MRI Safety is a Serious Problem

• Colombini “Incident” – Fatal Accident
• Patient burns are frequent
• Frequent “near misses” with ferrous objects
Medical Physicists Have an Emerging Role in MRI Safety

• ACR MRI Accreditation Program Requirements (28-OCT-2013):

“The annual medical physicist/MR scientist performance evaluation must also include an assessment of the MRI safety program (signage, access control, screening procedures and cryogen safety) as well as an inspection of the physical and mechanical integrity of the system.”

• (Joint Commission 2015 update mentions MR safety program but doesn’t require the physicist to be involved)
Medical Physicists Have an Emerging Role in MRI Safety

- ACR medical physicist forms posted 17-APR-2015:
- Physicist must verify that written MRI safety policy addresses a range of items

ACR Criteria for Compliance:
- Written policies are present and readily available to facility staff
- Written policies are reviewed and updated on a regular basis
- Facility has appropriate MR safety warning signage and methods of controlled access
- (Physicist: check Yes/No/NA to each of these)

- Physicist: Check overall “Pass” or “Fail” for safety program assessment
Important questions:

• What is the proper role of the medical physicist related to the other members of the clinical MR team?
• How can MP adequately evaluate MR safety?
• What standards and resources should we use?
• What is the responsibility – and liability – for the medical physicist in performing such evaluations?
The Approach:

1. Achieve *compliance* with applicable requirements
2. Provide *value* in medical physicist participation
One Proposed Model:

ACR Guidance Document on MR Safe Practices is **THE** standard for evaluation:

1. Use approach of radiation safety/RAM audits
2. Review documents and observe routine facility operations
3. Interview technologists

Report: State observations and limitations
Before you start...

• MUST familiarize yourself with 2013 ACR Guidance Document on MR Safe Practices

• J. Magn. Res. Img.

• Free download from ACR website

Visit the Department

• Look at simple, obvious things with fresh eyes

• Think like RCA or a “conspirator”
  • How could this situation become unsafe?
# ACR Accreditation Checklist for Medical Physicist

## Checklist based on ACR Guidance Document sections

<table>
<thead>
<tr>
<th>Establish, Implement, and Maintain Current MRI Safety Policies &amp; Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Apply to all magnets</td>
</tr>
<tr>
<td>✔ Reviewed and updated as needed for changes in site/ practice</td>
</tr>
<tr>
<td>✔ MR Medical Director appointed and given adequate authority</td>
</tr>
<tr>
<td>✔ Adverse event reporting procedures in place.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4-zone safety areas established</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Access to Zone 4 is restricted to screened and trained personnel</td>
</tr>
<tr>
<td>✔ Access to Zone 3 is appropriately restricted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quench policies &amp; procedures established</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NA Level 1 safety training for Level 1 MR personnel established</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Repeated annually</td>
</tr>
<tr>
<td>✔ List of trained individuals maintained</td>
</tr>
<tr>
<td>✔ Trained individuals have appropriate access to MR areas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2 safety training for Level 2 MR personnel established</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Repeated annually</td>
</tr>
<tr>
<td>✔ List of trained individuals maintained</td>
</tr>
<tr>
<td>✔ Trained individuals have appropriate access to MR areas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Screening of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Appropriate forms</td>
</tr>
<tr>
<td>✔ Appropriate procedures</td>
</tr>
<tr>
<td>✔ Appropriate policies</td>
</tr>
</tbody>
</table>

---

**The site’s written MRI safety policy addresses the following:**

- Designated MR medical director
- Site access restrictions (MR Zones)
- Documented MR Safety education/training for all personnel
- Patient and non-MR personnel screening
- Pediatric patients
- Magnet quench
- Cryogen safety
- Acoustic noise
- Pregnant patients and staff
- Contrast agent safety
- Sedations
- Thermal burns
- Emergency code procedures
- Device and object screening
- Designation of MR Safe/MR conditional status
- Reporting of MR safety incidents or adverse incidents
- Patient communication
- Infection control and medical waste

<table>
<thead>
<tr>
<th>Yes/No/NA</th>
</tr>
</thead>
</table>

---

**University Hospitals**

**Case Medical Center**

**SCHOOL OF MEDICINE**

**CASE WESTERN RESERVE UNIVERSITY**
Policies and Procedures Review

Compliance
• Review of documents
• Does each required policy exist?
• Does MRI medical director review, sign off regularly?

Value-Added
• Talk to the staff
• Are they aware of the policies?
• Observe the staff at work
• Do actual activities match the written procedures?
Access Control

• Facility access control per ACR 4-zone design

• Critical: restricted access entering Zone 3 to prevent unauthorized persons or objects from getting near the magnet room
  • Stopping them at the door from Zone 3 to Zone 4 is too late – NEAR MISS HIT!!!

• Are lockable doors unlocked?
• Are doors routinely left open which are supposed to be closed?
Access Control

Compliance
• Zones identified via floor plan
• Zone information posted

Value-Added
• Arrive 15 minutes early (especially for your first time)
  • In-house MP: Drop into department unannounced
• See if you could get into a magnet room without anyone stopping you
Signage ("Posting/Labeling")

- Signs posted in Zone III / Zone 3 identifying the area?
- Signs posted on entrances to Zone IV / Zone 4 magnet areas clearly identifying the hazard?
- Do signs clearly communicate:
  - A hazard?
  - Restricted access?
  - Magnet is always on?
Zone Signage

![Zone Signage](image)

- **CAUTION**
  - MRI
  - ZONE III
  - Screened MRI Patients and Personnel Only

- **DANGER!**
  - Restricted Area
  - MRI Zone IV
Pay Attention!

CAUTION
MRI ZONE III
Screened MRI Patients and Personnel Only

DANGER
MACHINE GUN FIRING RANGE
KEEP OUT
MRI Room Signage

**DANGER!**
REstricted Access

**STRONG MAGNETIC FIELD**

This Magnet is Always On!

- **NO PACEMAKERS, NO METALLIC IMPLANTS, NO NEURO STIMULATORS**
- Persons with pacemakers, neuro stimulators or metallic implants must not enter this area. Serious injury may result.

**NO LOOSE METAL OBJECTS**
Objects made from or containing ferrous metals should not be taken into this room. Serious injury or property damage may result.

Restricted items include:
- Cell phones, hearing aids, keys, jewelry & pagers

**WARNING**

**STRONG MAGNETIC FIELD**

- **NO PACEMAKERS NO METALLIC IMPLANTS NO NEUROSTIMULATORS**
- Persons with pacemakers, neurostimulators, or metallic implants must not enter this area. Serious injury may result.

- **NO LOOSE METAL OBJECTS**
- Iron, steel and other ferrous materials must not be taken into this area. Serious injury or property damage may result.
MRI Room Signage
Ferrous items/equipment kept in Zone 3 and 4? (“Posting/Labeling”)

• Safety category labeled on items?
• Unsafe items controlled/supervised by trained personnel?
  • And/or tethered?
Training

• All personnel working in MRI have had safety training?
• When was their last refresher?
• Do they remember taking it?
• Records of training available?
• Training materials available?
• Medical Director approval, sign-off, and periodic review of training materials and requirements?
Screening

Compliance
• Screening policy and forms exist
• ALL individuals entering MRI area screened
  • Not just patients!

Value-Added
• Observe screening of patient or visitor
• Is the form used?
• Is the policy/procedure followed?
• What support is available for unusual findings?
Clinical operational issues:

- Policies and procedures need to address – and staff must know – how to deal with:
  - Patient and staff pregnancy
  - Safety specific to pediatric patients
  - Medical emergencies in MRI patients
  - Quench, fire, and other environmental emergencies
  - Safety of emergency first responders
  - Patients with implants  (stick around for this session!)
  - Hearing protection
  - Claustrophobia
  - (For full list see ACR Guidance Document)
Incident reporting and monitoring

Compliance
• A policy and mechanism exists to collect and review data on adverse events in MRI

Value-Added
• Ask if staff know when, how, and to whom to report
• Ask to see prior incident reports (do they exist?)
• Ask what was done as result of past reports/reviews.
Evaluation Report

DO:

• Review all findings with lead/chief MRI technologist before preparing report

• Address report to MRI Medical Director, who has ultimate authority, responsibility for MR safety program

• Describe in detail *observations* – INCLUDING areas you feel may be outside your area of expertise

• If warranted, make *recommendations* using references
Evaluation Report

DO:

• Include the ACR accreditation review checklist (if ACR-accredited facility)
• State that observation and document review cannot identify and prevent all possible safety issues
• Identify individuals who were observed, participated in interviews, reviewed findings, or provided information
Evaluation Report

DO NOT:

• State concretely that the overall program is “Safe” or “Unsafe”

• Make *recommendations* about subjects you feel are outside your area of knowledge or expertise
Physicist’s Responsibility

• Fulfill ACR accreditation requirements (complete the form)
• Provide all services established in contract or employment/job description
• Accurately report observed facts
• Make only those recommendations within scope of expertise
• Identify limitations
MRI Safety Liability

- Liability for the MRI safety program rests with the facility and the MRI Medical Director
- Medical Physicist evaluates program as MRMD’s “eyes and ears”

- Similar to auditor / RSO relationship in RAM/nuclear medicine

- (DISCLAIMER: not legal advice)
Role of “MR Safety Officer”

- Emerging role, not yet fully defined; usually:
- Day-to-day presence in department (senior RT)
- *Reports to* MR Medical Director
- *Oversees* day to day safety
- *NOT* comprehensive authority of a Radiation Safety Officer

*Think:*

*Medical Director : MRSO = RSO : NM Lead Tech*
Review

• Medical physicists are required to evaluate the MR safety program for ACR-accredited facilities
• Physicist’s MR safety program audit can simply review policies and procedures
• By observing department activities and practices, physicist can help MR Medical Director uncover improvement opportunities
• Physicists should not hesitate to help
  • Liability can be limited
  • Expertise will develop
SAMS Questions
At which access control point is it most important to provide a physical barrier to prevent unauthorized persons or objects from entering the magnet?

1. Entering Zone 1
2. Passing from Zone 1 into Zone 2
3. Passing from Zone 2 into Zone 3
4. Passing from Zone 3 into Zone 4
5. Exiting Zone 4
At which access control point is it most important to provide a physical barrier to prevent unauthorized persons or objects from entering the magnet?

3. Passing from Zone 2 into Zone 3

References:

Which authority requires the medical physicist/MRI scientist to conduct an evaluation of a facility’s MRI safety program?

1. American College of Radiology (ACR)
2. Joint Commission
3. Centers for Medicare & Medicaid Services (CMS)
4. International Electrotechnical Commission (IEC)
5. Food and Drug Administration (FDA)
Which authority requires the medical physicist/MRI scientist to conduct an evaluation of a facility’s MRI safety program?

1. American College of Radiology (ACR)

References:

Who is responsible for the content and implementation of a facility’s MRI safety program?

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>1. Medical Physicist or MRI Scientist</td>
</tr>
<tr>
<td>2%</td>
<td>2. MR Safety Officer</td>
</tr>
<tr>
<td>0%</td>
<td>3. Lead or Chief MRI Technologist</td>
</tr>
<tr>
<td>95%</td>
<td>4. MR Medical Director</td>
</tr>
<tr>
<td>0%</td>
<td>5. MRI Manager or Supervisor</td>
</tr>
</tbody>
</table>
Who is responsible for the content and implementation of a facility’s MRI safety program?

4. MRI Medical Director

References:

Auditing and Evaluating MRI Facility Safety Programs

David W. Jordan, Ph.D., DABR, DABMP, DABSNM
Senior Medical Physicist,
University Hospitals Case Medical Center
Assistant Professor of Radiology,
Case Western Reserve University