

Baptist Health Care

MRI and Radiation

2024

Objectives:

At the conclusion of this Radiation Safety education the learner will be able to:

- Identify the two types of Radiation in health care.
- Discuss the principles how to minimize radiation exposure.
- List the Radiation Safety practices.
- Identify BHC's Radiation Safety Officer

At the conclusion of this MRI Safety education the learner will be able to:

- Describe the status of what "ALWAYS ON" means in speaking about the MRI Machine
- List the 4 MRI Safety Zones and Who may be in each zone
- Recite the ways to prevent burns with the MRI Machine
- Describe items to assist with patient safety and to help prevent harm for MRI Scans
- Catalog the Absolute Contraindications as described by the National Library of Medicine.
- Identify the Relative Contraindications as described by the National Library of Medicine.

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Radiation Safety

Types of radiation used in healthcare:

1. External beam radiation which is produced by x-ray machines and radiation oncology machines.
2. Radioisotopes used in Nuclear Medicine.

The ALARA principles help healthcare workers to minimize radiation exposure

1. **TIME:** Minimize exposure time. Minimize the time you are near the source.
2. **DISTANCE:** Maximize your distance. If a patient has been injected with a radioisotope, use precautions and maximize your distance whenever possible for a period of 2 to 4 hours after the time of the injection. With radiation, doubling your distance results in $\frac{1}{4}$ the dose!
3. **SHIELDING:** Wear a lead apron or incorporate other shielding equipment while holding a patient or working around x-ray equipment.

Radiation Safety Practices

- Film badges must be worn by team members who work in radiation-exposed areas.
- Female team members who are pregnant should notify their supervisor if subject to radiation exposure.
- If a team member is not currently pregnant and is of child-bearing age, there can still be risks associated with prolonged exposure.
- Never enter an area with a yellow and red radiation sign without permission.

BHC Radiation Safety Officer (Stephen Amos, CNMT, RSO)

In the event of an emergency or for concerns regarding radiation exposure or procedures, a Radiation Safety Officer is available and can be called.

MRI Safety

The MRI Magnet is ALWAYS On!

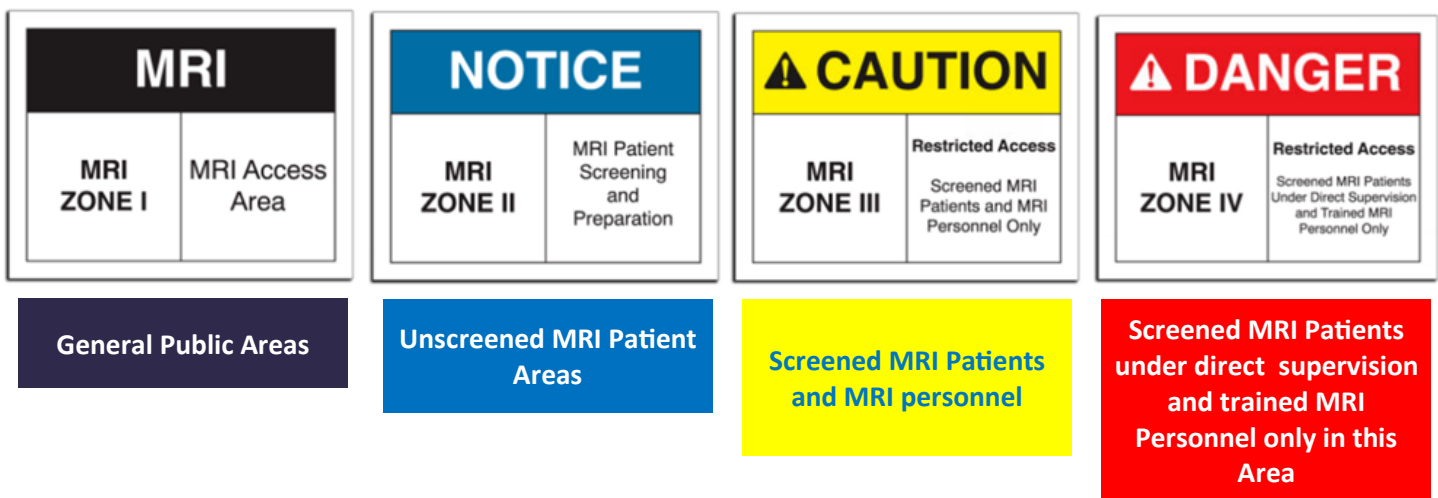
1. The MRI Magnet may look similar to a CT scan, but it uses intense magnets rather than radiation.
2. The magnets are on all the time, not just when a patient is being scanned!
3. All equipment, including maintenance equipment that is taken into the magnet area has to be non-ferrous and must be checked by MRI personnel.

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MRI Safety

There are 4 MRI Safety Zones

1. **Zone 1:** General Public Areas
2. **Zone 2:** Unscreened MRI Patient Areas
3. **Zone 3:** Screened MRI Patients and MRI personnel
4. **Zone 4:** Screened MRI Patients under direct supervision and trained MRI Personnel only in this Area



MRI Burn Prevention

1. Screen patients for implants, devices, and other metallic objects
2. Screen objects to ensure that anything entering the scan room is MR Conditional or MR Safe
3. Have patients change out of street clothes, if possible
4. Position patient to avoid skin-to-skin contact
5. Always use manufacturer provided padding and sheets/blankets if needed

MRI Patient Safety

MRI Pre-Procedure Screening Forms – filled out by the Nurse/MRI Tech/Family/Patient

This form help Medical personnel to determine the safety of beginning the Scan.

The below list are some of the items of concern that should be addressed prior to the scan.

1. Cardiac pacemaker/implanted device
2. Leads for EKG must be taken off of the patient prior to scan
3. Aneurysm clips
4. Metal objects in eye/body
5. Metallic personal belongings
6. Alert the technologist if the patient has anxiety or claustrophobia

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MRI Safety

Absolute Contraindications

1. The cardiac implantable electronic device (CIED) such as pacemakers, implantable cardioverter defibrillators (ICDs) and cardiac resynchronization therapy (CRT) devices: Patients with CIED are at risk for inappropriate device therapy, device heating/movement, and arrhythmia during MRI. These patients must be scheduled in a CIED blocked slot or scheduled with electrophysiology nurse or technician support. But nowadays MRI conditional cardiac implantable electronic devices are widely available.[6]
2. Metallic intraocular foreign bodies: The patient should be asked if he/she has ever welded without eye protection or had any facial injury with metal; if yes, an orbit x-ray must be taken and reviewed by the radiologist for approval before the MRI.
3. Implantable neurostimulation systems
4. Cochlear implants/ear implant: BAHA cochlear implant type can be scanned on a 1.5-tesla scanner only after the patient removes the battery. Cochlear implant wrapping scheduling must take place before the patient's MRI appointment.
5. Drug infusion pumps (insulin delivery, analgesic drugs, or chemotherapy pumps): If possible, the patient has to remove the device.
6. Catheters with metallic components (Swan-Ganz catheter)
7. Metallic fragments such as bullets, shotgun pellets, and metal shrapnel
8. Cerebral artery aneurysm clips
9. Magnetic dental implants
10. Tissue expander
11. Artificial limb
12. Hearing aid
13. Piercings

This information is from the National Library of Medicine. "It is important to know that some of these objects are unsafe, some are safe at 1.5 teslas only, and some are safe at 3 teslas MRI scanners. All devices and implants require investigation through a certified MRI safety website or the individual manufacturers' website. Any Referring physician, radiologist, or MR technologist must know how to find information about the compatibility of medical implants or devices in patients. It is for decades that medical materials, devices, and implants were made from non-ferromagnetic materials and are usually marked as MR safe or MR conditional. If there is no evidence or information about MRI safety of a device or implant, it has to be considered MRI unsafe." (M. Ghadimi, A. Sapro, 2023)

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MRI Safety

Relative Contraindications

A patient presenting with any of the following objects require an evaluation with caution before MRI:

- Coronary and peripheral artery stents
- Programmable shunts: patients must understand that they have to reprogram their shunt with their provider after the scan.
- Airway stents or tracheostomy: If the tracheostomy is plastic, continue with an MRI scan. If it is unknown or unsafe, have to swap out for a plastic trach before the patient entering the MRI scanner.
- Intrauterine device (IUD): Make and model merit investigation. Unknown IUDs are acceptable with 1.5 teslas only.
- Ocular prosthesis
- Stapes implants
- Surgical clips or wire sutures
- Penile prosthesis
- Joint replacement or prosthesis
- Inferior vena cava (IVC) filter: If make and model of filter unknown, the patient can be scanned on a 1.5 tesla after six weeks of being implanted.
- Harrington rods: These patients are scannable on 1.5-tesla scanners.
- Medication patch: The patches require removal before the procedure.
- Tattoos: If the tattoo is in the area of interest and is less than six weeks old, reschedule the patient. Ice packs or padding should be used against any tattoo that is in contact with the bore of the scanner or the MRI coil. Patients must be encouraged to squeeze the communication ball if they feel any warmth around their tattoos.
- Colonoscopy procedure in the last eight weeks: Obtain confirmation whether any endoscopy clips or pill cam were used or placed during the procedure with the patient or through patient's medical records. If existence is confirmed or unknown, there is a need for a consult with the radiology or referring physician.

(M. Ghadimi, A. Sapro, 2023)

MRI Tidbits of Knowledge

- MRI Exams average length of time is 15 to 17 minutes
- Patients who can not lay still for this long, will not have a successful MRI
- Patients who are claustrophobic need to be given PO medication as the body part that is imaged goes into the center of the MRI machine
- MRI Exams ARE LOUD, we provide hearing protection THAT MUST BE WORN.
- Telemetry Stickers that are placed anywhere other than MRI ARE NOT MRI SAFE!!!! And WILL BURN the PATIENT
- Any person who enters the MRI Room will be screened by our MRI Technologists, do not be offended.

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MRI Safety

Examples of Injury resulting from Ferromagnetic Objects

- Tearing of soft tissue in the brain due to movement of an aneurysm clip
- Blindness due to movement of metallic fragments in or near the eye
- Injury to a patient when an IV pole slid and struck the patient
- Injury to a patient when scissors were pulled out of a nurse's hand and struck the patient
- Injury to a technician when a steel tines (of a forklift) struck the technician
- Death of a pediatric patient when a metal oxygen tank fractured the patient's skull
- Note: Only equipment, including fire extinguishers and oxygen tanks, that have been tested and approved for use during MRI are permitted for use in Zone IV.



Figure 1. Depicts an example of an MRI radiofrequency-related burn. Reproduced and modified with permission from GE Healthcare.



A first degree tattoo burn caused by an MRI machine.
CREDIT: Mave/ NewsAiver | simplyphysics.com

Call for oxygen led to MRI death

How the accident happened

A sequence of events in the accident that fatally injured 5-year-old Michael Columbus at Westchester Medical Center July 27:

1. Michael is transferred to the MRI area for a preoperative exam in the early afternoon.
2. Michael is put head first into the MRI and receives oxygen through a tube under his nose. The oxygen tube is connected to an oxygen supply in the wall.
3. The doctor becomes concerned that the boy needs oxygen. He says he opens the door of the room in which the MRI was located, and indicates he needs oxygen, and a radiology nurse hands him a tank. He says he never stepped outside the room.
4. The powerful magnets in the MRI pull the metal oxygen bottle into the tube of the machine, crushing Michael in the head.

NEWS

Gun discharges in MRI at Indianapolis Veterans Affairs hospital

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View Comments

Roudebush VA Medical Center

MRI MACHINE CRUSHES NURSE

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References

MRI Prevention

1. National Library of Medicine/National Center for Biotechnology Information, (Ghadimi, M. & Sapra, A.) (2023, May 01) *Magnetic Resonance Imaging Contraindications*. StatPearls. [Magnetic Resonance Imaging Contraindications - StatPearls - NCBI Bookshelf \(nih.gov\)](https://www.ncbi.nlm.nih.gov/books/NBK557422/)