Committee approval. Revised the first coverage and criteria statements by moving New York Heart Association (NYHA) class II, III or ambulatory IV to the 2nd criteria bullet. Removed the FDA labeled indications for QRS duration by device. Added a 2nd coverage with criteria statement for biventricular pacemakers with or without an accompanying implantable cardiac defibrillator as a treatment of heart failure symptoms with a Note following for context of adequate trial of guidelines-directed medical therapy. Revised coverage criteria for biventricular pacemakers with or without an accompanying ICD (i.e., a combined biventricular pacemaker plus ICD) as an alternative to a right ventricular pacemaker for individuals who do not meet the criteria outlined above, but who have an indication for a ventricular pacemaker. Added Coverage with Criteria for replacement of biventricular pacemaker with or without an accompanying implantable cardiac defibrillator (ICD [i.e., a combined biventricular pacemaker plus ICD]).

Next Scheduled Review Date: 03/2026

Coding

The five character codes included in the Louisiana Blue Medical Policy Coverage Guidelines are obtained from Current Procedural Terminology (CPT®)‡, copyright 2024 by the American Medical Association (AMA). CPT is developed by the AMA as a listing of descriptive terms and five character identifying codes and modifiers for reporting medical services and procedures performed by physician.

The responsibility for the content of Louisiana Blue Medical Policy Coverage Guidelines is with Louisiana Blue and no endorsement by the AMA is intended or should be implied. The AMA disclaims responsibility for any consequences or liability attributable or related to any use, nonuse or interpretation of information contained in Louisiana Blue Medical Policy Coverage Guidelines. Fee schedules, relative value units, conversion factors and/or related components are not assigned by the AMA, are not part of CPT, and the AMA is not recommending their use. The AMA does not directly or indirectly practice medicine or dispense medical services. The AMA assumes no liability for data contained or not contained herein. Any use of CPT outside of Louisiana Blue Medical

Policy # 00009
Original Effective Date: 06/05/2002
Current Effective Date: 06/01/2025

Policy Coverage Guidelines should refer to the most current Current Procedural Terminology which contains the complete and most current listing of CPT codes and descriptive terms. Applicable FARS/DFARS apply.

Codes used to identify services associated with this policy may include (but may not be limited to) the following:

Code Type	Code
CPT	0515T, 0516T, 0517T, 0518T, 0519T, 0520T, 0521T, 0522T, 33211, 33213, 33217, 33224, 33225, 33228, 33229, 33230, 33231, 33249 Add codes effective 06/01/2025: 0861T, 0862T, 0863T, 33202, 33203, 33214, 33221, 33243, 33244, 33263, 33264 Delete code effective 06/01/2024: 33226
HCPCS	C1785, C2619, C2621, C7540 Add codes effective 06/01/2025: C7537, C7538, C7539, G0448 Delete code effective 06/01/2025: C1721
ICD-10 Diagnosis	All related diagnoses

*Investigational – A medical treatment, procedure, drug, device, or biological product is Investigational if the effectiveness has not been clearly tested and it has not been incorporated into standard medical practice. Any determination we make that a medical treatment, procedure, drug, device, or biological product is Investigational will be based on a consideration of the following:

A. Whether the medical treatment, procedure, drug, device, or biological product can be lawfully marketed without approval of the U.S. Food and Drug Administration (FDA) and whether such approval has been granted at the time the medical treatment, procedure, drug, device, or biological product is sought to be furnished; or
B. Whether the medical treatment, procedure, drug, device, or biological product requires further studies or clinical trials to determine its maximum tolerated dose, toxicity, safety, effectiveness, or effectiveness as compared with the standard means of treatment or diagnosis, must improve health outcomes, according to the consensus of opinion among experts as shown by reliable evidence, including:
    1. Consultation with technology evaluation center(s);
    2. Credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community; or
    3. Reference to federal regulations.

**Medically Necessary (or "Medical Necessity") - Health care services, treatment, procedures, equipment, drugs, devices, items or supplies that a Provider, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury, disease or its symptoms, and that are:

A. In accordance with nationally accepted standards of medical practice;

B. Clinically appropriate, in terms of type, frequency, extent, level of care, site and duration, and considered effective for the patient's illness, injury or disease; and
C. Not primarily for the personal comfort or convenience of the patient, physician or other health care provider, and not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.

For these purposes, "nationally accepted standards of medical practice" means standards that are based on credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community, Physician Specialty Society recommendations and the views of Physicians practicing in relevant clinical areas and any other relevant factors.

‡ Indicated trademarks are the registered trademarks of their respective owners.

NOTICE: If the Patient's health insurance contract contains language that differs from the BCBSLA Medical Policy definition noted above, the definition in the health insurance contract will be relied upon for specific coverage determinations.

NOTICE: Medical Policies are scientific based opinions, provided solely for coverage and informational purposes. Medical Policies should not be construed to suggest that the Company recommends, advocates, requires, encourages, or discourages any particular treatment, procedure, or service, or any particular course of treatment, procedure, or service.

NOTICE: Federal and State law, as well as contract language, including definitions and specific contract provisions/exclusions, take precedence over Medical Policy and must be considered first in determining eligibility for coverage.