



MRI Safety

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GEISINGER HEALTH SYSTEM



Boy, 6, Killed in Freak MRI Accident

A 6-year-old boy died after undergoing an MRI exam at a New York-area hospital when the machine's powerful magnetic field jerked a metal oxygen tank across the room, crushing the child's head.

The force of the device's 10-ton magnet is about 30,000 times as powerful as Earth's magnetic field, and 200 times stronger than a common refrigerator magnet.

The canister fractured the skull and injured the brain of the young patient, Michael Colombini, of Croton-On-Hudson, N.Y., during the procedure Friday. He died of the injuries on Sunday, the hospital said.

The routine imaging procedure was performed after Colombini underwent surgery for a benign brain tumor last week.

Why won't
this
happen
at your facility?

Medical Physicists are used to dealing with biological harm.

Interventional Fluoroscopy Procedure

Delivering 6.9 Gy in one hour.

Possibility of erythema in 2-4 weeks.

CT abdomen scan

Delivering 25 mGy.

possible increased risk of cancer sometime in next 30 years

MRI projectile incident

IMMEDIATE AND CATASTROPHIC!

ACR Guidance Document on MR Safe Practices: 2013

Expert Panel on MR Safety:

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Zones

ZONE I

This region includes all areas that are freely accessible to the general public.

This area is typically outside the MR environment itself and is the area through which patients, health care personnel, and other employees of the MR site access the MR environment.

In this space, there is no differentiation between patients, staff, etc.

ZONE 2

This area is the interface between the publicly accessible, uncontrolled. Zone I and the strictly controlled Zones III and IV.

Typically, patients are met in Zone II.

It is in Zone II that the answers to MR screening questions, patient histories, etc. are typically obtained.

In this space, individuals change from undifferentiated to candidates for the MRI exam.

ZONE 3

This area is the region in which free access by unscreened non-MR personnel or ferromagnetic objects or equipment can result in serious injury or death as a result of interactions between the individuals or equipment and the MR scanner's particular environment.

The patient has been accepted for the procedure and is prepared for entry into the scanner.

Restrict access to Zone III

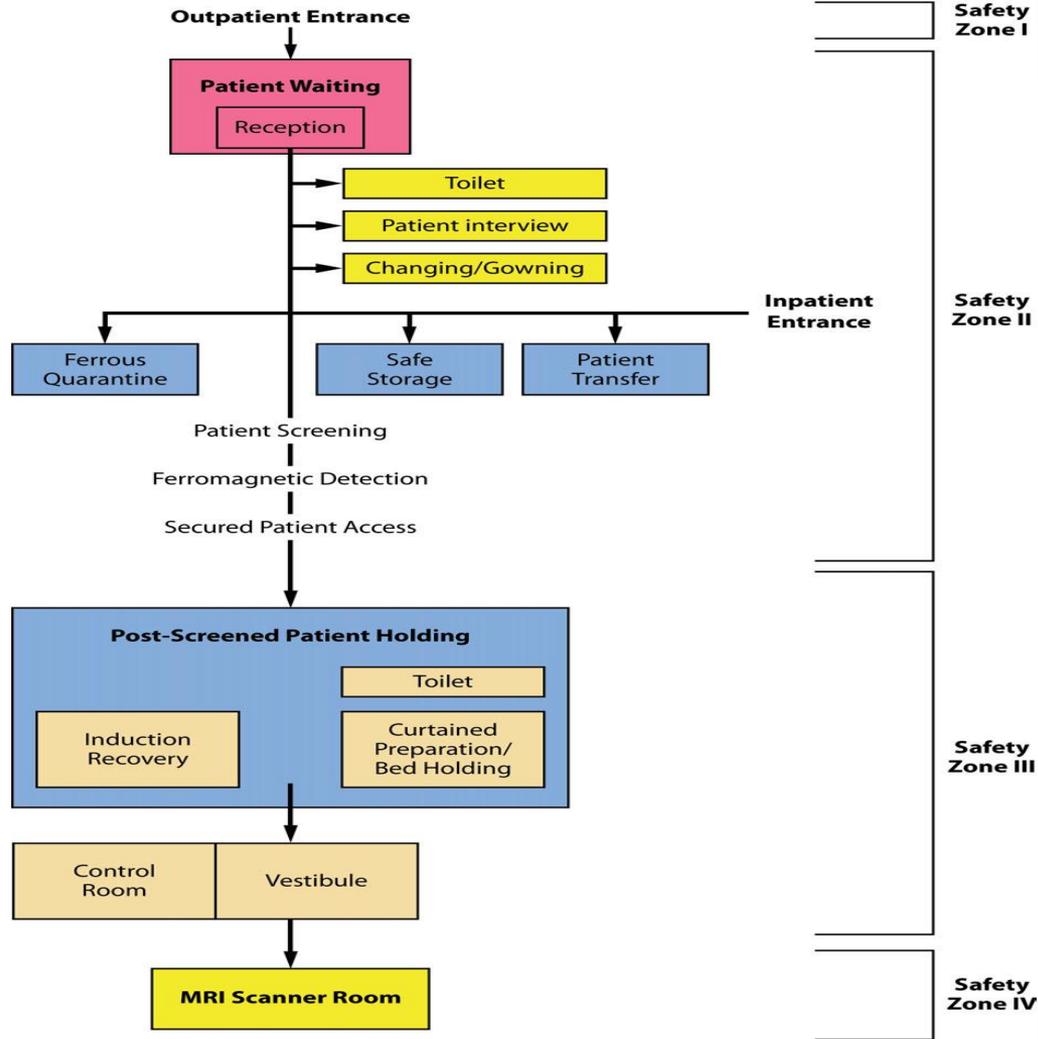
All access to Zone III is to be severely restricted, with access to it and regions within it (including Zone IV) controlled by, and entirely under the supervision of, MR personnel.

ZONE 4

This area is the MR scanner magnet room itself, i.e., the physical confines of the room within which the MR scanner is located.

The patient is scanned.

MRI Functional Diagram



ACR Guidance Document on MR Safe Practices: 2013

Zones are conceptual. They should instill the occupant with the level of caution needed to work safely within them.

They should become universal in interpretation, just as 'RADIATION AREA', 'HIGH RADIATION AREA', and 'CAUTION RADIOACTIVE MATERIALS' have become.

ZONE 4

Zone IV should be clearly marked as being hazardous due to the presence of very strong magnetic fields.







DANGER

**HIGH
VOLTAGE**



DANGER !!!

STRONG MAGNETIC FIELD !!

KEEP OUT !

As part of the Zone IV site restriction, all access pathways into Zone IV should be under **direct visual observation** by level 2 personnel.

Level 2 personnel must be able to directly observe and control, by means of line-of-sight or video monitors, the entrances or any access to Zone IV from their normal positions when scanning a patient.

Access Control

Zone IV must be secure from inadvertent entry!

§ 20.1802 Control of material not in storage.

The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

Direct Observation

Video monitors

Mirrors

Locks

Card Access

Zone IV must be secure from inadvertent entry!

Staffing

Except for emergent coverage, there will be a minimum of 2 MR technologists or one MR technologist and one other individual with the designation of MR personnel in the immediate Zone II through Zone IV MR environment.

For emergent coverage, the MR technologist can scan with no other individuals in their Zone II through Zone IV environment as long as there is in-house, ready emergent coverage by designated department of radiology MR personnel (e.g., radiology house staff or radiology attending).

Why won't
this
happen
at your facility?

Staffing

Need to care for patient and monitor entry to Zone IV

- Initiating the scan

- Removing the patient

- Medical Emergency

Emergency Response Assistance

- Who? Where are they coming from?

Staffing

Solution

There will be a minimum of 2 MR technologists or one MR technologist and one other individual with the designation of MR personnel in the immediate Zone III - Zone IV MR environment.

Staffing

Level 1 MR personnel:

Those who have passed minimal safety educational efforts to ensure their own safety as they work within Zone III.

Level 2 MR personnel:

Those who have been more extensively trained and educated in the broader aspects of MR safety issues.

Doorman

Gowning

Any individual undergoing an MR procedure must remove all readily removable metallic personal belongings and devices on or in them (e.g., watches, jewelry, pagers, cell phones, body piercings (if removable), contraceptive diaphragms, metallic drug delivery patches cosmetics containing metallic particles (such as eye make-up), and clothing items which may contain metallic fasteners, hooks, zippers, loose metallic components or metallic threads).

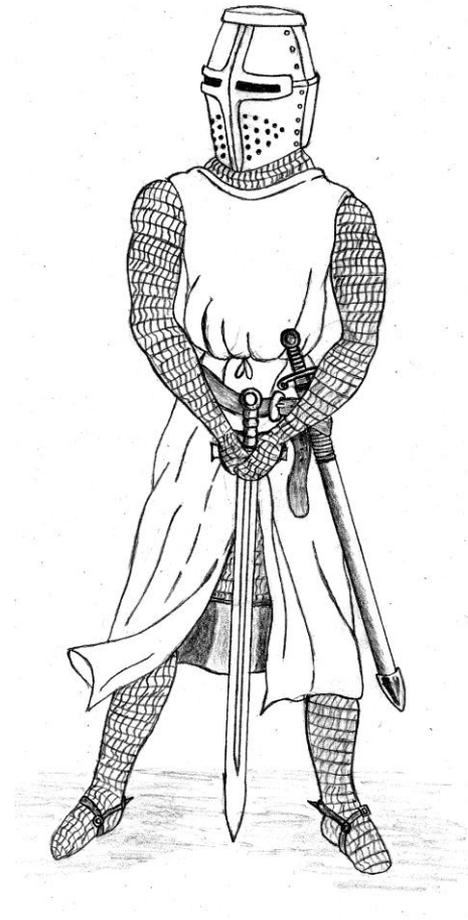
Not to mention emptying the pockets

It is therefore advisable to require that the patients or research subjects wear a site-supplied gown with no metal fasteners when feasible.

Are you sure you've emptied your pockets of all metal objects?



You can't trust them!



Equipment

All portable metallic or partially metallic devices that are on or external to the patient (e.g., oxygen cylinders, fire extinguishers) are to be positively identified in writing as MR Unsafe or, alternatively, MR Safe or MR Conditional in the MR environment before permitting them into Zone III.

Ensure that any such objects 'near' the MRI suite are MR safe,
and,

labelled as such!!!



Make sure maintenance equipment is properly labelled.



Is the patient acceptable?

SCREENING

Nonemergent patients should be safety screened by a minimum of 2 separate individuals. At least one of these individuals should be level 2 MR personnel. At least one of these 2 screens should be performed orally or interactively.

Emergent patients and their accompanying non-MR personnel may be screened only once, providing the screening individual is level 2 MR personnel. There should be no exceptions to this.

SCREENING

Patients are to complete written MR safety screening questionnaires before their introduction to Zone III.

The patient, as well as the screening MR staff member must both sign the completed form. This form should then become part of the patient's medical record.

No empty responses will be accepted—each question must be answered with a “yes” or “no” or specific further information must be provided as requested.

SCREENING

The screening process and screening forms for patients, non-MR personnel, and MR personnel should be essentially identical. Specifically, one should assume that screened non-MR personnel, health care practitioners, or MR personnel may enter the bore of the MR imager during the MR imaging process.

SCREENING

Detection Devices

Conventional metal detectors which do not differentiate between ferrous and nonferromagnetic materials are not recommended.

SCREENING

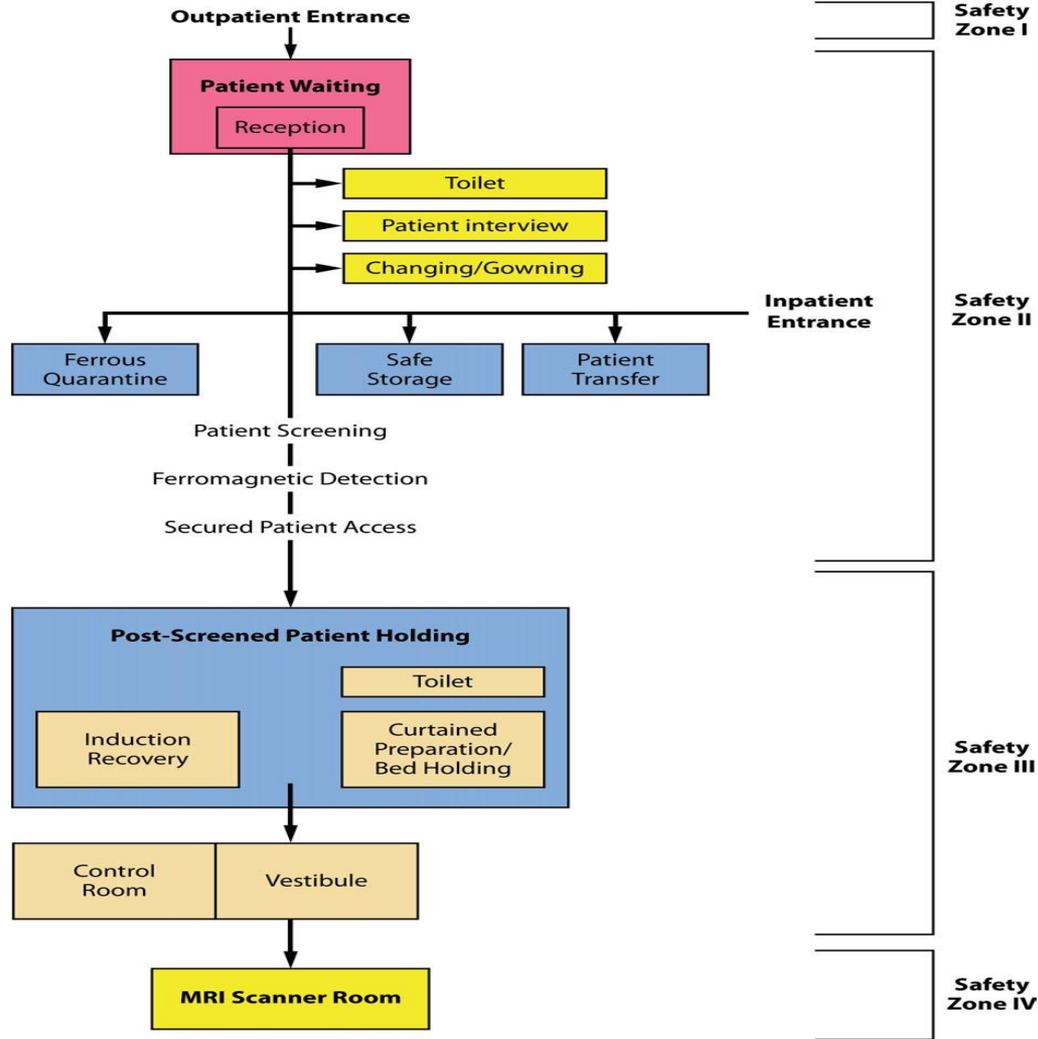
The use of ferromagnetic detection systems is recommended as an adjunct to thorough and conscientious screening of persons and devices approaching Zone IV.

Their use is in not meant to replace a thorough screening practice, which rather should be supplemented by their usage.

SCREENING

The use of ferromagnetic detection systems is also recommended for nonresponsive patients.

MRI Functional Diagram



ACR Guidance Document on MR Safe Practices: 2013

PROBLEM: Existing Imaging suite contains back-to-back MRI and CT units



CT patients and screened MRI patients are housed together.

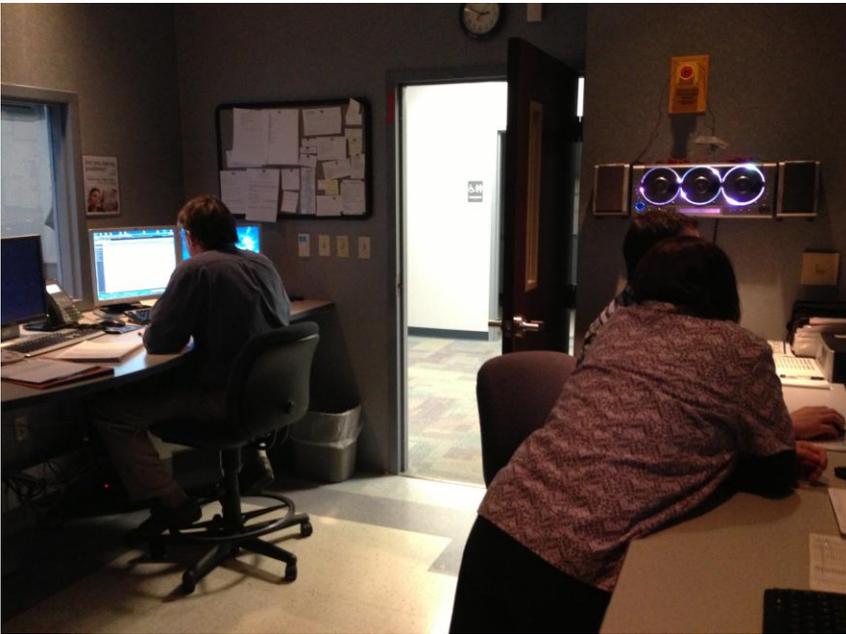
CT stretcher patients, with unsafe Oxygen cylinders are in Zone III.

CT technologists have unlimited access to Zone III.



Solution:

1. CT technologists are trained as MR personnel



Solution, cont.

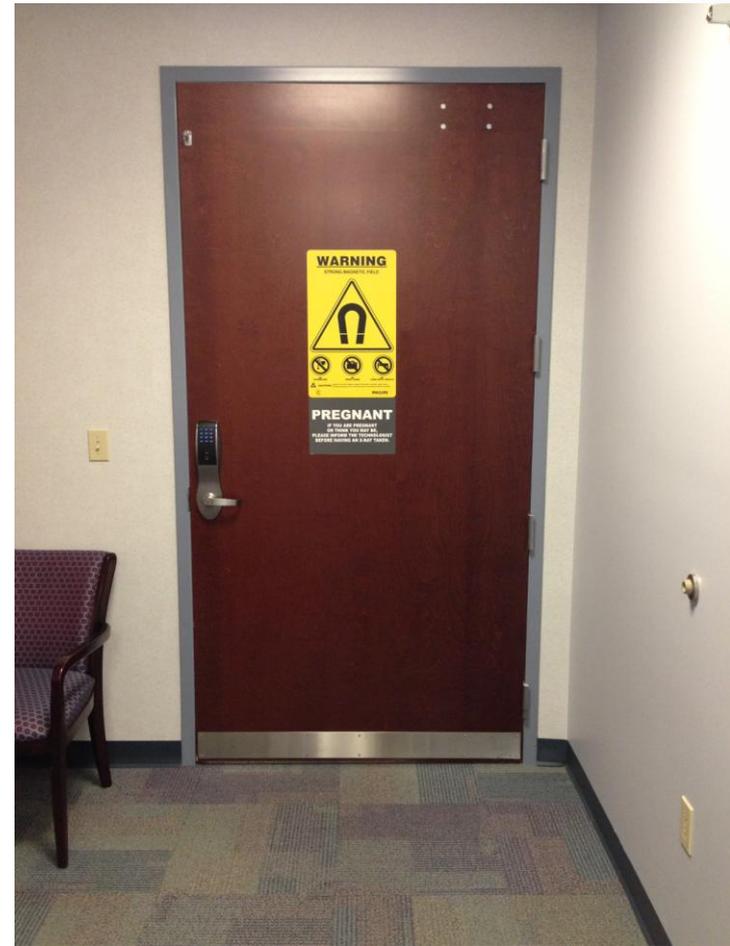
CT patients are escorted directly to the CT scanner from Zone II.

They are always under the direct supervision of a CT technologist/MR personnel, in Zone III.

MR patients are screened in Zone III. They are also always under the direct supervision of an MR technologist in Zone III.

Solution, Cont.

A locked door is installed, separating Zone II and Zone III.



PROBLEM: Imaging center with MR and CT units sharing the same waiting room. Space – Challenged facility









Solution

1. CT technologists are trained as MR personnel.
2. CT patients are assigned a new waiting room, remote from the MRI Zones.
3. CT patients are escorted to the CT unit under the constant surveillance of MR trained personnel.

Solution



Door to MRI scanner, (Zone IV) is locked, except when occupied by MR personnel.

Solution

A barrier is being built separating Zone II from Zone III.



Additional Tools / Policies and Procedures

Radiology Administrative Manual

	<i>Policy</i>	<i>Section</i>	<i>Title</i>
	10.091	10.0 Provision of Care, Treatment and Services	Magnetic Resonance (MR) Safe Practices

<i>This policy applies to:</i>		
<input checked="" type="checkbox"/>	Geisinger Medical Center campus	<i>Geisinger Health Plan</i>
<input checked="" type="checkbox"/>	Geisinger Wyoming Valley Medical Center campus	<i>ISS</i>
<input type="checkbox"/>	<i>GMC Center for Aesthetics & Cosmetic Surgery</i>	<i>Geisinger Medical Management Corporation</i>
<input checked="" type="checkbox"/>	GMC Outpatient Surgery-Woodbine	<i>Geisinger Gastroenterology and Endoscopy Center - Lewistown</i>
<input type="checkbox"/>	<i>GWVMC-Same Day Surgery@GSWB</i>	<i>Geisinger Community Medical Center</i>
<input checked="" type="checkbox"/>	Community Practice Service Line	<i>Mountain View Care Center</i>
<input type="checkbox"/>	<i>Geisinger Community Health Services</i>	
<input type="checkbox"/>	<i>Marworth</i>	
<input type="checkbox"/>	<i>Geisinger Medical Laboratories</i>	
<input type="checkbox"/>	<i>Geisinger Clinic</i>	
<input type="checkbox"/>	<i>Geisinger System Services</i>	
<input type="checkbox"/>	<i>Geisinger Endoscopy & Surgery Centre - Scenery Park</i>	

I. Purpose:

There are potential risks in the MR environment, not only for the patient but for the accompanying family members, attending health care professionals, and others who find themselves occasionally or rarely in the magnetic fields of MR scanners, such as security or housekeeping personnel, firefighters, police, etc.

The purpose of this policy is to prevent unauthorized, inadvertent entry into Zone IV of the MRI suite. Therefore this policy has been established to achieve the following goals.

Additional Tools / Safety Audit

Geisinger Health System MRI Safety Audit		
Location <input style="width: 80%;" type="text"/>	Surveyor <input style="width: 80%;" type="text"/>	Date <input style="width: 80%;" type="text"/>
Policy	Comments	
<p style="text-align: center;">MR Safety Policies and Procedures</p> <p>The MRI Department maintains Safety Policies and Procedures, which are established, implemented, maintained, and routinely reviewed and updated, as appropriate. <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	
<p style="text-align: center;">Zoning</p> <p>The MR areas shall have signage posted documenting the Zone level or number</p>		
<p style="text-align: center;">Zone I</p> <p>This region includes areas that are freely accessible to the general public. <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	
<p style="text-align: center;">Zone II</p> <p>This area is the interface between the publicly accessible, uncontrolled areas and the strictly controlled areas. Typically, patients are greeted in Zone II and are not free to move throughout Zone II at will, but rather are under the supervision of MR personnel. <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	
<p style="text-align: center;">Zone III</p> <p>Where possible, entry to Zone III shall be restricted to level I and II MR personnel and screened individuals. Individuals not meeting this restriction are permitted in Zone III, provided they are under the direct supervision, and constant surveillance, of Level II MR personnel. <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	
<p style="text-align: center;">Zone IV</p> <p>This area is the MR scanner magnet room. Zone IV is clearly marked as being potentially hazardous due to the presence of very strong magnetic fields. Entry to Zone IV shall be restricted to level II MR personnel and screened individuals. Where possible, the entrance to Zone IV shall be under the direct surveillance of the MR operator. In situations or areas, where the above is not possible, the entry to Zone IV will be secured from unauthorized entry. The door to Zone IV shall be posted with a conspicuous sign bearing the words, "DANGER: STRONG MAGNETIC FIELD". <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	
<p style="text-align: center;">MR Personnel and Non-MR Personnel</p> <p>All individuals working within at least Zone III must have successfully completed an MR safety lecture or review.</p>		
<p style="text-align: center;">Level 1</p> <p>Those who have passed minimal safety educational efforts to ensure their own safety as they work within Zone III. <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	
<p style="text-align: center;">Level 2</p> <p>Those who have been more extensively trained and educated in the broader aspects of MR safety issues. <input type="radio"/> Compliant <input type="radio"/> Non-Compliant</p>	<input style="width: 100%; height: 30px;" type="text"/>	

RECOMMENDATIONS

1. Obtain a copy of the ACR Guidance Document.
2. Mandate that all new MRI Installations follow the 4 Zone concept.
3. For existing non-compliant units- develop ways to meet the intent of the 4 Zone concept.
4. Secure Zone IV from inadvertent entry.
5. Develop and use serious warning signs.

RECOMMENDATIONS

6. Gown all Patients.
7. Label all devices near or in the MRI suite; Safe or unsafe.
8. All patients to be screened by two individuals.
9. Screen everyone who is going into Zone IV; Visitors, maintenance staff, Qualified Medical Physicists/MR Scientists.

RECOMMENDATIONS

10. Use ferromagnetic metal detectors to supplement screening procedures.
11. Ensure that MRI operations are staffed/covered by two individuals at all times.
12. Develop comprehensive policy/procedures.
13. Develop comprehensive periodic audit.