*National Imaging Associates, Inc.	
Clinical guideline **IMPLANTABLE CARDIOVERTER DEFIBRILLATOR (ICD)**	**Original Date: February 2013**
CPT Codes: 33230, 33240, 33249	**Last Revised Date: April 2023**
Guideline Number: NIA_CG_321	**Implementation Date: January 2024**

GENERAL INFORMATION

- *It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.*
- *Where a specific clinical indication is not directly addressed in this guideline, medical necessity determination will be made based on widely accepted standard of care criteria. These criteria are supported by evidence-based or peer-reviewed sources such as medical literature, societal guidelines and state/national recommendations.*

All indications are predicated on a meaningful life expectancy of greater than one year if the ICD is implanted.

INDICATIONS FOR ICD INSERTION[1-7]

ISCHEMIC HEART DISEASE (CAD)[1, 4, 5]

Primary Prevention of SCD (prophylactic ICD implantation)

- LVEF ≤ 35% due to nonischemic or ischemic heart disease and NYHA class II or III, despite guideline-directed medical therapy (GDMT), and at least 40 days post-myocardial infarction (MI) who have reasonable expectation of meaningful survival of > 1 year
- LVEF ≤ 30% due to ischemic heart disease, NYHA class I, GDMT, and at least 40 days post-MI who have reasonable expectation of meaningful survival of > 1 year
- LVEF ≤ 40% with prior MI, NSVT, and inducible sustained ventricular tachycardia (VT) or ventricular fibrillation (VF) at electrophysiological testing

Secondary Prevention of SCD

- Patients with documented ventricular fibrillation (VF), hemodynamically unstable ventricular tachycardia (VT), or sustained VT, after exclusion of reversible causes
- Syncope of undetermined origin, with inducible VF or sustained VT at electrophysiological study (EPS)
- Syncope of undetermined origin, with EF ≤ 35%

NONISCHEMIC CARDIOMYOPATHY (NICM)[1]

Primary Prevention of SCD (prophylactic ICD implantation)

- Lamin A/C gene mutation, with ≥ 2 risk factors from the following: NSVT, LVEF < 45%, male sex, missense mutation
- LVEF ≤ 35% and NYHA functional Class II or III, despite at least 3 months of GDMT: Recommended
- LVEF ≤ 35% and NYHA functional Class I despite at least 3 months of GDMT: May be considered

Secondary Prevention of SCD

- Patients with documented VF, hemodynamically unstable VT, or sustained VT, after exclusion of reversible causes
- LVEF ≤ 50% with unexplained syncope presumed to be due to VA and who do not meet indications for primary prevention ICD implantation

ADVANCED HEART FAILURE & TRANSPLANTATION[1, 5]

- In non-hospitalized patients with NYHA class IV who are candidates for cardiac transplantation or left ventricular assist device (LVAD)[1, 4, 5]
- In a patient with an LVAD, sustained ventricular arrhythmias[1]
- In NYHA ambulatory class IV, with appropriate indications for CRT (see Background Information section for definition of ambulatory NYHA class IV)

MYOCARDIAL DISEASES

Hypertrophic cardiomyopathy (HCM)

- Previously documented cardiac arrest or sustained ventricular tachycardia
- Adult patients with HCM with at least 1 risk factor for SCD as follows:
    - Sudden death attributable to HCM in at least 1 first-degree relative who is ≤ 50 years of age
    - LVH ≥ 30 mm
    - At least 1 recent episode of syncope suspected by history to be arrhythmic (unlikely neurocardiogenic (vasovagal) and especially occurring within 6 months of evaluation (events beyond 5 years do not appear to have relevance))
    - LV apical aneurysm
    - LV systolic dysfunction (EF < 50%)

- Pediatric patients with HCM with at least 1 risk factor for SCD as follows:
    - Including unexplained syncope
    - LVH ≥ 30 mm
    - Nonsustained ventricular tachycardia
    - Family history of HCM-related SCD

NOTE: **ICD placement for the sole purpose of participation in competitive athletics should not be performed**

- **Cardiac Sarcoidosis** with one of the following[1, 3, 5]:
    - Cardiac arrest or documented sustained VT
    - LVEF ≤ 35%
    - LVEF > 35% with inducible sustained ventricular arrhythmia at EPS
    - Syncope and/or scar on CMR or positron emission tomography (PET)
    - Requires a permanent pacemaker
- **Neuromuscular Disorders (including but not limited to Duchenne, Becker, Limb-girdle type 1B, Limb-girdle type 2C-2F, Limb-girdle type 2I, Myotonic type 1, Myotonic type 2, Emery-Dreifuss, Facioscapulohumeral)** with one of the following[1]:
    - Primary and secondary prevention, with same indications as for NICM[5]
    - Emery-Dreifuss or limb-girdle type I-B muscular dystrophy with progressive cardiac involvement
- **Arrhythmogenic right ventricular cardiomyopathy** and **at least 1** of the following risk factors for SCD[1-3, 8, 9]:
    - Resuscitated sudden cardiac arrest
    - Sustained VT
    - Right or left ventricular systolic dysfunction with an ejection fraction ≤ 35%
    - Syncope with documented or presumed ventricular arrhythmia

CHANNELOPATHIES

- **Congenital long QT syndrome** with **one** of the following[1, 2, 5, 10, 11]
    - Sudden cardiac arrest
    - Sustained VT or recurrent syncope when beta blocker is ineffective or not tolerated
    - QTc > 500 ms on a beta blocker[1]
    - Strong family history of SCD
    - High risk genotype
- **Brugada syndrome and spontaneous type 1 Brugada electrocardiographic pattern** with **one** of the following[1, 2, 5, 12]:
    - Cardiac arrest
    - Documented sustained ventricular arrhythmia
    - Syncope presumed to be due to ventricular arrhythmia
- **Catecholaminergic polymorphic VT** with **one** of the following[1, 2, 4, 13]:
    - Sudden cardiac arrest

    - Syncope or sustained VT
    - Inducible VT or VF
- **Early Repolarization ("J-wave Syndrome") or Short QT Syndrome** with **one** of the following[1, 5]:
    - Cardiac arrest
    - Sustained ventricular arrhythmia
- **Idiopathic Polymorphic VT/VF** with **one** of the following[1]:
    - Cardiac arrest due to polymorphic VT or VF

ADULT & PEDIATRIC CONGENITAL HEART DISEASE (CHD)[1, 3, 5, 14-16]

- Cardiac arrest due to VF or VT, or unstable VT, after exclusion of a reversible etiology
- Systemic LVEF ≤ 35%, biventricular physiology, and NYHA class II or III on GDMT
- Tetralogy of Fallot with one of the following[1, 3]:
    - Spontaneous sustained VT
    - Inducible VF or sustained VT
    - ≥ 1 risk from the following list:
        - Prior palliative systemic to pulmonary shunts
        - Unexplained syncope
        - Frequent PVCs (Premature Ventricular Contractions)
        - Atrial tachycardia
        - Left ventricular dysfunction or diastolic dysfunction
        - NSVT
        - QRS duration ≥ 180 ms
        - Dilated right ventricle
        - Residual pulmonary regurgitation or stenosis
        - RV Hypertension
- Single or systemic right ventricular ejection fraction (RVEF) < 35%, in the presence of an additional risk factor such as:
    - NSVT
    - Unexplained syncope
    - NYHA class II or III, despite GDMT[1, 5]
    - QRS duration ≥ 140 ms
    - Severe systemic AV valve regurgitation
- Syncope of unknown origin in the presence of either at least moderate ventricular dysfunction or marked hypertrophy or inducible sustained VT or VF[1, 3]
- Syncope and moderate or severe complexity CHD, with high clinical suspicion of ventricular arrhythmias
- Non-hospitalized patients with CHD awaiting heart transplantation
- Left ventricular non-compaction that meets same indications as NICM, including a familial history of SCD[4, 17]

EXEMPTIONS

Indications for ICD with an Appropriate Pacing Modality in Special Situations[4, 18] *

- ICD criteria met, and elevated troponin is deemed not due to a myocardial infarction[1]
- ICD criteria met, except for myocardial infarction within 40 days or revascularization within 3 months, but a non-elective permanent pacemaker (new or replacement) is required, and recovery of left ventricular function to LVEF > 35% is uncertain or not expected[4] **
- ICD criteria met, except NICM or ischemic cardiomyopathy has not had 3 months' time for LVEF to improve on medical therapy, a non-elective permanent pacemaker is required, and recovery of LVEF is uncertain or not expected**
- Patient met primary prevention criteria for an ICD prior to coronary revascularization, and it is unlikely that LVEF will recover to > 35% despite a 90-day wait[18]

*** With these ICD indications, CRT would sometimes be the appropriate pacing modality. CRT is likely to be the appropriate modality** with anticipated requirement for significant (> 40%) ventricular pacing

**** These indications avoid a second implantation procedure within less than 3 months**

BACKGROUND[1-7]

The implantable cardioverter defibrillator (ICD) has become valuable in the management of patients with ventricular arrhythmias (VA) capable of causing syncope, cardiac arrest, and sudden cardiac death (SCD).

Patient eligibility for an ICD presumes all the following:

- Anticipated reasonable quality of life for ≥ 1-year post implantation[12]
- Patient's ability to live with a shock-delivering device that requires management
- Absence of a completely reversible cause that led to VA for which an ICD is being considered
- Completion of ≥ 3 months of guideline-directed medical therapy (GDMT) for heart failure (HF), unless an intervening indication for pacemaker implantation arises (see Overview Information section for definition of GDMT)
- ICD indications are present in most scenarios in which cardiac resynchronization therapy (CRT) is appropriate
- Sustained VT is defined as having duration > 30 seconds or requiring termination due to hemodynamic compromise in < 30 seconds

Guidelines for the pediatric population are extrapolated from the adult population due to a lack of relevant trials.[5, 14]

OVERVIEW

General[1-7]

Implantable cardioverter defibrillators (ICDs) are indicated for the treatment of life-threatening ventricular tachycardia and ventricular fibrillation. An ICD system includes a pulse generator and one or more leads. ICDs are indicated both for patients who have survived life threatening rhythm disturbances (secondary prevention) and for those who are at risk for them (primary prevention).

- An ICD continually monitors heart rhythm. If a rapid rhythm is detected, the device delivers electrical therapy directly to the heart muscle to terminate the rapid rhythm and restore a normal heart rhythm. There are two types of therapy that can be delivered:
    - Rapid pacing OR
    - High-voltage shocks are necessary for ventricular fibrillation and when rapid pacing has failed to correct the abnormal rhythm
- In addition, all ICDs have pacing capability, and deliver pacing therapy for slow heart rhythms (bradycardia)
- The parameters defining limits for pacing therapy and for tachycardia therapy are programmable using noninvasive radio signals on all available ICDs

NYHA Class Definitions[4, 19, 20]

- **Class I:** No limitation of functional activity or only at levels of exertion that would limit normal individuals
- **Class II:** Slight limitation of activity. Fatigue, palpitation, or dyspnea with moderate exercise
- **Class III:** Marked limitation of activity. Fatigue, palpitation, or dyspnea with minimal activity
- **Class IV:** Severe limitation of activity. Symptoms even at rest, worse with activity
- **Ambulatory Class IV:** Class IV heart failure with 1) no active acute coronary syndrome; 2) no inotropes; and 3) on GDMT

Guideline-Directed (or Optimal) Medical Therapy for Heart Failure[7]

- Angiotensin converting enzyme (ACE-I), angiotensin receptor blockers (ARB), or combined angiotensin receptor inhibitor and neprilysin inhibitor (ARNI)
- Beta blockers
- Addition of loop diuretic for all NYHA class II – IV patients
- Addition of hydralazine and nitrate for persistently symptomatic African Americans
- Addition of an aldosterone antagonist, provided eGFR is > 30 ml/mi
- Normal serum sodium and potassium

- Not required for consideration of ICD: Ivabradine for NYHA class II – III, when a beta blocker has failed to reduce a sinus rate to < 70 bpm. Ivabradine listed as a class IIa recommendation, while others are class I recommendations. CRT trials antedated routine use of Ivabradine.

Abbreviations

ACE-I	Angiotensin converting enzyme inhibitor
ARNI	Combined angiotensin receptor inhibitor and neprilysin inhibitor
ARVD/C	Arrhythmogenic right ventricular dysplasia/cardiomyopathy
AV	Atrioventricular
CAD	Coronary artery disease, same as ischemic heart disease
CHD	Congenital heart disease
CHF	Congestive heart failure
CRT	Cardiac resynchronization therapy
CRT-D	Cardiac resynchronization therapy ICD system
DCM	Dilated cardiomyopathy
ECG	Electrocardiogram
EF	Ejection fraction
EPS	Electrophysiologic Study
GDMT	Guideline-Directed Medical Therapy
HCM	Hypertrophic cardiomyopathy
HF	Heart failure
HV	His-ventricle
ICD	Implantable cardioverter-defibrillator
LBBB	Left bundle-branch block
LV	Left ventricular/left ventricle
LVAD	Left ventricular assist device, mechanical heart
LVEF	Left ventricular ejection fraction
LVH	Left ventricular hypertrophy
MI	Myocardial infarction
ms	Milliseconds
NICM	Nonischemic cardiomyopathy
NSVT	Nonsustained ventricular tachycardia
NYHA	New York Heart Association
PET	Positron emission tomography
PVC	Premature Ventricular Contraction
RV	Right ventricular/right ventricle
RVEF	Right ventricular ejection fraction
SCD	Sudden Cardiac Death
STEMI	ST-elevation myocardial infarction
SND	Sinus node dysfunction
VT	Ventricular tachycardia
VF	Ventricular fibrillation

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POLICY HISTORY

Date	Summary
April 2023	• Added nonischemic CM indication for EF ≤ 35% and removed statement about requirement of 90-day post revascularization • Added statement on clinical indications not addressed in this guideline
February 2022	• Removed statement about hypertrophic cardiomyopathy being reasonable with family history of SCD

Reviewed / Approved by NIA Clinical Guideline Committee

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