



# A Systematic Workflow in Ensuring Safe MRI Examination for Patients with Coronary Implantable Electronic Devices (CIEDs)



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## Introduction

- Many Coronary Implantable Electronic Devices (CIEDs) models have been engineered in recent years to be conditional for the use in Magnetic Resonance Imaging (MRI) environment.
- Compliance with the conditions of use for the CIED during MRI is important to prevent safety issues such as death, burns and implant malfunction.
- A systematic workflow across multi-disciplinary teams maps the journey of the patient which allows visibility of all critical steps done before and after MRI examination which is paramount for patient safety.

## Methodology

### Collaboration:

- Discussion with (i) TTSH Cardiology (ii) TTSH Diagnostic Imaging
- ✓ gain expertise in safe handling CIED patients for MRI
  - ✓ promote consistent handling of the work processes for all CIED patients scheduled for MRI

### Development:

#### a) Standardised MRI workflow for different CIED systems and patient groups

- ✓ maps CIED patient's journey from the ward/home to non-invasive cardiac lab (NICL), to radiology for scan and back to cardiology for post procedure programming which ensures consistent practice in delivering quality and safety health care.

#### b) MRI-CIED checklist

- ✓ Means of communication between the departments which improve confidence level between staff.
- ✓ Verification tool before progressing to next step which enhances safety.
- ✓ As a loop closure which ensures follow-up after programming which assures safety.

## Results

Requesting clinician declares CIED information in Aurora, including

1. Date of implantation
2. Brand & model of CIED
3. Model of all leads



MRI Radiographer checks on compatibility of CIED with respect to the region of scan requested.

*\* A MRI conditional CIED may not be compatible to scan in certain body parts*



MRI Radiographer raises request to MRI Consultant to assess risk-benefit of request

Approved by MRI Consultant

### Outpatients

### Inpatients

#### Pacemakers

#### Cardiac Resynchronisation Therapy (CRT) & Implantable Cardioverter Defibrillators (ICD)

#### Office Hour (Before 3pm)

#### After Office Hour

Inform Patient to report to NICL 30mins before MRI appointment for programming

1. NICL will arrange for vendor for programming.
2. Inform patient to report to radiology for programming.

Requesting clinician and BCLS trained staff accompany patient to NICL 30mins before MRI appointment for programming.

*+ Monitoring via defibrillator for CRT & ICD during transportation.*

Requesting clinician will liaise with Cardiologist to arrange for vendor.

Requesting clinician and BCLS trained nurse accompany patient to radiology for programming and scan.

### Cardiology & Radiology Department to follow guidelines as listed in the MRI-CIED Checklist.

CHECKLIST FOR PATIENTS WITH MRI CONDITIONAL PACEMAKER / ICD	
FOR PATIENTS WITH IMPLANTED MRI-CONDITIONAL CARDIAC PACEMAKER (PPM) / IMPLANTABLE CARDIOVERTER DEFIBRILLATOR (ICD) UNDERGOING MRI EXAMINATION	ACCOUNT NO. NICL NO. NAME OF PATIENT ADDRESS SEX/BIRTH DATE/RACE
Part I Cardiac Technologist/Cardiology Senior Resident - Pre-Scheduling Checklist	
PPM/ICD Model: _____ Leads Model: _____	Checked <input type="checkbox"/>
1) Patient's implanted PPM / ICD system is MR-Conditional;	<input type="checkbox"/>
2) Implant more than six weeks;	<input type="checkbox"/>
3) Pectoral implant;	<input type="checkbox"/>
4) Pacing Thresholds <2.5V @ 0.4ms	<input type="checkbox"/>
5) Lead impedance >100-1,500 ohms	<input type="checkbox"/>
6) No other devices, leads (including abandoned), adaptors or extenders	<input type="checkbox"/>
Verified by:	
Cardiac Technologist/Cardiology SR Name _____ Signature _____ Date _____	
Part IIA Cardiac Technologist's/Cardiology Senior Resident's Pre-Scan Checklist - On day of MRI Scan	
Before MRI Scan: MRI Mode programmed "ON" - Time: _____ Pacing Mode: _____	
Performed by:	
Cardiac Technologist/Cardiology SR Name _____ Signature _____ Date _____	
Part IIB Radiographer's Checklist	
Pre-scan	Checked <input type="checkbox"/>
1) PPM / ICD verified to be MR-Conditional	<input type="checkbox"/>
2) 1.5T closed bore MRI used;	<input type="checkbox"/>
3) Confirm with Cardiac Tech that MRI Mode is programmed ON;	<input type="checkbox"/>
4) Observe Restriction zone of scan, if any	<input type="checkbox"/>
5) ACLS trained clinician onsite	<input type="checkbox"/>
6) An external defibrillator / resus trolley is available nearby	<input type="checkbox"/>
During scan	<input type="checkbox"/>
7) Patient's (batteries/leads) function is monitored throughout the scan;	<input type="checkbox"/>
8) Whole body SAR < 2W/kg, Head SAR < 1.2 W/kg	<input type="checkbox"/>
9) Cumulative scan time not more than 30 min (Cumulative scan time: _____)	<input type="checkbox"/>
Verified by:	
Radiographer's Stamp _____ Signature _____ Date _____	
Part III Cardiac Technologist's/Cardiology Senior Resident's Post-Scan Checklist - On the day of the MRI scan	
1) After MRI Scan: MRI Mode programmed "OFF" - Time: _____	
Performed by:	
Cardiac Technologist/Cardiology SR Name _____ Signature _____ Date _____	

Part I: Cardiac Technician & Cardiologist Pre-Scheduling Checklist

(a) Reaffirm MRI conditional status of CIED system.  
(b) Ensure the integrity of the system meets the criteria.

All boxes must be checked before progressing to next step.

Part IIA: Cardiac Technician & Cardiologist Pre-Scan Checklist - On Day of MRI Scan

Interrogate and program the CIED system to a MRI safe pacing mode.

Hands MRI-CIED checklist & MRI summary print-out to radiology for verification before the scan starts.

Part IIB: Radiographer's Checklist

(a) Check Part I & IIA with all boxes checked.  
(b) Check pacing mode and observe any restriction zone.  
(c) Prepare emergency support.  
(d) Practice during-scan requirements.

MRI-CIED checklist will be given to Cardiac technician/vendor for post scan reprogramming.

Part III: Cardiac Technician & Cardiologist Post Scan Checklist

(a) Change the device mode back to its original working parameters.  
(b) Ensure there is no corruption of device parameters.

Closing the loop by ensuring this portion is checked.

## Conclusion

1. Implementation of a harmonised and systematic workflow in handling CIED patients for MRI allows mapping of their journey in a structured manner where there are multiple checkpoints to ensure that the requirements are followed, leading to a seamless and safe process.
2. The MRI-CIED checklist allows identification of gaps in pre- and post programming and serves as a communication tool between cardiology and radiology which improves safety outcome.