MRI Safety: Fields and Devices
The Mayo Clinic Arizona Experience
Anshuman Panda, PhD

MR Safety: Systems Engineering

People
Administrative Controls

Process
Procedural Controls

Technology
Engineering Controls

“Blame the process, not the people” – Deming

Provider
- training
- distractions
- fatigue

Technical
- poor designs
- deferred maintenance

Funding & resources

Organization
- culture
- incomplete policies

Team
- shifting responsibilities
- handovers

Patient
HARM

No conflict of interest to declare
MR Safety – Process Designed for People

MR Safety – Starts with Process

People
- Training
- Policies
- Guidelines

Process
- Personnel
- Access
- Screening

Technology
- Connect
- Empower
- Enforce

Process Foundation


There are potential risks to the MR environment, not only for the patient (3,8) but also for the surrounding healthy individuals, including health-care providers, hospital staff, and visitors. The presence of a metallic object, such as a pacemaker, is of particular concern to patients and staff. The presence of a metallic object can affect the accuracy of the MR images, which can lead to misdiagnosis. Therefore, it is important to identify and remove any metallic objects before entering the MR suite.

Special Communication


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Process – Procedural Controls

- Personnel – Level 1, Level 2
- Controlled Access
- Screening Requirements
- Emergency Response

Personnel Classification

- BASIC: Basic MR safety knowledge
  - Staff who interact with patients in MR area but do not require access
  - Or need supervised access
- Level 1: Enhanced MRI safety knowledge
  - Staff who access Zones 2, 3 and 4
  - Responsible for their own safety
- Level 2: Advanced MR safety knowledge
  - Radiology staff working Zone 3 and Zone 4
  - Responsible for their own safety and safety of others

Personnel Classification

- BASIC: Basic MR safety knowledge
  - General Nursing, Radiology Technologists, Housekeeping
- Level 1: Enhanced MRI safety knowledge
  - Security, Facilities, Clinical Engineering, Rad Nursing, SWAT, Anesthesia, CRNA, Physicists, Radiologists
- Level 2: Advanced MR safety knowledge
  - MR Technologists and PET-MR Nuclear Medicine Technologists
Controlled Access

• Badge access
  - Level 1
  - Level 2

• Who grants access?
  - Security after MR safety committee review

• Annual review
  - Disable access
  - Diligence!

Screening

• Patient Screening
  - Both verbal and paper
  - Reliability
  - Sedated patients

• Staff Screening
  - Verbal screening every time
  - HIPAA
  - Reminders in annual online MR safety training
Emergency Response

- Know who responds first to emergency
  - Code – Mayo Code Team
  - Fire/Quench/911 – Mayo Security
Emergency Response – Move to Zone 2!

- Stationary vs undockable table
  - All MR scanner tables at Mayo Arizona are undockable
- Level 2 training – MR Techs

Process – Summary

- Personnel
  - Basic, Level 1, Level 2
- Controlled Access
  - Levels of access
  - Periodic review and update access list
- MRI Safety Screening Requirements
  - Patients
  - Staff
- Emergency Response – Move to Zone 2!
  - Stationary vs undockable tables
  - Code, Quench, Fire, Smoke

People – Administrative Control

- MR Safety Training
- Signs and Labels
- MR Safety Committee
MR Safety Training

- **BASIC**: Basic MR safety knowledge
  - Mandatory online BASIC module on hire (initial) and then annually
- **Level 1**: Enhanced MRI safety knowledge
  - Mandatory online LEVEL 1 module on hire (initial) and then annually
  - Initial hands-on training
  - Ongoing hands-on training varies with work group
- **Level 2**: Advanced MR safety knowledge
  - Annual LEVEL 2 online module
  - Annual competency and inservice

Online Training Modules

- **Level BASIC**
  - MR is always on! - projectile hazard
  - Workflow and screening
- **Level 1**
  - Level BASIC, plus
  - Emergency procedures
  - Equipment labels (safe, unsafe, conditional)
- **Level 2**
  - Patient and staff screening – screeners
  - Burn prevention, PNS
  - Scanning sedated patients

Online Module – Mayo Examples
Hands-on Training

• Four broad areas
  1. Self-screening for MR safety (including filling screening form) (5 mins)
  2. Expectations when coming to MR area (4-step screening process) (10 mins)
  3. Projectile Hazard (10 mins)
  4. What happens in case of emergency (5 mins)

Final Survey

Hands-on Training – Projectile Hazard

Hands-On Training Frequency (Under Review)

• MR and PET-MR Technologists – Annual
• Surgery (Hybrid OR) – Annual
• Security – Annual
• Radiology Nursing – 2 years
• Radiation Oncology Therapist – 2 years
• Anesthesiologist/Resp Therapist – 5 years
• CRNA – 5 years
• Anesthesia Tech – 5 years
• Housekeeping/EVS – 5 years
• Radiologists/Radiology Fellows/Residents – Once
Level 2 Training – MR Technologists

- **Annual Online Module**
  - Common screening gaps
  - Burn prevention
  - Scanning sedated patient

- **Scanning/Screening Competencies - FOUR**
  1. Inpatient and non-communicative
  2. Outpatient
  3. Interventional MR-OR
  4. Staff Screening

- **Annual Hands-On Training**
  - Screening equipment
  - Asserting authority

*Hands-on Training Survey*

- **Please identify your department and position:**
  - Department: Radiology
  - Position: Radiologist

- **Answer the following questions using a 5-5 scale**
  1. Was this training helpful for understanding the hazards in MRI environment? 1 2 3 4 5
  2. Was the training useful for understanding MRI safe patient and procedures? 1 2 3 4 5
  3. How relevant was this training to your job? 1 2 3 4 5
  4. Would you recommend this training to your colleague? 1 2 3 4 5

- **Get one thing that was most helpful or informative:**
  - hands-on and in person is superior to solely online
### Competency – Outpatient

<table>
<thead>
<tr>
<th>Item</th>
<th>CRITICAL ELEMENTS</th>
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<tbody>
<tr>
<td>1.</td>
<td>Patient must be able to identify and sign the screening form.</td>
<td></td>
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<td>2.</td>
<td>Have a family member or an advocate assist in providing the patient with a hearing aid.</td>
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<td>3.</td>
<td>Provide a family member or an advocate to assist in providing the patient with a hearing aid.</td>
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<td>Patient must be able to identify any contraindications to MRI.</td>
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<td>Provide a family member or an advocate to assist in providing the patient with a hearing aid.</td>
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### Competency – Inpatient/Sedated

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Competency – Staff Screening

Administrative Control: Signs and Labels

- Access and Zone signs
- Workflow signs
- Personnel safety signs
- Safety markers – 200 Gauss
- Equipment labels
Administrative Control: MR Safety Committee

- Radiologist (MRMD)
- Technologist (MRSO)
- Physicist (MRSE)
- Administrators (Supervisors and Managers)
- Radiology Chair – ad hoc

MR Safety Committee: Training and Education

MRI Safety Level 1
### MR Safety Committee: Change Management

**Patient Hearing Protection**
- 3M EAR Classic: NRR 29 dB
- Radians FP80 Foam: NRR 33 dB
  - Highest available!

**Staff Hearing Protection**
- 3M H7 Delux: NRR 27 dB
- MRI Safe Pro-Ears: NRR 30 dB

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### MR Safety Education Requirements

**MR (Magnetic Resonance) Zone 3 Access Policy, Arizona**

**MR Safety Committee: Change Management**

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Practice Changes: Hybrid MR-OR

MR-OR Step-by-Step Patient Transfer Workflow

Root Cause Analysis – Safety Report (SERF)
People – Summary

• MR Safety Training
  • Level BASIC and Level 1
    • Online and hands-on
  • MR Personnel – Level 2
    • Advanced (Screening; Burn prevention)
• Signs and Labels
  • Access and Zone signs
  • Workflow signs
  • Personnel safety signs
  • Safety markers – 200 Gauss
  • Equipment labels

People – Summary

• MR Safety Training
• Signs and Labels
• MR Safety Committee
  • Policies and guidelines
  • Safety compliance – TJC, ACR
  • Change management
    • New equipment evaluation/integration
    • Clinical workflow updates and checklists
  • Safety education and training
  • Root cause analysis
    • Safety incidents/Near misses

Technology – Engineering Controls

• Construction and Shielding
• MRI Safety Zones
• MRI Screening Equipment
• Barriers and Monitoring
Construction: Fringe Fields (5 Gauss)

Construction: Pressure Release Hatch

Four Zone Setup
Staff Screening Process – Equipment Need

- Any staff with possibility of entering Zone 4 for patient care is screened
- Four step process to enter Zone 4:
  1. Verbally, inspired pat down (self-screening) – Zone 2
  2. Visually (Ferroguard) – Zone 2 or 3
  3. CEIA white hand-held (if Ferroguard senses metal)
  4. Respect final barrier yellow tape or Techgate
     - Only MR technologist can open or close
     - MR technologist has the final authority
Staff Screening Process – Step 1

- Detects ferrous vs non-ferrous metal
- MR technologist has final authority to clear items flagged by screeners for zone 4 entry
- Balance between safety, efficiency and flexibility
- Empowers MR Technologists!

Staff Screening Process – Step 2

Staff Screening Process – Step 3
Final Barrier – Step 4

Enforcement

Only MR technologist can open or close the final barrier! No ducking!

Enforcement – Smile, You are on Camera!

Zone 3 - Control Room

Zone 3 is the location of the control room for the MRI scanners. It can be shared between multiple MRI scanners.

The MRI technologists are in charge of patient and staff safety in Zones 3 and 4.

REMEMBER!
NCHA MRI Safety policy requires everyone to comply with the MRI technologists’ instructions in the MRI environment.
Technology - Summary

- Construction and Shielding
  - Fringe field
  - Pressure release hatch
- MRI Safety Zones
  - Get involved in design phase (just like radiation shielding)
- MRI Screening Equipment
  - Site process will determine what’s best
  - Empower the technologists
- Barriers and Monitoring
  - Key for safety enforcement!

Peer Review

- Look for emails about oxygen tank
Peer Review - MR Safety Week!

MR Safety Week 2017

(6) John Smith is recognized as a "MR Safety Week!" The SIRM safety committee, in support and recognition of this event, has compiled a variety of resources to assist you in improving your practice and to review and verify patient and field MRI safety.

Check back every day during MR Safety Week for new advisories and activities, and help keep MRI safety on the forefront of our collective minds.

Monday:
- Click here to view today's video.
- What is your MRI preprocedure screening protocol?
- Is everyone who enters your MRI area required to wear a gown?
- If you have patients being examined, are you using a safety protocol to reduce MRI risks?

Tuesday:
- What is your patient flow for changing patients out of clothes?
- Are all patients being prepared and premedicated appropriately prior to their MRI examination?

Wednesday:
- What is your procedure for removing the contraindicated MRI preprocedure screening form with the patient?
- Do you have a policy for removing medication patches prior to the MRI examination?


MR Safety in Practice – Mayo Clinic Arizona

People  Process  Technology

Peer Review

Antelope Canyon
Page, Arizona