

UC San Diego Health

Protocol Name:	MRI Safety and Device Management in Patients with Cardiac Implantable Electronic Devices
Departments:	Radiology, Electrophysiology
Effective Date:	February 17, 2026

I. Protocol Statement and Scope

This protocol establishes a standardized framework for performing Magnetic Resonance Imaging (MRI) on patients with Cardiac Implantable Electronic Devices (CIEDs) at the University of California, San Diego (UCSD). Its purpose is to ensure the safe imaging of patients with CIEDs by clearly defining requirements for patient risk stratification and device management, Staff responsibilities and training expectations, and procedural safeguards for device interrogation, MRI-mode programming, and post-MRI device restoration.

This protocol applies to all UCSD personnel involved in the scheduling, monitoring, programming, and management of patients with the following CIED devices undergoing MRI:

- Pacemakers (PM)
- Implantable cardioverter-defibrillators (ICDs)
- Cardiac resynchronization therapy (CRT-P/CRT-D) devices
- Leadless pacemakers
- Implantable loop recorders (ILRs)

All patients with a CIED must undergo device interrogation and programming both before and after MRI scanning in accordance with manufacturer safety guidelines and UCSD institutional protocols. These functions must be performed by trained and qualified UCSD personnel with documented competency in CIED management for MRI.

II. Definitions

- A. *MRI conditional CIED*- Device demonstrated to pose no known hazards in a specified Magnetic Resonance (MR) environment with manufacturer defined MRI scan conditions when used under defined programming conditions of safety (FDA Safety Standards, n.d.). This category includes PMs (transvenous and leadless), ICDs, CRTs and ILR devices.
- B. *MRI conditional ILR*- Devices classified as MRI conditional and do not require programming or Electrophysiology (EP) clearance prior to undergoing MRI scanning.
- C. *MRI Non-conditional CIED*- Devices not specifically studied for MRI safety or those that do not meet all manufacturer-defined MRI safety conditions.
- D. *Device Interrogation*- A systemic evaluation of device function, including parameters, lead impedance, lead sensing, lead threshold(s), and battery status. Documentation of interrogation is required within 6 months prior to MRI, including whether patient is pacer dependent.
- E. *Abandoned Leads*-Leads that remain in situ and have been capped or otherwise rendered inactive.
- F. *Magnetic Resonance Medical Doctor*- MRMD (consistent with ACR and other society designation) A medical doctor specializing in MRI who is responsible for oversight of MRI safety, and clinical decision-making for patients undergoing MRI.
- G. *Electrophysiology Medical Doctor (EP MD)* - A cardiologist specializing in electrophysiology, responsible for CIED management.
- H. *ERI*-Elective Replacement Indication on a pacemaker signals the battery is nearing depletion.

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III. Staff and Training Requirements

- A. All staff involved in MRI procedures for patients with CIEDs must complete annual UCSD MRI Safety Training and annual MRI Safety Attestation
- B. Advanced Resuscitation Training (ART) certified personnel and a code cart must be readily available throughout the scan.
- C. Device programming must be performed by personnel with demonstrated experience and approval in CIED programming by the Director of Electrophysiology. (i.e., EP Device Nurse)
- D. Radiology nurse with documented training in manufacturer-specific MRI-mode programming may perform MRI-mode programming when supported by the device manufacturer. (i.e., Medtronic SmartSync, Boston Scientific)

IV. Risk Stratification

A. Low Risk – *Imaging may proceed without MRMD approval or EP consent*

- MRI-conditional CIED devices in place for > 6wks
- Mixed Manufacturer CIED conditional systems (i.e., conditional lead(s) and a conditional generator from different manufacturers)
- Conditional CIED generator replacement
- Capped epicardial wires placed during surgery for purpose of temporary epicardial pacing
- Multiple conditional CIEDs (e.g., ILR + PM or ILR + ICD)
- Patients previously cleared by MR MD for same-body-part MRI with no changes to implant(s)

B. Moderate Risk – *MRMD approval and EP consent required to Proceed*

- Multiple implanted devices (e.g., Neurostimulator and ICD)
- MRI Non-conditional CIEDs
- Permanent Active epicardial leads
- Abandoned leads
- Pediatric patients (<18 years)
- MRI Conditional CIED system implanted <6 weeks may undergo MRI without delay. Note, patients can undergo MRI without delay, but with moderate risk workflow
- Battery longevity at ERI and Not Pacer Dependent
- Generator located in abdomen

C. High Risk – *Contraindicated (Do Not Proceed)*

- Fractured lead(s)**
- CIEDs implanted prior to 2002
- Device at ERI and patient is Pacer Dependent
- Transvenous temporary pacing systems

**HIGH RISK – MRI exam likely contraindicated. If fractured lead is present, involve MRMD for risk/benefit assessment. EP consent required if there is decision to proceed.

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V. Procedure and Responsibilities

A. Scheduling and Pre-Screening

- Scheduler or MyChart query for CIED presence; positive responses generate MRI Screening Form routed to the designated EPIC work queue (WQ).
- MRI screening process must include manufacturer, model, lead data, implant date, last remote or device interrogation and pacer dependence.
- Patients should be scheduled in designated CIED MRI time slots.

B. Clearance Requirements

- Device interrogation within 6 months prior to MRI scan
- Documentation of whether patient is pacing dependent.
- EP clearance and informed consent is required for Moderate Risk category.
- Chest X-ray (frontal anterior-posterior [AP] or posteroanterior [PA] view) with interpretation by the supervising radiologist, completed within 1 year of CIED implantation without device revision.
 - Exception, if device interrogation completed within the past 6 months confirms stable lead and device function, a Chest X-ray may be omitted.
- EP MRI consent remains valid for **12 months** for repeat scans of any body part unless health status changes or device implant modifications have occurred.

C. Day-of-MRI Workflow

1. Radiology RN confirms documentation (interrogation, chest X-ray, consent, pacing orders).
2. MRI technologist completes screening form for contraindications.
3. MRI-compatible cardiac monitor, BP cuff, and pulse oximeter applied before Zone IV entry.
4. No IV required if device is deemed conditional, Low Risk category.
5. IV required for Moderate Risk category.
6. Patient height/weight entered for SAR (specific absorption rate) calculations.
7. Device interrogation/programming performed outside magnet room (Zone IV).
8. Continuous monitoring by ART trained Radiology RN with vitals every 15 minutes.

D. Post-MRI completion

- The CIED is restored to baseline settings.
- Any abnormalities will be immediately communicated to the EP Device Nurse (web paging) or EP provider on call.
- Documentation in Electronic Medical Record- EPIC includes;
 - Pre- and post-MRI interrogations uploaded to Media tab
 - Interdisciplinary note with device parameters [Mode, Atrial pacing %, BiV/Ventricular pacing %, battery status, underlying rhythm] and MRI mode settings with EP provider cosignatory
- EP provider reviews/cosigns documentation within 24 hours

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VI. REFERENCES/RESOURCES

- A. Russo RJ, et al. "2017 HRS Expert Consensus Statement on MRI and Implantable Devices." *Heart Rhythm*, 2017. <http://10.1016/j.hrthm.2017.04.025>
- B. Manufacturer MRI Protocols and Technical Manuals (e.g., Medtronic SureScan, Abbott Assurity MRI Guidelines)
- C. UCSD MRI Safety Guideline
- D. Assessing the Risks Associated with MRI in Patients with Pacemaker Defibrillator *N Engl J Med* 2017; 376: 755-764. February 23, 2017. <http://www.nejm.org/doi/full/10.1056/NEJMoa1603265>
- E. A Prospective Evaluation of a Protocol for Magnetic Resonance Imaging of Patients with Implanted Cardiac Devices. *Annals of Internal Medicine*, Vol 155; No7. 4 October 2011.
- F. Magna Safe Registry: Determining the Risks of MRI in the Presence of Pacemakers and Implantable Cardioverter Defibrillators. February 2012. Principal Investigator of National Trial: Robert Russo, MD; Investigational Device Number {IDE} G090031. <http://clinicaltrials.gov/show/NCT00907361>
- G. Konig, C. A., et al. {2021}. Is diversity harmful?-Mixed-brand cardiac implantable electronic devices and magnetic resonance imaging. *Wiener Klinische Wochenschrift*, 133(15-16), 765-772. <https://doi.org/10.1007/s00508-021-01924-w>
- H. Nazarian, S., et al. (2017). 2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices. *Heart Rhythm*, 14(7), e97-e153. <https://doi.org/10.1016/j.hrthm.2017.04.025>

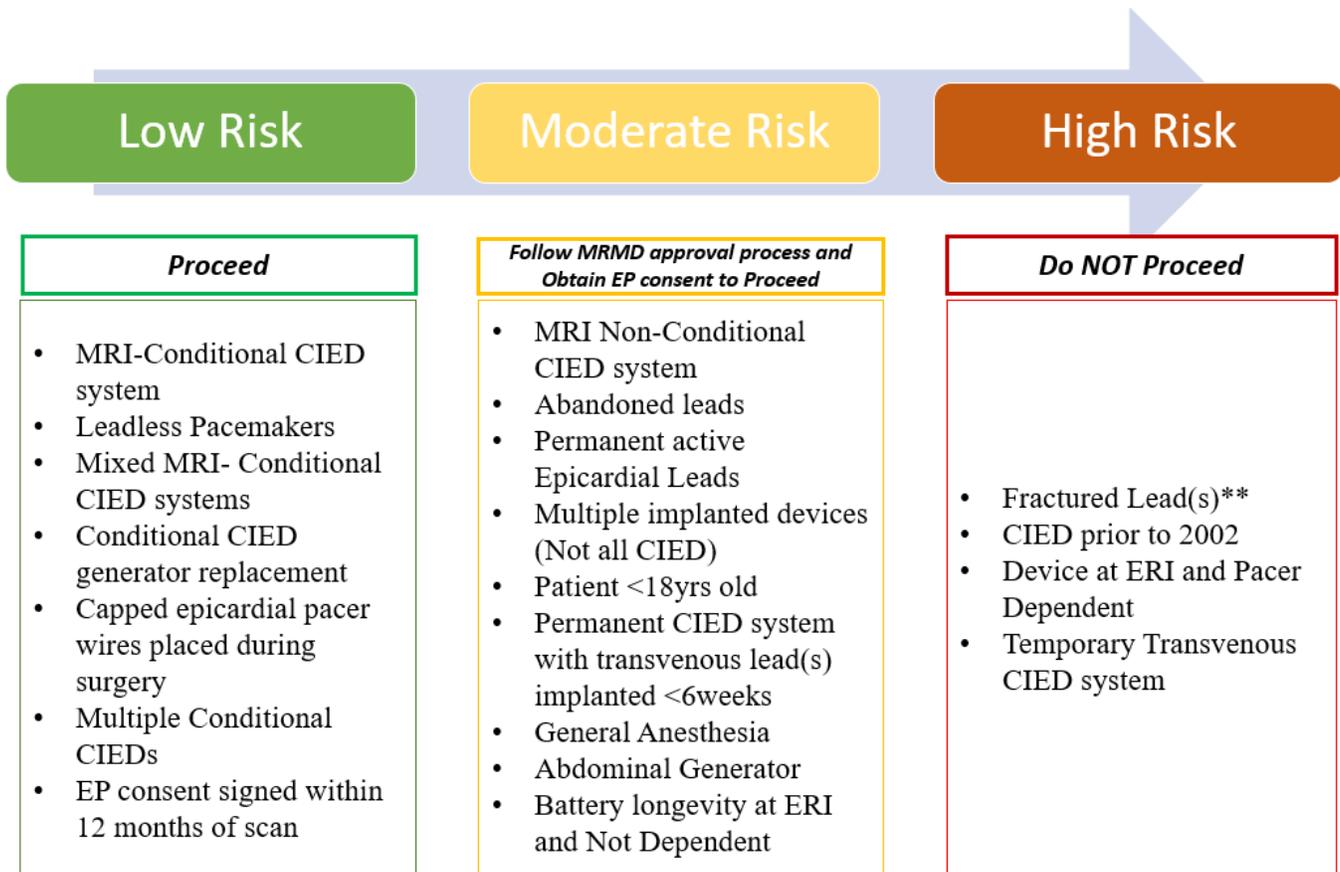
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VII. ATTACHMENTS:

A. MRI CIED Risk Stratification Protocol

MRI CIED Risk Stratification

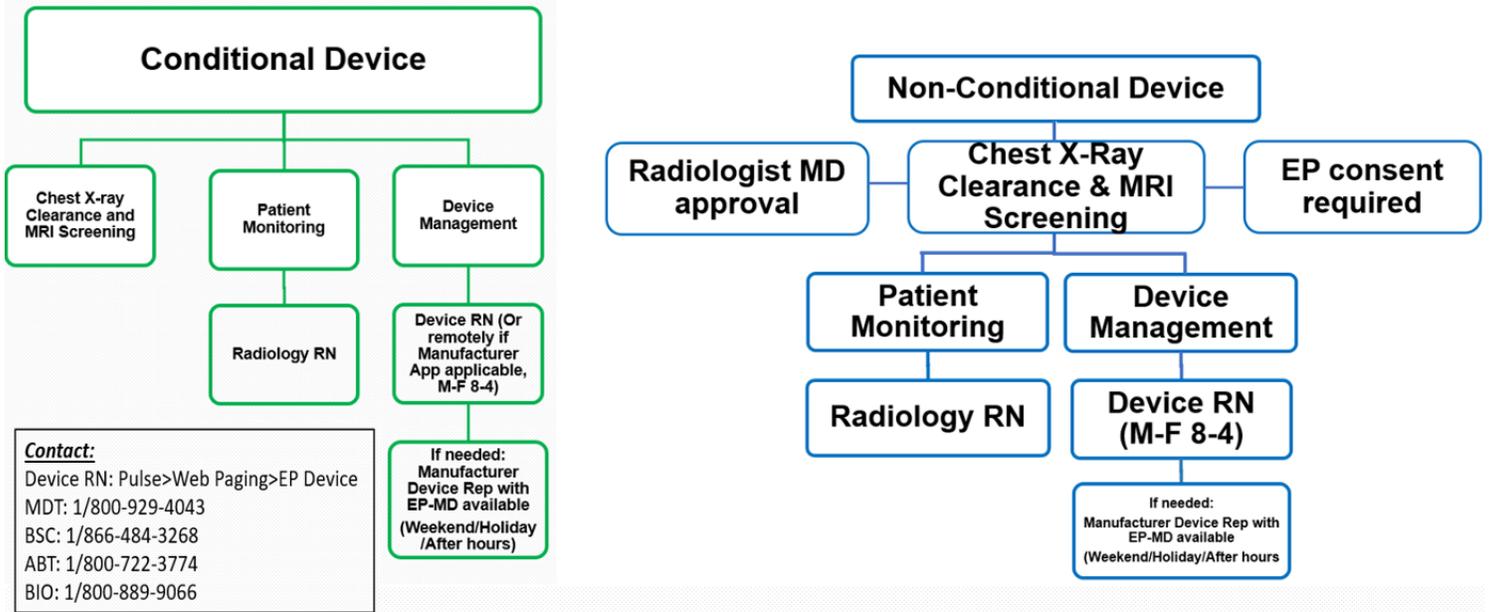


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B. MRI CIED Device Programming Workflow

UCSD CIED MRI Workflow



C. MRI Screening Form D393

<https://pulse.ucsd.edu/departments/supplychain/Documents/formDocs/D393.pdf>

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III. APPROVALS: This protocol was approved by:

Name/Department:

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