• An MRI machine uses combination of a large magnet, radiofrequencies, and a computer to produce detailed images of organs and structures within the body.

• LPCH and SHC have two types of MRI machines, both are VERY strong magnets
  • 1.5 Tesla 30,000 times the strength of the earth's magnetic field
  • 3 Tesla system is 60,000 times the earth's magnetic field
An MRI machine is a very large and **VERY STRONG MAGNET**.

The magnetic field increases in **STRENGTH** rapidly over a short distance. **Even more so at 3T than 1.5T**

The magnetic field extends past the magnet itself- to the edge of the room.

This means that once you enter the MR room, you are in the magnetic field and susceptible to all of its effects. As you get closer to the magnet, its effects increase **RAPIDLY**.
MRI SAFETY

THE MAGNET IS ALWAYS ON !!!!

THE MRI MAGNET IS ALWAYS ON, EVEN WHEN NOT IN USE
• LOOSE OBJECTS are very hazardous to MRI as they will become projectiles when they interact with the magnetic field.

• All items such as keys, change, cell phones, SHOULD NOT BE BROUGHT INTO THE MRI SUITE.
MRI Safe: an item (device or equipment) that poses no known hazard in all MRI environments.

- Examples include, non-conducting, non-metallic items such as plastic Petri dishes
MRI CONDITIONAL: an item that has been demonstrated to pose no known hazards in a specified MRI environment with specified conditions of use.

- Field conditions that define the environment include static magnetic field strength, spatial gradient, radio frequency (RF) fields.
- Examples include patients with DBS (deep brain stimula), MRI infusion pumps, MR monitor.
MRI UNSAFE: any item, device, or equipment labeled as MR unsafe **CANNOT** go into the MR magnetic field.
MRI LABELING

• **NO** non-MRI safe compressed cylinders (oxygen tanks, air tanks) are allowed in the MRI/CT suite.
  • Before entering the MRI Room, patients on oxygen will be switched to the oxygen set up in the MRI room. Check that no oxygen bottles are hidden under blankets.

• Only MRI IV poles are allowed in the MRI magnetic field.
  • MRI IV poles will be labeled accordingly.
HOSPITAL EQUIPMENT

Hospital equipment that is not MRI compatible will WILL BECOME A PROJECTILE if brought into the MRI Room
Freak MRI Accident Kills W'chester Boy Magnet sends canister flying into him

Magnetized oxygen tank flies across room, smashes his skull

Freak Accident During MRI Exam Kills Boy, 6

A 6-year-old boy undergoing an MRI exam was killed when the machine's powerful magnet pulled a metal oxygen tank through the air, fracturing his skull.
PATIENT/ FAMILY SCREENING

• ALL PATIENTS AND FAMILY MEMBERS MUST BE COMPLETE AN MRI SCREENING FORM BEFORE THEY ARE ALLOWED IN THE magnetic field

• For non-sedated patients, one family member is allowed in the room during the scan.
HOSPITAL STAFF SCREENING

• All hospital staff must review the MRI safety board and sign the MRI safety book before entering the magnetic field.
SCREENING

• For LPCH, **EVERYONE** entering the magnetic field (Patients, Family members, AND Hospital Staff) will ALL be screened with the MRI SAFE SCANNER (a ferro-magnetic detector) before entering the room.
IMPLANTS/ DEVICES

• **ALL** implants and/or devices must be screened and cleared by the MRI technologist or Radiologist prior to entering the magnetic field

• **When in doubt, the patient will NOT be scanned.**

• **DOCUMENTATION** of what kind of device/implant is often necessary to determine MRI safety

• Remember, this is done for the safety of the person entering the field. Potential hazards can be fatal.

• References: [mrisafety.com](http://mrisafety.com), [ismrser.org](http://ismrser.org)
SAFETY ZONES

ONE, TWO, THREE, FOUR

• The MRI/CT department is a controlled access department.
  • Only MRI and CT employees, Radiologists, and Anesthesiologists are allowed direct access to the department

• The MRI suite is divided into four zones.
• This will be followed and adhered to with NO exceptions.
SAFETY ZONES

ZONE ONE

• Any area outside the MRI suite that is freely accessible to the public, medical staff and employees.

• At LPCH, this is the hallway adjacent to the sub-holding room outside the double doors that lead into and exit the MRI Suite.

• Everything outside the double doors leading into the MRI Suite is Zone 1.
SAFETY ZONES

ZONE TWO

• Zone 2 is where patients and MRI staff enter into the department.
• Zone 2 includes the holding rooms, the central station and CT.
• Patients and non MRI personnel are to be MONITORED and ESCORTED by a staff member until they exit out of the department.
SAFETY ZONES

ZONE THREE

• This area includes the Anesthesia induction rooms, MRI control room and the MRI equipment room.

• MRI 1 (1.5T): Zone 3 begins in the hallway, directly after the bathroom at the red line.

• MRI 2 (3T): Zone 3 begins at the induction room and the control room

• ONLY those with direct access to the department are allowed into zone 3 without being DIRECTLY monitored.
SAFETY ZONES

ZONE FOUR

• This zone is the area occupied by the MRI Scanner itself.

• This zone is defined by the sealed door entrance.

• ONLY those with direct access to the department are allowed into zone 4 without being monitored.

• ONLY required staff, the patient and one parent/guardian may have access to this room.
GRADIENT SAFETY

• NOISE

• Acoustic noise is generated as a result of rapidly changing gradients.

• HEARING PROTECTION must be used by patients AND others in the magnetic field during image
The transfer of energy to living tissue has a warming effect. Resonant induction loops can be created accidentally.

- These may act as additional unwanted RF antennas
- Unwanted RF Antennas can create a current in the patient.
- This can heat the patient or potentially burn them.
- Foley temperature catheters need to be removed entirely- not cut.
AVOID UNWANTED RF ANTENNAS:

• This patient had a cervical fixation device. Proper scanning guidelines were not followed. The result was multiple 3rd degree burns where the titanium pins inserted into his skull.
AVOID UNWANTED RF ANTENNAS:

- Tattoos that cover large areas and/or with multiple bright colors that may contain iron oxide based pigment can heat up and potentially burn.

- Piercings can heat up through MRI-induced currents and cause burns. They can move or be displaced, which can even result in a serious injury.
AVOID UNWANTED RF ANTENNAS:

- Burn on patient caused by direct contact with Receiver coil, coil cables, or skin to skin contact.

- 3rd degree Burn on a child in Alabama due to unsafe practices during an MRI.
TO AVOID UNWANTED RF ANTENNAS:

- Cables should be parallel to the main magnetic field
- Keep cables straight, avoid loops.
- Coil cables, such as ECG/VCG cables should be separated and parallel.
- Layer of insulation/padding between the patient and the coils.
- NO skin to skin contact
- Never use damaged coils or equipment
EMERGENCY PROCEDURES

• ALL emergency procedures will be run OUTSIDE of the MRI scan room.
• If there is a CODE, the patient must IMMEDIATELY be removed from the room for treatment from the code team.
• During a code, the MRI technologist will monitor /secure the door to the scan room.
EMERGENCY PROCEDURES

•ONLY MRI SAFE FIRE EXTINGUISHERS ARE ALLOWED IN THE MAGNETIC FIELD.

•ALL EMERGENCY PERSONNEL MUST BE SCREENED BEFORE ENTERING THE MAGNETIC FIELD.