



Children's | *of*
Hospital of Pittsburgh | UPMC

Basic MRI Safety



Course Objectives

At the end of this course the learner will:

- Know the basic principles of how MRI works.
- Understand MRI safety precautions and procedures.
- Comprehend the differences and the roles of both Level I and Level II staff.



Chapter 1

MRI Basics



THE MAGNET IS ALWAYS ON!!!!

24 hours a day, 7 days a week, 365 days a year!!
The magnet **NEVER** shuts off!!

MRI Basics

- Clinical Magnetic Resonance Imaging (MRI) uses the magnetic properties of hydrogen and its interaction with both a large external magnetic field and radiowaves to produce highly detailed images of the human body.
- NO radiation involved



MRI Terms

- Ferromagnetic
 - Having a high susceptibility to magnetization, the strength of which depends on that of the applied magnetizing field, and that may persist after removal of the applied field.
 - **Examples:** iron, nickel, cobalt, BB's, bullets
 - Ferromagnetic items **CANNOT** be brought into the MR environment



Chapter 2

MR Signs and Equipment

Important signs:

- MRI safe
- Caution
- NOT Safe





Important signs:

- **MRI Safe**
 - These items can be taken into the scanner if marked properly with an “MRI Safe” sticker
 - Ex: IV poles, Step stools, and stethoscopes
 - Keep these items in MRI! They are **very** expensive!





Important signs:

- **MRI Conditional**
 - Some of these items can be taken in the scanner, some cannot
 - Some items can only be taken into 1.5 TESLA rooms
 - **Ask MRI Technologist before taking into scanner**
 - Ex: IV poles, Step stools, and stethoscopes





Important signs:

- **MRI Unsafe**
 - These items **CANNOT** be taken into MRI
 - Ex: Oxygen tanks, Phones, Pagers, Laryngoscopes



Hand Magnet

- A hand magnet is used to test external items for MR safety
- This is **NOT** a safe way to test implants in a patient's body
- If there is any doubt, **DO NOT** take items into rooms!



Specialty equipment for the MRI...

- Wheelchairs
- Stretchers
- Monitors
- Oxygen tanks
- IV pumps
- These items are kept in MRI



Oxygen Tanks

- Color of oxygen tank **DOES NOT** determine whether tanks are MR safe or not
- Oxygen tank **MUST** be labeled “non magnetic”





Chapter 3

Patient/Employee Screening



Patient/Employee Screening

- All patients, family members, and staff **MUST** be screened by Level II personnel before entering the MRI environment
 - **Note:** Level II personnel are the only staff able to metal screen
- Level II personnel must ask questions regarding metal implants before patient is brought into the MRI room
- Patient screening must be entered into radiology assessment before bringing the patient into the room



What to Ask?

- Example of questions in radiology assessment
- Level II personnel will ask all of the questions to the right
- If any answers are yes, they will seek more information.



Metal Screen			
Hx Metal In Eyes	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Hx Working w/Metal	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Pacemaker / Cardioverter	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Aneurysm Clips	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Shrapnel / BB's / Bullets	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Body Art	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Orbit X-Ray	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Heart Valve Replacements	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Embolization Coils / Stents	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Dentures / Braces / Wigs	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Implants	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Hearing Aids / Ear Implants	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Other Metal Screen	<input type="radio"/> Y	<input checked="" type="radio"/> N	<input type="radio"/> U
Source Of Metal Hx.	PATIENT 5/17/201		



Metal Implants

- If a patient, family member, or staff member has a metal implant, the implant make and model number will have to be reviewed in the MRI safety handbook by level II personnel. If there is no documentation, a radiologist will have to decide on whether the patient can be scanned or not.
- Documentation of implants and/or consents **MUST** be entered into radiology assessment before patient is brought into MRI
- If a patient has an implant without documentation, they will **NOT** be allowed in the scanner. There are **NO** exceptions



Working with Metal

- If a patient or staff member has worked with metal and has had metal shavings in his/her eyes, an orbital x-ray will need to be obtained and a radiologist will need to clear the images before the patient can have an MRI
- If a family member or staff member has metal in their eyes they **CANNOT** enter the MR environment without orbital x-rays. X-rays will only be done if it is absolutely necessary that the person be in the room
 - (ex: MRI tech, MRI nurse)

Example:

- Patient with metal in or around eye
- No heavy eye makeup or metal in eyes
- Metal in eyes can result in burning of the optic nerve, causing permanent vision loss



Burns

- MRI will generate heat at a very fast rate
- Remove before the scan to reduce the risk of burns:
 - Medication patches
 - EKG patches
 - Pulse Ox sensors
 - All metallic clothing
 - Jewelry
- Burns can be caused by any of the above items



Examples of MRI Burns



Items NOT permitted in scanner:



- Purse, wallet, money clip, credit cards, cards with magnetic strips
- Electronic devices such as beepers or cell phones
- Hearing aids
- Metal jewelry, watches
- Pens, paper clips, keys, coins
- Hair barrettes, hairpins
- Any article of clothing that has a metal zipper, buttons, snaps, hooks, underwire, or metal threads



Chapter 4

MR Personnel



MRI Personnel

- There are two types of MRI Personnel:
 - Level I Personnel
 - Level II Personnel



Level I Personnel

- Employees that need a basic knowledge of MRI, but do not work in MRI on a full time basis include:
 - Facilities
 - Public Safety
 - Anesthesia Students
 - Physician's Assistants
 - CRNP's
 - Floor Nurses
 - ICU Nurses
- These employees **DO NOT** have access to MRI. They need to be monitored by Level II personnel



Level II Personnel

- Employees that work full time in MRI and have a vast knowledge of MRI and the safety risks involved
- These employees are in charge of making sure the MRI area is a safe environment **AT ALL TIMES**
- **Examples:**
 - MRI Technologists
 - MRI Nurses
 - Radiologists
- Absolutely **NO** other staff can have access to MRI



Chapter 5

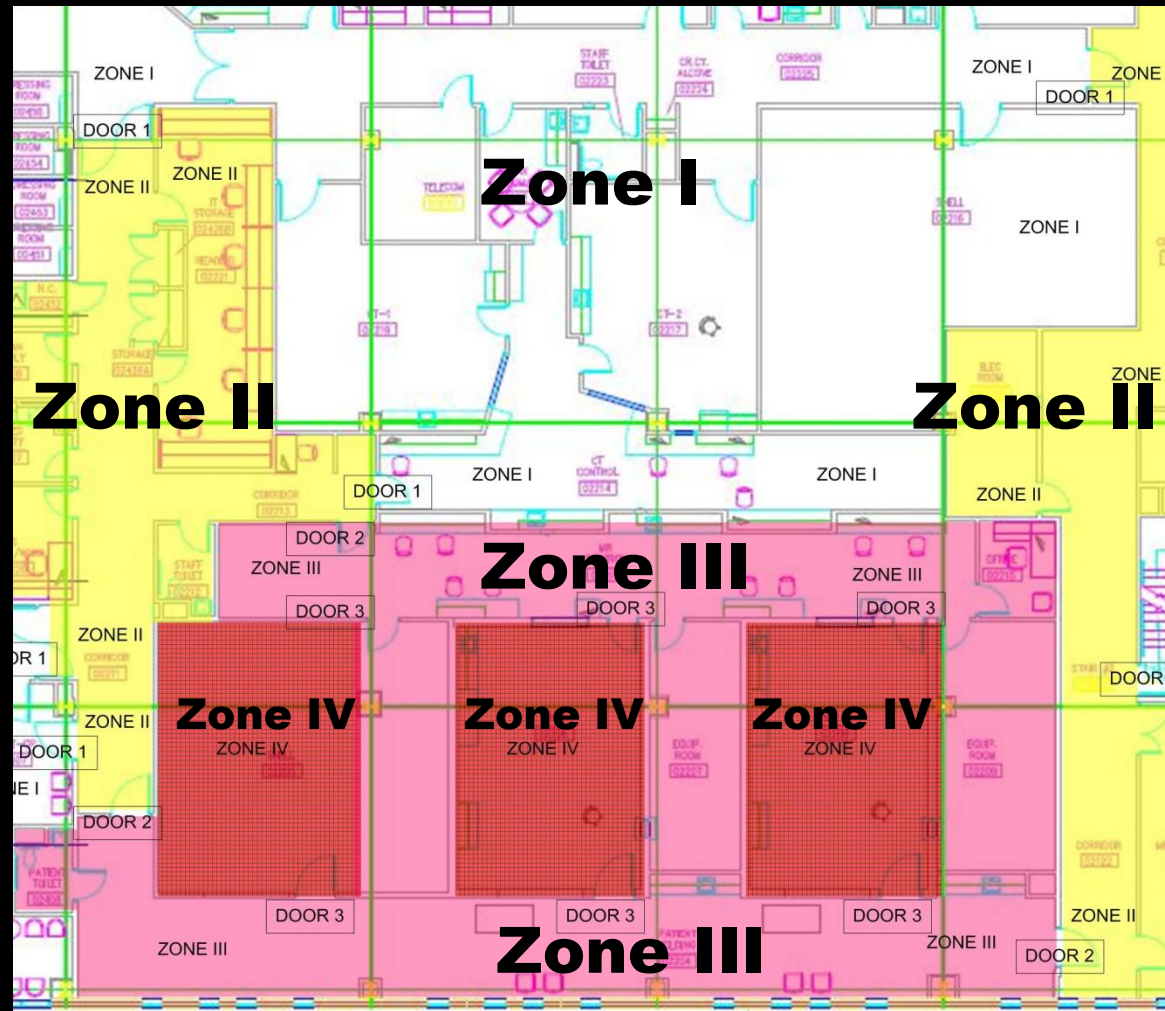
MRI Zones



MRI Zones

- All MRI suites have designated “zones” to ensure safety
- Zones are labeled I-IV, I being the furthest from the scanner and IV being the scanner itself
- **Note: Zones III and IV are restricted to MRI staff ONLY**

CHP MRI Zones





Staff Attire – Zones III and IV

- **Anyone** entering Zones III and IV of the MRI department **MUST** be changed into the approved MRI Pocketless Scrubs! This includes:
 - Technologists
 - Floor Nurses
 - Physicians
 - Respiratory
 - All other staff

Patient Attire

- A patient requires a FULL CHANGE of attire, including undergarments. This also applies to any accompanying parents/guardians.
- Not properly changing a patient can cause burns and heating





Chapter 6

Condition A/C



Condition A/C

- Codes are **NEVER** to be run in the MRI room!
- If there is reason to call a code, the patient will be removed from the scanner and the code will be run in the back hallway (Zone III)
- **NEVER** bring the crash cart into the room!



Condition A/C Policy

- CHP Policy #460 “Response to Cardiopulmonary Arrest/Medical Emergencies”
 - **“Condition A or C in Magnetic Resonance Imaging (MRI)** In the event of a crisis in MRI, it is the responsibility of the MRI technologists and nurses to remove the patient from the scanner and take the patient into the hallway behind the MRI scanners. The Condition A/C team will respond to the MRI suite and their entrance will occur via the MRI technologist opening the door to this hallway. The code team will care for the patient in this area. The Condition A/C team is not to enter into the scanner because of safety and therefore will take responsibility for the patient once the patient is in this designated hallway.”



Chapter 7

MRI Accidents

MRI Accidents

- If a ferromagnetic item is brought into the room (wrench, oxygen tank) this item will become a projectile and attract towards the magnet with tremendous force
- This item will fly toward the center of the magnet and take anything in its path with it
- **Ex:** If a patient comes in with an unsafe wheelchair, the wheelchair will fly to the center of the magnet with the patient in the chair

MRI Accidents (cont.)

- There have been many MRI accidents since MRI was introduced in the 1980's
- **Examples include, but are not limited to:**
 - Patient having an MRI Unsafe aneurysm clip in the brain, resulting in the death of the patient
 - Six year old boy struck with an oxygen tank, resulting in his death
 - Patient having nail clippers in his pocket. When being sent into the scanner, the clippers flew out of the pocket and struck the patient in the eye. As a result, this patient lost his eye



MRI Accidents (cont.)

- Patient bed that was brought into the MR environment



www.MRImetalDetector.com

MRI Accidents (cont.)



← IV Pole

Floor Buffer →





Chapter 8

Magnet Quench

Magnet Quench

The only way to deplete the magnetic field is to perform a quench. A quench involves the rapid boil-off of cryogenic fluid.

- Only to be done in a life threatening emergency
 - **Ex:** if a person is trapped between a table and the magnet OR if there is a fire in the room and emergency staff are coming into the area

Quenching the magnet is extremely expensive and takes the magnet out of commission for weeks. There is a possibility that quenching the magnet could be irreversible.





What Happens During a Quench?

- Extremely loud noise
- Gas being ventilated from the magnet to outside
 - Some gas will be ventilated into the room, raising the risk for an oxygen shortage and liquid oxygen on the floors
- Possible dangers of quenching:
 - Frostbite
 - Asphyxiation
 - Hearing damage

Magnet Quench Button



- **DO NOT** touch this button unless directly advised to by MRI staff!



In Conclusion...

What If?

- A patient has an unknown implant?
 - See the MRI technologist. An MR technologist and radiologist must clear the patient in writing before starting the exam
- A patient codes in the scanner?
 - Take the patient in the back hallway to conduct the code. **NEVER** run the code in the room
- A patient complains of burns?
 - Take the patient out of the room and investigate further



What If?

- **A person is pregnant?**
 - See MRI technologist. As far as science can tell, MRI is safe, but policy at CHP is that no person be in the room during radiofrequency while pregnant. This means a pregnant person should not be in the room while there is noise in the room.
- **Policy MOD-102.0: Pregnant Staff (MR)**
 - The pregnant staff member may continue to perform the duties/responsibilities as defined by her job description unless otherwise directed by a personal physician. The pregnant RT may archive, film, inject contrast, and enter the scanner room before and/or after an acquisition to attend to patient care needs. The pregnant RN may administer adjunct medication, monitor vital signs and enter the scanner room before, during, and/or after an acquisition to attend to patient care needs as appropriate.





Important Reminders:

- **NEVER** bring metal into the room
- **DO NOT** bring anyone into the MR environment without completing the metal screening process by level II personnel
- Codes are **NEVER** to be run in the MRI room
- Ferromagnetic items being brought into the MR environment can easily cause injury or death

Policies

- For additional information on any of these topics, see these policies on Radiology Sharepoint:
 - MOD 100.0: General Magnetic Resonance Safety
 - MOD 101.0: Metal Screening for Patient, Parent, Legal Guardian, Staff
 - MOD 102.0: Pregnant Staff (MR)
- See these items in CHP Policies on Intranet:
 - CHP Policy #460: Response to Cardiopulmonary Arrest/Medical Emergencies





Questions/Comments

- If there are any questions regarding MR Safety, please contact a lead MRI technologist:
 - Kristen Harman
 - Colleen Cooper
 - Denny Willaman
- 692-3038



Remember...

THE
MAGNET IS
ALWAYS
ON!!!!