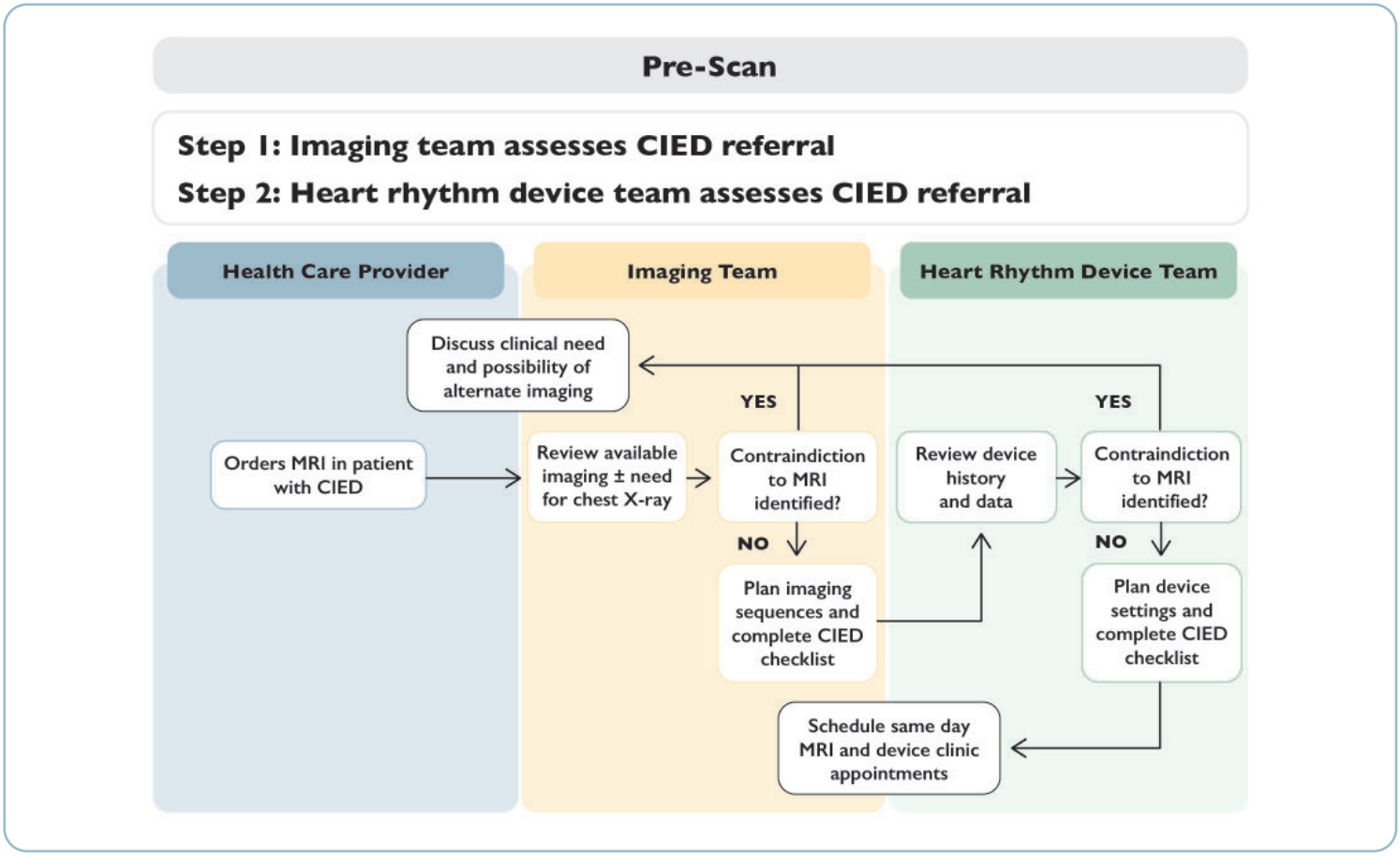
Sample Standardized Protocol for Magnetic Resonance Imaging in Patients with Cardiac Implantable Electronic Devices

Is your patient safe to scan?

Canadian Society of Cardiovascular MRI | Société Canadienne de l'IRM Cardiovasculaire

The 2021 CCS/CHRS/CanSCMRI Joint Statement on Safety of Magnetic Resonance Imaging recommends use of a standardized protocol when patients with cardiac implantable electronic devices (CIEDs) are referred for and undergo Magnetic Resonance Imaging (MRI). This clinical decision-making tool will help you and your team members complete the steps necessary to clear patients with CIEDs for safe MRI scanning or to avoid scanning when not safe to do so. Refer to the pre-, day of- and post-scan algorithms to understand step-flow processes and your role for MRI safety. Collaboration of imaging and heart rhythm device teams minimizes the risk of adverse events for all patients with CIEDs undergoing MRI.

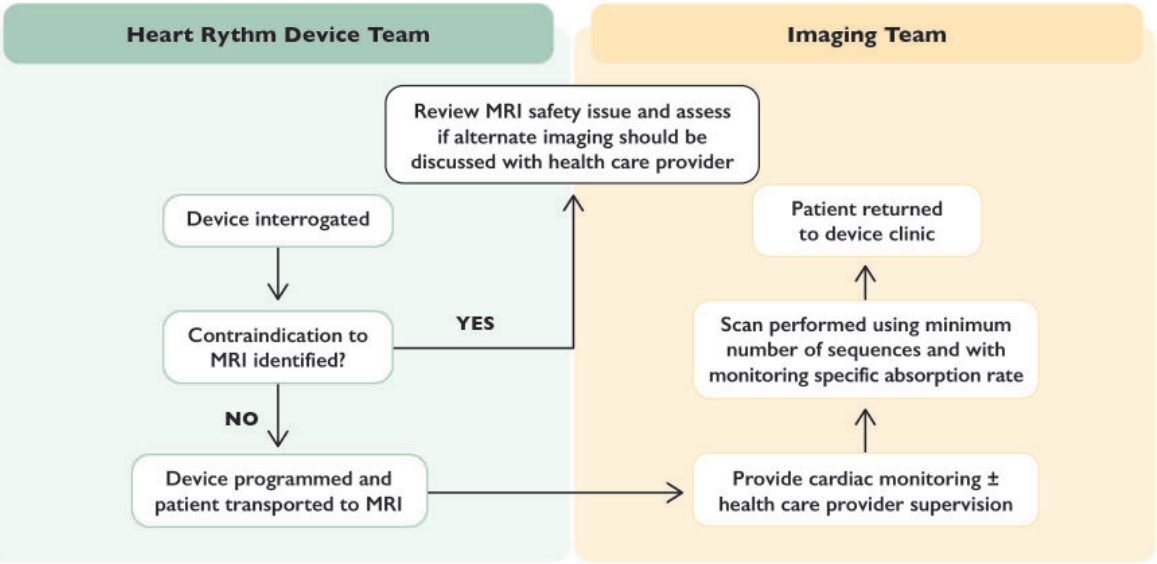
Recommended Full Protocol for MRI in Patients with CIEDs



Day of Scan

Step 3: Heart rhythm device team conducts device interrogation and programming immediately before MRI

Step 4: Imaging team performs MRI with continuous cardiac monitoring

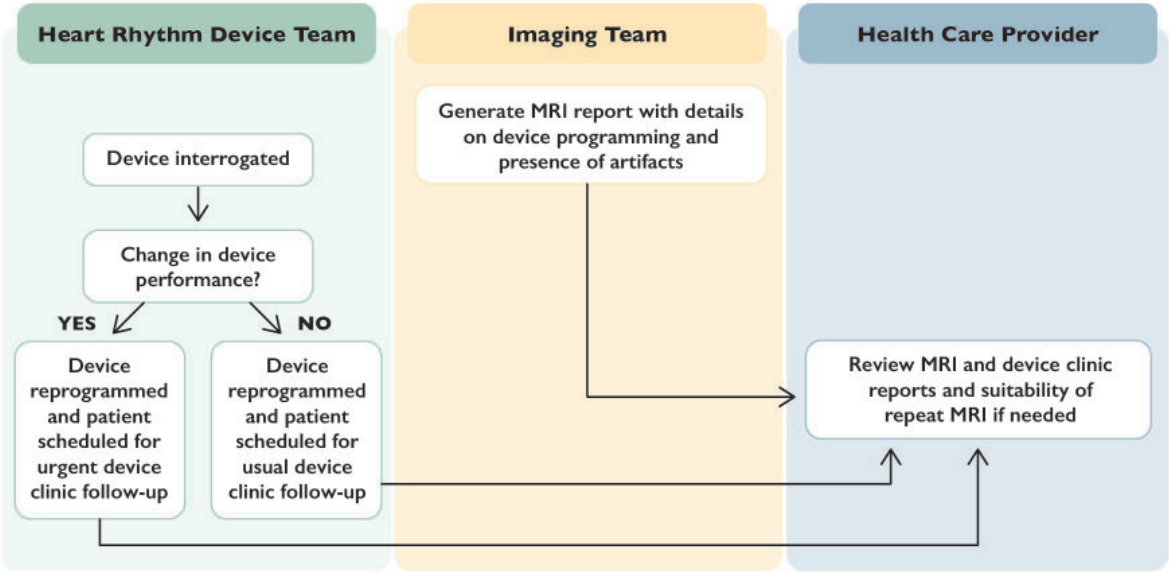


Post-Scan

Step 5: Heart rhythm device team conducts device interrogation and re-programming immediately after MRI

Step 6: Imaging team generates MRI report

Step 7: Referring health care provider organizes follow-up



Step 1: Imaging team assesses patient with CIED

Review and complete these steps for patients with CIEDs **before the MRI scan**.

A. Confirm patient identity (Name, age, DOB, health card, etc.) _____

B. Assign supervising MRI physician _____

C. Review initial MRI scan request

Date: _____

Indication: _____

Urgency: _____

Referring Physician: _____

Area of scan:

D. Confirm device type and implant date

Device type: _____ Implant date: _____

E. MRI team: *confirm* MRI-conditional status

☐ Yes ☐ No: Discuss with referring health care provider if MRI is necessary

Note: The heart rhythm device team must obtain separate confirmation of MRI-conditional status in Step 2.

F. Arrange and/or review chest X-ray (p.a. and lateral) and review recent device interrogation if available.

Date of chest X-ray: _____

Identify contraindications to MRI scanning:

i. **Absolute contraindications:** Fractured leads, lead extenders or adapters
   - ☐ Yes: Discuss alternative imaging with referring health care provider
   - ☐ No

ii. **Relative contraindications:** Leads implanted < 6 weeks before MRI date, epicardial leads, abandoned transvenous leads or scanned region overlaps with region of CIED
   - ☐ Yes: Consider MRI if clinical need is strong and outweighs potential risks
   - ☐ No

G. Develop scan protocol

MRI field strength: _____ MRI sequences: _____

Step 1 decision

- ☐ **Absolute contraindication(s)?** Discuss alternative imaging with referring health care provider
- ☐ **MRI nonconditional CIED and/or relative contraindication(s)?** Consider MRI if clinical need is strong and outweighs risks. Document need / risks and seek informed consent before proceeding or discuss alternative with the referring health care provider
- ☐ **MRI-conditional CIED and no contraindication?** Safe to proceed with MRI

Step 2: Heart rhythm device team assesses patient with CIED

Review and complete these steps for patients with CIEDs **before the MRI scan**

A. Confirm patient identity (Name, age, DOB, health card, etc.) _____

B. Assign supervising device physician _____

C. Verify device information on local CIED checklist

i. Implantation date: _____

ii. Type of device, vendor and model _____

MRI conditional status: _____ Pulse generator: _____

Leads: _____ Components under advisory: _____
(Location; fractured/abandoned/non-functional, epicardial)

iii. Other components

Lead extenders/adaptors: _____ Abandoned leads: _____
(Type and location) (Type and location)

Caps/plugs; Location: _____

D. Perform interrogation of MRI-nonconditional CIED (if applicable)

i. Pacing dependency ☐ Yes ☐ No

ii. Lead parameters: Sensing, capture and impedance _____

E. Identify contraindications to MRI scanning

i. **Absolute contraindications to MRI scanning:** Fractured leads, lead extenders or adapters ☐ Yes ☐ No

ii. **Relative contraindications to MRI scanning:** Leads implanted < 6 weeks before MRI date, epicardial leads, abandoned transvenous leads, scanned region overlaps with region of CIED ☐ Yes ☐ No

F. Confirm patient eligibility for MRI scan

i. MRI-conditional status of CIED

☐ Yes ☐ No: Request referring health care provider assesses whether MRI is necessary

ii. Contraindications to MRI scanning

☐ Yes: Review clinical need with referring health care provider ☐ No

G. Plan device settings

☐ MRI-conditional CIED: program device to MRI compatible mode

☐ Pacemaker dependence: program device to Asynchronous pacing

☐ No pacemaker dependence: program device to Sense only mode

☐ Implantable cardioverter-defibrillator: Turn off tachycardia therapies

☐ Implantable/injectable loop recorder: Download data before scan

H. Return CIED checklist to MRI department Date: _____

Step 2 decision

☐ **Absolute contraindication(s)?** Discuss alternative imaging with team, not cleared for MRI scanning

☐ **Relative contraindications?** Consider if MRI clinical need is strong and outweighs risks

☐ **No contraindications?** Cleared for MRI scanning

Step 3: Heart rhythm device team conducts device interrogation and programming immediately before MRI

A. Confirm patient identity (Name, age, DOB, health card, etc.) _____

B. Review results of CIED patient assessment from step 1 and step 2

C. Perform device interrogation
Devices include pacemakers, implantable cardioverter-defibrillators (ICD), subcutaneous ICDs, loop recorders

D. If no contraindication to MRI identified, program device for MRI and proceed with MRI scan

Program device as follows – check one:

- ☐ Patients with an MRI-conditional CIED: program device to MRI compatible mode
- ☐ Patients with MRI non-conditional pacemaker and no pacemaker dependency, program device to sense only mode: OAO, OVO or ODO
- ☐ Patients with MRI non-conditional pacemaker and pacemaker dependency, program to asynchronous pacing mode: AOO, VOO or DOO
- ☐ Patients with MRI non-conditional transvenous ICD or subcutaneous ICD: turn off tachycardia therapies
- ☐ Patients with implantable or injectable loop recorder: download the stored data before MRI scanning

Step 4: Imaging team perform MRI with continuous cardiac monitoring

A. Confirm patient identity (Name, age, DOB, health card, etc.) _____

- ☐ **Scan recommended field strength at 1.5 T (unless specified otherwise by manufacturer)**
- ☐ **Provide continuous cardiac monitoring**
- ☐ **Trained Advanced Cardiac Life Support health care provider present for monitoring of non-conditional devices (except pacemakers and no dependency) or MRI conditional defibrillators**
- ☐ **Give preference to fast gradient echo sequences for cine imaging and wide-band sequences for late gadolinium enhancement imaging**
- ☐ **Scan using minimum number of sequences and with monitoring of specific absorption rate**

Step 5: Heart rhythm device team conducts device interrogation and re-programming immediately after MRI

A. Confirm patient identity (Name, age, DOB, health card, etc.) _____

B. Interrogate and re-program device, schedule for device clinic follow-up

- ☐ Re-programming done
- ☐ Follow-up at device clinic (date, time, location): _____

C. If change in device performance post-MRI: document changes and *ensure urgent follow-up*

- ☐ Document changes: _____
- ☐ Follow-up (date, time, location): _____

Step 6: Imaging team generates MRI report

☐ **Generate MRI report – specifically mention device, patient consent and comment on artifacts**

Step 7: Referring health care provider organizes follow-up

☐ **Review MRI and device reports**

☐ **Determine follow-up MRI (if needed)**

☐ **Ensure follow up by heart rhythm device team**

Pre-read the MRI Safety CPU and engage the health care team plus hospital administration to implement this clinical decision support tool into your institution. This tool features information from the: Joint Statement CCS/CanSCMRI/CHRS Safety of Magnetic Resonance Imaging Position Statement. CJC, 37(6), pp.835-847.

The CCS MRI Safety KT program was made possible with unrestricted grant support from Bayer Inc. The CCS thanks Bayer for their commitment to improving cardiovascular care in Canada.