

**MRI scanner produces a strong magnetic field that will pull ferromagnetic objects to the machine with great force. Hence there are a number of safety procedures to follow.**

### ***Safety screening for MRI***

- Patients, staff, doctors and other visitors will be screened for objects of potential injury or risk from exposure to the magnetic field before entry to the MRI room.
- No one with a pacemaker or other implanted device is allowed to enter the restricted magnetic field area.
- Warning signs are posted where magnetic field exceeds 5 gauss
- No metal (ferrous or magnetism sensitive) objects are permitted to be in or on a person when entering the restricted magnetic field area.
- Approval of the technologist or nurse must be ensured before a patient, personnel or visitor is to enter the MR scan room.
- Patients are also screened for pregnancy prior to being MR scan

### ***Metal detector***

- There are metal detectors installed at the entrances to all the MRI rooms to detect any items that may have been missed during medical and personal screening.
- The metal detectors should not to be used in place of medical and personal screening.
- Before entering the MRI room, staff and doctors must ensure they are cleared for access and have screened themselves for any ferromagnetic objects.
- Anytime a metal detector sounds alarm, the personnel entering the MRI room must stop immediately and check their body for ferrous metal objects and remove them before stepping into the MRI room.
- Metal detectors will be operational at all times.
- Metal detectors will not be shut off at the end of the day or week-ends.



metal detectors

### ***Warning signs***

- The wall sign that identifies the hazards associated with the MRI equipment and ferrous metal objects will be posted on the doors of the MRI rooms.
- The signs warn of strong magnetic field prohibiting anyone with a pacemaker and metallic implants from entering the MRI rooms.
- Other articles which will be affected by the magnetic field of the MR magnet are listed below



## MRI safety labels

**Understanding MRI Safety Labeling**

The MR environment has unique safety hazards for patients with implants, external devices and accessory medical devices. Implants, medical devices and other equipment used in or near the MR environment should be labeled as **MR Unsafe**, **MR Conditional**, or **MR Safe**.

**MR Unsafe** items should not enter the MRI scanner room. Patients with MR Unsafe devices should not be scanned.

**MR Conditional** items may safely enter the MRI scanner room only under the very specific conditions provided in the labeling. Patients should not be scanned unless the device can be positively identified as MR Conditional AND the conditions for safe use are met. The conditions for safe use will be different based on the intended use of the device.

For items intended to enter the bore of the MRI system, the MRI Safety labeling should be matched with the MRI system for:

- Static field strength
- Maximum spatial field gradient
- dB/dt limitations (usually only applicable to active implants)
- SAR limits
- Any other conditions needed for safe use of the device, for example restrictions on the types of coils that may be used

When present, information about expected temperature rise and artifact extent may inform the risk/benefit decision of whether or not a patient should undergo an MRI examination. Expected temperature rise and artifact extent information are not conditions that must be met.

Items **NOT** intended to enter the bore of the MRI system usually have gauss line positioning restrictions or requirements to tether or affix the device to an unmovable part of the room.

**MR Safe** items pose no safety hazards in the MR environment. They may be placed anywhere in the MR environment. Patients with MR Safe devices have no scanning restrictions.

FDA U.S. FOOD & DRUG ADMINISTRATION SMRT A WORLD OF SAFETY



**Safety and Prohibition Signs**

Danger: Strong magnetic field

Danger: High frequency electro-magnetic field

Pacemakers are prohibited

Loose ferromagnetic objects are prohibited

Metal body implants are prohibited

Credit cards and pen drives are prohibited

Watches, cameras and electronic items are prohibited

## Caution in handling objects near magnetic field

- Iron or other magnetic objects must not be brought into the vicinity of the magnet
- Such objects will be attracted by the magnet and may injure the patient or the personnel in the magnet room.
- Information on magnetic carriers such as pen drives, disks and magnetic strips on credit cards will be erased by the magnetic field
- Keep safe distance - maximum 5mT (=50 gauss) magnetic field strength is permitted
- Do not allow nonferrous metallic objects to be brought into the magnetic field area, including jewellery, hairpins, buttons, prosthetics, etc.
- These nonferrous metallic objects may disturb the RF signal and may cause image artefacts
- Only MRI compatible patient care accessories such as wheelchair, stretcher, O2 tanks must be used when entering the MR scan room.

## Magnet safety

MR scanners are provided with a magnet emergency stop button, which would strictly be used only under the following conditions:

- Injury caused to patient or personnel inside the MR room due to magnetic field. This would require an immediate shutdown of the magnetic field.
- Crisis entry to the MRI room by emergency personnel due to fire or other unexpected accidents requiring immediate action.

## Cryogen safety

- The superconducting magnet in MRI scanner uses cryogen (Liquid Helium) for superconduction and cooling of the magnet.

- The superconducting magnet creates a magnetic field that does not require continuous electrical energy source. The windings in the core of the superconducting magnet must be cooled to less than 9.5 K or -440°F.
- This is accomplished by surrounding the magnet windings with a dewar filled with liquid helium, which has a boiling point of 4.2 K.
- Cryogen boil off and hence require replenishment. This operation must be performed only by fully trained personnel following proper safety procedures.
- A quench of a magnet refers to the rapid loss of magnetic field. This can happen if the temperature of the magnet windings rises above 9.5 K. The magnet windings heat up and can cause vaporization of 100 to 150 L of helium and nitrogen in less than one minute. In such a situation, these gases vent directly to the outside.
- During quench
  - There will be a loud hissing or a roaring sound followed by release of large quantities of gaseous helium. There is proper venting and hence nearly all of the released gas will escape through the vent to the outside, where a large cloud of vapours will be seen billowing into the sky.
  - Some cryogen can also escape into the scanner room, filling it with a smoke-like mist. The cold gas will cause a sudden drop in room temperature and produce an evident chill in the air.
  - Liquid Helium will cause complete depletion of oxygen in the MRI room. If inhaled, it may lead to loss of consciousness within a few seconds with the possibility of asphyxia and death. It can also cause cold thermal injuries to eyes or skin.
- Patients and staff must hence be evacuated immediately from the MR scanner room if a quench occurs.



### ***Definitions of terms***

- Ferromagnetic Object - Ferrous means iron. Ferrous materials are magnetic. Some examples are steel, stainless steel (some) and all types of iron. The MRI scanners are large magnets and ferromagnetic objects can be highly dangerous as they get close to the magnets.
- Restricted Magnetic Field Area - this area includes the magnet room, control room and computer room for the MRI unit.