Reducing healthcare costs. Improving healthcare quality.

MRI Safety Toolkit
September 2011

Does your healthcare facility's safety culture include a comprehensive program on MRI Safety?

A partnership with Amerinet Quality Solutions can help ensure that your facility is educated on MRI Safety which could eliminate the risk of serious harm.

Value Proposition:

The Amerinet MRI Safety Toolkit provides a comprehensive, easily accessible resource containing best practice tools and information that will help facilities to maximize quality and safety outcomes while optimizing financial outcomes.

Table of Contents

Definition

- Magnetic resonance imaging, more commonly referred to as MRI, was introduced to healthcare in the late 1970s
- MRI provided, at the time, cutting edge technology which allowed two and three dimensional views of body tissue and structure
- Today, over 10 million MRI scans are performed in the United Sates each year
- While the capabilities of the MRI scanner are widely known, the inherent dangers are not

Source: The Joint Commission, SE Alert- Preventing accidents and injuries in the MRI suite, February 14, 2008

Extent of Problem

Types of injuries which can occur during an MRI Scanning Process:

- Projectile Effect
  - Magnetic pull or missile effect
  - Ferromagnetic and some non-ferromagnetic materials can be pulled into the magnet bore
  - Objects that have been reported include: oxygen cylinders, IV poles, transport stretchers, floor buffers, wheelchairs, drills, patient walkers, stethoscopes, IV pumps, scissors, hair barrettes, paper clips, and hairpins
  - Paper clips and hairpins near a 1.5T magnet can reach speeds of 40 mph
  - Projectile effect can be fatal, cause significant equipment damage, cause a quench of the magnet, and can result in large amounts of magnet downtime

Extent of Problem

Types of injuries which can occur during an MRI Scanning Process:

- Twisting or Torque Effect
  - Magnetic objects align parallel with the MRI magnetic field
  - Cochlear implants and cerebral aneurysm clips can twist in the body causing potentially fatal damage
  - Magnetic components can come loose from their base causing device failure or patient injury

- Acoustic
  - Injury caused by loud knocking nose produced by MRI scanner

Extent of Problem

Types of injuries which can occur during an MRI Scanning Process:

- Burns
  - External cable connections contacting the patient
  - Electrodes touching the patient
  - Conductive loops formed by poor patient positioning
  - Metallic tattoos or permanent eye liner containing iron oxide can heat to cause burns

- Image Artifacts
  - Presence of metals near the image site can product image artifacts; such as, signal voids or image distortion. Signal voids can mask pathology or be misinterpreted as pathology
  - RF emissions from equipment may be picked up by the MRI RF receiver resulting in image artifacts

Sources: VA National Center for Patient Safety, September 2008
The Joint Commission, SE Alert- Preventing accidents and injuries in the MRI suite, February 14, 2008

Extent of Problem

Types of injuries which can occur during an MRI Scanning Process:

- Device Malfunction
  - Devices with analog gauges, electric motors, transformers, relays, and switches can be adversely affected by the static magnetic field. For instance, battery-powered devices can suddenly fail ;some programmable infusion pumps may perform erratically; and pacemakers and implantable defibrillators may malfunction.
  - ECG waveforms can be distorted by interaction with the gradient magnetic field

Sources: VA National Center for Patient Safety, September 2008
The Joint Commission, SE Alert- Preventing accidents and injuries in the MRI suite, February 14, 2008

Contributing Factors

Images Provided By : www.simplyphysics.com

Contributing Factors

What Makes the MRI Environment Potentially Unsafe:

- MRI Magnets are powerful
  - Large invisible magnetic fields extend in three dimensions
  - MRI magnets are as much as three times as powerful as magnets used to lift cars
  - MRI magnets are always ‘ON’
  - Shutting off the MRI magnet by quenching it have inherent risks of asphyxiation, frostbite, fire hazards, plus costs which range from $20,000 – $500,00

- Major incidents are severely under-reported
  - Near misses with no injury to staff or patients are rarely reported
  - Incidents with magnet damage are rarely reported
  - Media often discover and report near misses or major incidents

Contributing Factors

What Makes the MRI Environment Potentially Unsafe:

- Objects do not appear to be ferrous or contain ferromagnetic materials
  - Ferromagnetic materials can become projectiles or twist in the magnet bore
  - All metals are conductors which can become hot or cause image artifact

Examples of Ferromagnetic Objects

Buffing Machines	Mops	Shrapnel
Chest Tube Stands	Nail Clippers and Files	Sandbags (metal filings)
Clipboards (patient charts)	Oxygen Cylinders	Steel Shoes
Gurneys	Pulse Oximeters	Stethoscopes
Hairpins	Pacemakers	Scissors
Hearing Aids	Pagers	Staples
Identification Badges	Paper Clips	Tools
Insulin Pumps	Pens and Pencils	Vacuum Cleaners
Keys	IV Poles	Watches
Medical Gas Cylinders	Prosthetic Limbs	Wheelchairs

Source: The Joint Commission, SE Alert- Preventing accidents and injuries in the MRI suite, February 14, 2008

Incidence and Prevalence

In 2005, an independent analysis of the FDA's MAUDE database was performed by Jason Launders, a medical physicist with the ECRI Institute.

Findings:

- Over a 10 year span, 389 reported MRI-related events, including nine deaths
- More than 70 percent of the 389 reports were burns
- 10 percent were projectile-related, another 10 percent were "other events", including implant disturbances
- 4 percent were acoustic injuries, another 4 percent were fire-related
- 2 percent were internal heating-related

Source: The Joint Commission, SE Alert- Preventing accidents and injuries in the MRI suite, February 14, 2008

Risk Reduction Strategies

- With 99 percent sensitivity, the use of ferromagnetic detectors may help in screening patients for remaining objects
- In helping to prevent projectile cylinder accidents, implement protocols that permit maintenance and housekeeping personnel to enter MRI suite only after proper safety education and when no patient is in the suite
- Appoint a safety officer responsible for implementing and enforcing safety procedures

Risk Reduction Strategies

- Support safe MRI practices by establishing, implementing and maintaining written protocols and checklists
- Periodically review and assess your organizations MRI polices
- As general practice, only bring MR safe devices or equipment into the MRI environment
- Ensure that procedures are in place for reporting all adverse events, MR safety incidents, or " near incidents" that occur in a timely fashion (within 24 hours)

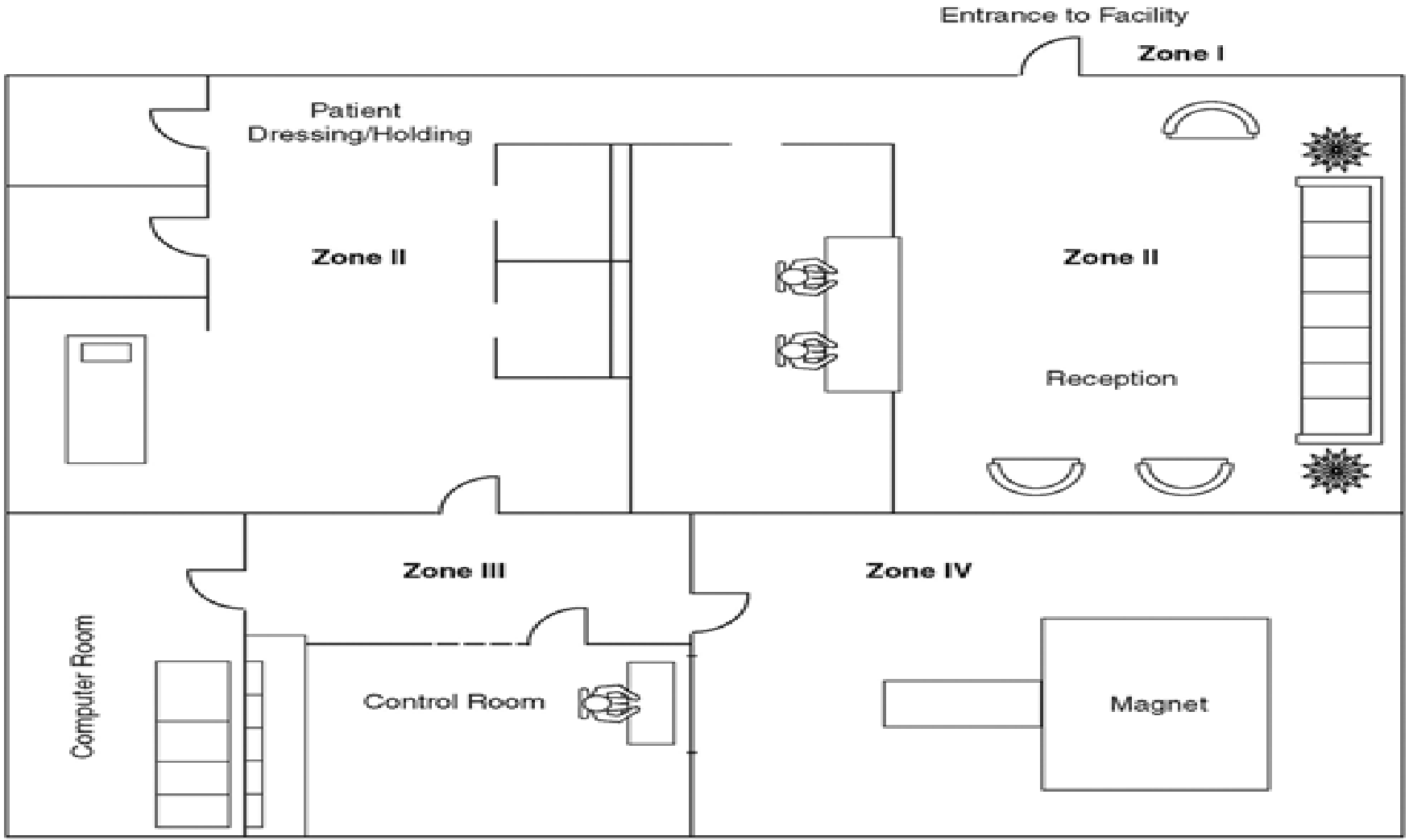
Sources: ACR Guidance Document for Safe MR Practices: 2007, AJR:188, June 2007
The Joint Commission, SE Alert- Preventing accidents and injuries in the MRI suite, February 14, 2008

Risk Reduction Strategies

- Restrict access to all MRI sites by Implementing the Four Zone Concept
  - Zone I: General Public
  - Zone II: Unscreened MRI Patients
  - Zone III: Screened MRI Patients and Personnel
  - Zone IV : Screened MRI Patients under Constant Direct Supervision of Trained MR Personal

Source: ACR Guidance Document for Safe MR Practices: 2007, AJR:188, June 2007

Model MR Facility Zone Configuration



Source: ACR Guidance Document for Safe MR Practices: 2007, AJR:188, June 2007

Risk Reduction Strategies

The new MR safety marking standard will only be effective if it is well understood and properly implemented by device manufacturers and MR departments

ASTM (American Society for Testing and Materials) Terminology

- MRI Safe: an item that poses no known hazards in all MRI environments
- MRI Conditional: an item that has been demonstrated to pose no known hazards in a specified MRI environment with specified conditions for use; such as, field strength, spatial gradients, SAR, etc.
- MRI Unsafe: an item known to pose hazards in all MRI environments

Source: Pennsylvania Patient Safety Authority: Safety in the MRI Environment: Ferromagnetic Projectile Objects in the MRI Scanner Room, Vol. 6, No. 2, June 2009

Interventions/Prevention Strategies

11 Steps to Prevent Infections in the MRI Environment:

1. Develop an appropriate written infectious control policy which includes MRI cleaning procedures and schedule
2. Implement a mandatory hand washing / hand sanitizing procedure
3. Between each patient, clean the MRI system, tables, inside the bore of the MRI system and any other items that come into contact with the patient.
4. After each patient, clean all comfort pads and positioning sponges with an approved disinfectant.
5. Periodically inspect the pads and positioning pads with a magnifying glass, particularly at the seams, to identify fraying or tearing. If present, the pads should be replaced.
6. Regularly check all padding material with an ultraviolet (black) light and remove and biological material found.

Interventions/Prevention Strategies

11 Steps to Prevent Infections in the MRI Environment: (continued)

7. Replace damaged or contaminated pads with new pads incorporating permanent antimicrobial agents.
8. Use pillows with a waterproof covering that is designed to be surface wiped. Replace pillows when their barrier is compromised.
9. Promptly remove any body fluids and then disinfect surface and all other contaminated areas.
10. If a patient has an open wound or any history of MRISA or other infection:
    - Gloves and gowns should be worn by all staff coming in contact with the patient and removed before touching other areas not coming in contact with the patient.
    - Thoroughly clean the table and all the pads before the next patient is scanned. For patients with any known infections, add 10-15 minutes onto the scheduled scan time to assure there is enough time to thoroughly clean the room and all the pads.
11. All furniture should be cleaned periodically. Ideal surfaces are those that are waterproof and easily wiped. Infection control experts recommend this be done between each patient.

Source: Rothschild, P. MD, Patient Comfort Systems

Interventions/Prevention Strategies

Redesign of the MRI environment:

- Identify and physically mark the 5 gauss line to stop MRI Unsafe items from entering the magnet room
- Identify and physically mark the 30 gauss line to prevent MRI Conditional items from being brought too close to the magnet
- Hang posters in multiple languages clearly explaining the dangers associated with the MRI environment
- Design MRI suites for safety and consider installing ferromagnetic detectors as a supplement to screening patients

Interventions/Prevention Strategies

Redesign of the MRI environment: (continued)

- Installation o f piped in oxygen systems to reduce the risk that oxygen cylinders will be brought into the magnet room
- Control access to the MRI environment by instituting the AC Guidance Document for Safe MRI Practices – 2007 Zoning
- Provide a designated quarantine area so patients arriving in MRI Unsafe wheelchairs or walkers will have those items locked away during the MRI scan
- Finished surfaces should be designed to facilitate cleaning for infection control. All MRI environments should have a sink/hand-washing station

Interventions/Prevention Strategies

Training:

- Initial and refresher training on MRI safety for all MRI personnel and those who may need to enter the MRI environment. Included are MRI technologists, nurses, and physicians, plus staff from emergency, transport, maintenance, housekeeping, and security departments
- Outside agency training should include police and firefighters
- Conceptual and practical training for radiology residents and fellows
- Drills for all emergency conditions which may occur in the MRI environment should be conducted

Interventions/Prevention Strategies

Procedural:

- Assign MRI safety duties to appropriate staff to assure that MRI policies and procedures are in effect and personnel are trained
- Always assume the magnet is ON
- MRI Technologists should have control over access to the MRI environment
- All personnel entering the MRI environment should be screened for magnetic or conductive materials in, on, or attached to the body
- Check the patient's medical record for implants or other devices contraindicated for MRI scans

Interventions/Prevention Strategies

Procedural: (continued)

- Patients should don hospital-provided gowns acceptable to the MRI environment and lockers for their belongings should be provided
- Use a hand held magnet to screen objects on or accompanying patients and other items that need to be brought into the MRI environment
- Maintain a database of MRI Safe and MRI Conditional equipment and label the devices for their classification
- If the magnet is upgraded or a new magnet is purchased, the existing equipment should be tested for appropriate labeling

Interventions/Prevention Strategies

Procedural: (continued)

- Do not make any assumptions about implants, devices, or equipment being suitable for the MRI environment
  - Read the technical information about the product
  - Call the manufacturer of the product to obtain information about the suitability of the device in the MRI environment and obtain their written policy
  - Call the manufacturer of the MRI system
- Assume that blankets and clothing are hiding something missed during the screening process
- Place sensors and cables as far away as possible from RF coils and the magnet bore
- Remove all unneeded conductors from the magnet bore

Interventions/Prevention Strategies

Procedural: (continued)

- Do not let the patient contact the magnet bore and place insulation between the patient and bore if necessary
- Periodically check sensors for heating on sedated or unconscious patients
- Do not position the patient so their body tissue makes a loop
- All codes must be conducted outside of the MRI environment
- Report all incidents to the MRI Safety Officer and FDA
- Cryogen vents should be inspected annually

Interventions/Prevention Strategies

Purchasing:

- All equipment purchased for use in or near the MRI environment should be suitable for the specific environment
- Use manufacturer approved fiber optic, carbon fiber, or graphite leads rather than conductive leads
- Use manufacturer approved large surface area, low impedance ECG Eletrodes
- Purchase sand bags containing sand, pillows without magnetic springs, and non-ferrous chairs for family in the magnet room
- Provide the patient with some type of alarm device suited for the MRI environment to alert the MRI staff

Source: "MRI Hazard Summary", published by the Veterans Administration, September 29, 2008

Interventions/Prevention Strategies

Anesthesia Considerations:

- Frequently have a large number of ferrous items on their person which are safe in the OR but not MRI
  - Stethoscopes
  - Cell phones, pagers, wallets (credit cards are erased by the magnet), shoes
  - Pens, clipboards to document the case

- Frequently use equipment which is MRI Conditional
  - Anesthesia machines
  - Laryngoscopes
  - Patient Monitors
  - Often use ferrous products purchased for joint use by MRI and CT, where they are safely used
  - Equipment must be kept outside the MRI with lines run through waveguides or equipment is tethered to the wall with chains and feet kept inside a specific area outlined on the floor

Interventions/Prevention Strategies

Anesthesia Considerations: (continued)

- Practice Advisory on Anesthetic Care for Magnetic Resonance Imaging, a report by the American Society of Anesthesiologists Task Force on Anesthetic Care for Magnetic Resonance Imaging, published in Anesthesiology 2009; 110:459-79.
  - Assist the anesthesiologist in decision making in patient care in the MRI
  - Highlights the dangers involved in anesthesia in MRI due to the use of ferrous equipment or anesthesia person carrying ferrous items into the magnet room

- The Child in MRI and CT, *Considerations and Techniques*, International Anesthesiology Clinics, Volume 47, Number 3, 15-23 by Cheryl K. Gooden, MD
  - Increasing use of MRI and CT on pediatric patients due to technological advances in diagnostic radiology
  - Anesthesiologist providing care to the pediatric patient in the MRI and CT settings often results in better and more accurate scans and patient outcome

Source: "MRI Hazard Summary", published by the Veterans Administration, September 29, 2008

Educational Opportunities

- MRI Safety Week was founded to celebrate and promote excellence in MRI safety. This is the anniversary of the tragic 2001 MRI death of young Michael Colombini, age 6, who died when a portable steel oxygen cylinder was brought into the MRI room during his exam.

- The 2011 observance marks the 10 year anniversary

Colombini MRI Case: Root Cause Analysis - 10 Years Later

Courtesy of : Reliability Center, Inc. Hopewell, VA. www.reliability.com

Educational Opportunities

- American College of Radiology
  Self-Assessment Module Online: Patient Safety

- ECRI Institute e-Learn
  Screening Patients for MRI Procedures to Ensure Safety

- Institute for Magnetic Resonance Safety, Education and Research
  MRI Safety Training Videos

- Reliability Center, Inc
  MRI Coil Failures

Educational Resources

- American College of Radiology
  ACR Guidance Document for Safe MR Practices: 2007

- The PA Patient Safety Advisory
  Safety in the MR Environment: Ferromagnetic Projectile Objects in the MRI Scanner Room

Informational Websites

- American College of Radiology
- ECRI Institute's Patient Safety Blog
- FDA MAUDE Database
- FDA Medical Device Safety
- Institute for Magnetic Resonance Safety, Education, and Research
- National Quality Forum

Educational Tools

- PA Patient Safety Authority MRI Patient Screening Form

Magnetic Resonance Imaging Patient Screening Form

Magnetic resonance (MR) facilities and units can refer to this sample MR screening form as a guide in developing a comprehensive MR screening form. All questions on the screening form should be answered completely to avoid confusion or misunderstanding as to the metal medical history and metal exposure history of the patient. The completed screening form should be reviewed with the patient (or patient's representative) by two separate MR personnel to verify completeness and accuracy.

Patient Identification No.: _____

Patient Name: _____ Age: _____ Date of Birth: _____ Today's Date: _____

Home Address: _____

Gender: _____ Height: _____ Weight: _____

Area of Body to Be Examined: _____

Reason for MRI: _____

Referring Physician: _____ Telephone No.: _____

1. Have you ever had a prior surgical procedure of any kind? ❑ Yes ❑ No

If yes, please indicate the date (approximate if unknown) and type of surgery:

Date _____ Type of Surgery _____

Date _____ Type of Surgery _____

Date _____ Type of Surgery _____

2. Have you ever had a prior diagnostic imaging study or examination (e.g., MRI, CT, X-ray)? ❑ Yes ❑ No

If yes, please list:	Body Part	Date	Facility
MRI			
CT/CAT Scan			
X-ray			
Ultrasound			
Nuclear Medicine			
Other _____			

3. Have you ever experienced any problem related to a previous MR procedure? ❑ Yes ❑ No

If yes, please explain : _____

4. Have you ever been a welder, grinder, or sheet metal worker? ❑ Yes ❑ No

If yes, please explain : _____

5. Have you had an eye injury involving a metallic object or fragment (e.g., metallic slivers, shavings)? ❑ Yes ❑ No

If yes, please explain : _____

Continued . . .

6. Have you ever been injured by a metallic object or foreign body (e.g., BB, bullet, shrapnel)? ❑ Yes ❑ No
   If yes, please explain : _____

7. Have you recently had a small bowel endoscopy study with ingestion of a small camera capsule? ❑ Yes ❑ No
   If yes, how recent: _____

8. Are you currently taking or have you recently taken any medication or drug? ❑ Yes ❑ No
   If yes, please list medications or drugs: _____

9. Are you allergic to any medication or drug? ❑ Yes ❑ No
   If yes, please list medications or drugs: _____

10. Do you have anemia or any disease(s) that affects your blood, a history of renal (kidney) disease, renal (kidney) failure, renal (kidney) transplant, high blood pressure (hypertension), liver (hepatic) disease, or seizures? ❑ Yes ❑ No
    If yes, please explain: _____

11. Do you have a history of asthma, allergic reaction, respiratory disease, or reaction to contrast medium or dye used for MRI, CT, or x-ray procedures? ❑ Yes ❑ No
    If yes, please explain: _____

12. Have you ever had a reaction to or have been told that you should not have contrast medium injections for imaging studies? ❑ Yes ❑ No
    If yes, please explain: _____

For Female Patients:

13. Date of last menstrual period: _____ Are you postmenopausal? ❑ Yes ❑ No

14. Are you or could you be pregnant or experiencing a late menstrual period? ❑ Yes ❑ No

15. Are you taking oral contraceptives or receiving hormonal treatment? ❑ Yes ❑ No

16. Are you taking any type of fertility medication or having fertility treatments? ❑ Yes ❑ No
    If yes, please explain: _____

17. Are you currently breastfeeding? ❑ Yes ❑ No

Continued . . .

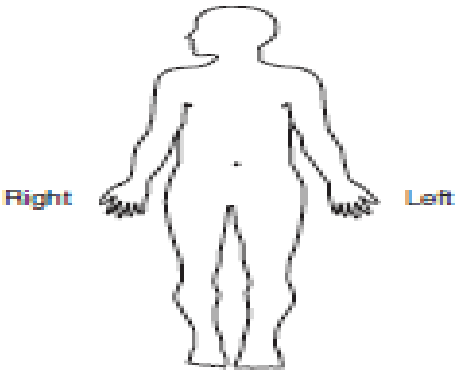
CAUTION

Magnetic resonance imaging (MRI) systems use strong magnetic fields and radio-frequency energy for imaging soft tissue in the body. Certain implants, devices, or objects may pose a hazard to individuals in close proximity to the magnet of the MRI system and/or may interfere with the MRI procedure.

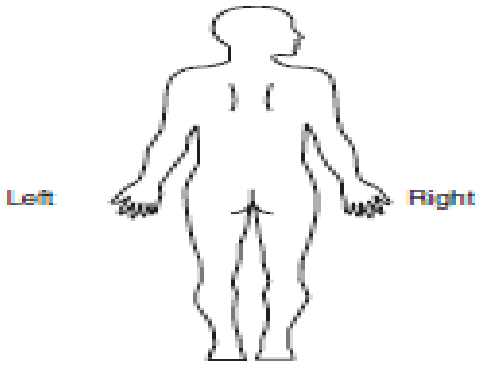
Please indicate if you currently have or ever had any of the following:

Aneurysm clip(s)	❑ Yes	❑ No	Radiation seeds or implants	❑ Yes	❑ No
Cardiac pacemaker	❑ Yes	❑ No	Swan-Ganz or thermodilution catheter	❑ Yes	❑ No
Implanted cardioverter defibrillator (ICD)	❑ Yes	❑ No	Medical patch (transdermal)		
Electronic implant or device	❑ Yes	❑ No	(e.g., Nicotine, Nitroglycerine)	❑ Yes	❑ No
Magnetically activated implant or device	❑ Yes	❑ No	Any metallic fragment or foreign body	❑ Yes	❑ No
Neurostimulator	❑ Yes	❑ No	Wire mesh implant	❑ Yes	❑ No
Spinal cord stimulator	❑ Yes	❑ No	Tissue expander (e.g., breast)	❑ Yes	❑ No
Bone growth/bone fusion stimulator	❑ Yes	❑ No	Surgical staples, clips, or metallic sutures	❑ Yes	❑ No
Internal electrodes or wires	❑ Yes	❑ No	Joint replacement (hip, knee, etc.)	❑ Yes	❑ No
Cochlear, otologic, or other ear implant			Bone/joint pin, screw, nail, wire, plate, etc.	❑ Yes	❑ No
(including hearing aid)	❑ Yes	❑ No	Intrauterine device (IUD), diaphragm,		
Insulin or other infusion pump	❑ Yes	❑ No	or pessary	❑ Yes	❑ No
Implanted drug infusion device	❑ Yes	❑ No	Braces, dentures, or partial plates	❑ Yes	❑ No
Any type of prosthesis (e.g., eye, penile)	❑ Yes	❑ No	Tattoo or permanent makeup	❑ Yes	❑ No
Heart valve prosthesis	❑ Yes	❑ No	Body piercing jewelry	❑ Yes	❑ No
Blood clot filter	❑ Yes	❑ No	Wig or hair implants	❑ Yes	❑ No
Eyelid spring or wire	❑ Yes	❑ No	Hair accessories (e.g., hairpins)	❑ Yes	❑ No
Artificial or prosthetic limb	❑ Yes	❑ No	Other implant	❑ Yes	❑ No
Metallic stent, filter, or coil	❑ Yes	❑ No	Breathing problem or motion disorder	❑ Yes	❑ No
Shunt (spinal or intraventricular)	❑ Yes	❑ No	Claustrophobia	❑ Yes	❑ No
Vascular access port and/or catheter					
(e.g., Broviac, Port-A-Cath, Hickman)	❑ Yes	❑ No			

Please mark on the figure(s) below the location of any implants, metal, tattoos, or permanent makeup inside or on your body.



Front



Back

Patient Instructions

Please use the hospital-supplied hearing protection (e.g., earplugs, headphones) during the MRI scan because the MRI scanner produces significant acoustic noise that may affect your hearing or that you may find uncomfortable.

Please remove all metallic objects before entering the MRI scan room, including the following:
Jewelry (e.g., earrings, rings, body piercings), hairpins, hair clips, dentures, false teeth, partial dental plates, hearing aids, eyeglasses, watch, pager, cell phone, keys, safety pins, paper clips, money clip, any magnetic strip cards (e.g., bank, credit), coins, pens, pocketknife, nail clipper, tools, and clothing with metal fasteners or containing metal thread.

It may be necessary for you to remain still for up to one hour while lying on your back during the MRI procedure. If you do not believe you can remain still for that long, please discuss this with the MRI technologist or radiologist before entering the MRI scan room.

Discuss any questions or concerns that you may have or if you are unsure if an item should be removed with the MRI technologist or radiologist prior to entering the MRI scan room.

I have reviewed the above information and attest that the information is accurate to the best of my knowledge. I have read and understand the entire contents of this form and had the opportunity to ask questions regarding this information and the MRI procedure.

Patient Name (please print): _____

Patient Signature: _____ Date: _____

Patient Guardian or Authorized Representative Name (please print): _____

Patient Guardian or Authorized Representative Signature: _____ Date: _____

Relationship to Patient: _____

Form Information Reviewed by: Date: _____

❑ MRI Technologist ❑ Registered Nurse ❑ Radiologist ❑ Other: _____

For more information, go to http://www.patientsafetyauthority.org.
This form accompanies the following:
Safety in the MR environment: MR safety screening practices.
Pa Patient Saf Advis
2009 Mar;6(1):20–6.

Adapted with permission from:
Frank G. Shellock, PhD, Adjunct Clinical Professor of Radiology and Medicine, Keck School of Medicine; Adjunct Professor of Clinical Physical Therapy, Division of Biokinesiology and Physical Therapy, School of Dentistry, University of Southern California; Director for MRI Studies of Biominetic MicroElectronic Systems, National Science Foundation, Engineering Research Center, University of Southern California; Institute for Magnetic Resonance Safety, Education, and Research; President, Shellock R & D Services, Inc.

References

Appendix 3: safety screening form, MRI hazard checklist, and patient instructions. In: Kanal E, Barkovich A, Bell C, et al. ACR guidance document for safe MR practices: 2007. *Am J Roentgenol* 2007 Jun;188(6):1447-74.

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Shellock FG. Magnetic resonance (MR) procedure screening form for patients [online]. [cited 2009 Feb 23]. Available from Internet: http://www.mrisafety.com/screening_form.asp.

Educational Tools

[MRI Safety Poster](#)

MRI Safety: "Sandbags" May Not Be What You Think…

Pennsylvania Patient Safety Reporting System (PA-PSRS)

Janet Johnston, RN, MSN, JD; William Marella, MBA; Edward Finley, BS

Background

More than 460 Pennsylvania hospitals, ambulatory surgery centers, birthing centers, and selected abortion facilities report to PA-PSRS patient-related adverse events and near misses. PA-PSRS collects such reports, analyzes the data, and provides feedback to reporting facilities about lessons learned, including evidence-based safety strategies. Since its inception in June 2004, more than 500,000 reports have been submitted to PA-PSRS.

Problem

The following PA-PSRS report was submitted:

A post cardiac catheterization patient with a sandbag placed on the left groin went to MRI. When the technician moved the patient into the MRI, the magnet pulled the sandbag from the patient's groin to the outer housing of the MRI unit.

Application to Patient Safety

Healthcare workers may be unaware of the risk of ferromagnetic "sandbags" — manufacturer labels may not indicate that a sandbag contains metal pellets, or whether it is MRI compatible. The sandbag may be concealed with a sheet or blanket. Order forms/catalogs, invoices, or vendor packing slips may fail to indicate that the product contains metal rather than sand. Disseminating such information reduces the potential of patient injury in the MRI setting.

Other MRI Incompatible Items Reported to PA-PSRS

- Ferromagnetic sandbags
- Dentures
- Rings/wristwatches/hairpins
- Knives
- Cell phones
- Metal implants/aneurysm clips
- Permanent makeup/tattoos
- Crutches/walkers
- Laryngoscopes
- Capsule endoscopies
- Medication patches
- Neurostimulators
- Guidewires/probes/stents
- Implants
- Tracheostomy tubes: metal/metal fibers

Patient Safety Strategies

- If feasible, do not allow MRI-incompatible sandbags in your facility.
- Assume that items are MRI incompatible until proven otherwise.
- Use a powerful hand magnet (>1000G) — **NOT the MRI magnet** — to evaluate sandbags and confirm they do not contain metal.
- Have only sandbags in the MRI environment labeled as MRI compatible.
- Do not allow sandbags from other departments into the MRI area unless confirmed that they are non-ferromagnetic.
- Add ferromagnetic sandbags to lists of MRI-incompatible equipment posted in the MRI area.
- Revise MRI screening checklists to include evaluating patients for ferromagnetic sandbags.
- If the facility must use ferromagnetic sandbags, clearly label them as containing iron and that they are not for use in the MRI area.
- Ensure that potential magnetic objects are not covered/concealed/stored on transport equipment or the patient. Look under patient gown, blankets, sheets, and towels.
- Transfer patients to MRI-compatible equipment before they enter the MRI area.
- Prior to MRI, check patients' medical records to determine whether a recent procedure/complication may have required the use of a sandbag (such as cardiac catheterization).
- Assign trained healthcare personnel the responsibility for physically evaluating the patient and securing the MRI area.
- Heighten awareness of healthcare providers of this potential patient safety problem.

Outcomes

- An article was published in the *PA-PSRS Patient Safety Advisory* (quarterly publication) regarding this hazard that included several patient safety strategies to reduce the potential for serious patient injury from sandbags in the MRI environment.
- In a survey of 186 Pennsylvania Patient Safety Officers conducted in December 2006, 27% indicated that this article helped drive changes in their facilities.

for more information visit:
www.psa.state.pa.us

This poster was adapted from
"'Sandbags' May Not Be What You Think."
PA-PSRS Patient Safety Advisory.
September 2006. Vol. 3, No. 3.

MRI Safety
Supplier Best Practice Information

- Kopp Development

Kopp Development, Inc. Company Overview

- Founded in January, 2004
- Product lines patented in U.S. and Europe
- Company website: www.koppdevelopment.com
- Worldwide network of manufacturer's representatives, distributors, and OEM partners

Kopp Development, Inc. Company Overview

- Kopp Development FerrAlert™ Halo Prescreen and FerrAlert™ Halo Entry are the only Ferromagnetic Detectors Made in America

- Product Lines
  - FerrAlert™ Halo Prescreen Ferromagnetic Detector
  - FerrAlert™ Halo Entry Ferromagnetic Detector
  - GaussAlert™ Magnetic Field Strength Alarm System
  - FerrAlert™ SOLO Patient and Staff Screener (New Product – not on contract at this time)

- FerrAlert Halo Devices are installed in over 500 facilities on 4 continents

Product Descriptions

- **FerrAlert™ Halo Prescreen** is intended for use with outpatients, family members, and hospital staff to detect small ferrous objects on the person down to the size of a typical hairpin. The recommended placement for this device is near the patient lockers or changing area. One method of installation is parallel to a wall, about six (6) inches away to allow a patient or family member to walk into the FerrAlert Prescreen, turn around, and walk out, giving you the security that the front, back, and sides of the person have been screened. Additional information is available at: www.koppdevelopment.com/prescreen.html

- **FerrAlert™ Halo Entry** is installed unobtrusively onto the frame of the magnet room door, outside or inside the magnet room, depending on the swing of the door. FerrAlert Entry has the capability to detect ferromagnetic mass of moderate to large size, similar to a bandage scissors or larger, and can significantly help to protect your investment in the magnet and to avoid a catastrophic accident, usually caused by large ferrous projectiles, which can severly injure those in the magnet room; the technologist, patient, family member, or other hospital staff; and, could damage the magnet itself. Additional information is available at: www.koppdevelopment.com/entry.html

Product Descriptions

- Both **FerrAlert** devices have 24 sensors, 12 on each side, which change from green to yellow when a ferrous object has been detected, alerting you to the presence and location of the object; in addition, both **FerrAlert** Products have an adjustable width ultrasonic sensor built into the top crossbar. In the most open position, a person who has a ferrous object will be detected and the alarm will sound and LED's change to yellow at the location of the ferrous object approximately 15 inches before the person enters the **FerrAlert** device.

- **FerrAlert Entry** has received Compatibility Certification by Siemens Medical Solutions on their 1.5T and 3T magnets with no noise, interference, or image artifact with the power ON or OFF. Testing was done using a FerrAlert Entry mounted inside the magnet room. The Test Certificate may be downloaded at: www.koppdevelopment.com/pdfs/Testcertificate_Kopp_FerrAlertHaloEntry.pdf

KOPP Development Inc.

Amerinet

Product Descriptions

- **GaussAlert Magnetic Field Strength Alarm System** is available in three standard product alarm threshold point configurations:

  GaussAlert Model 501-10 (10 gauss or 0.1 mT) is intended to be mounted on MRI Unsafe equipment which should never be brought into the magnet room as it may become a projectile or pose other risks of injury to a patient or MRI personnel, or cause damage the magnet. Products such as emergency crash carts, defibrillators, oxygen cylinders, medical gas cylinders, IV poles, and micro infusion pumps fit into this category.

  GaussAlert Model 501-30 (30 gauss or 0.3 mT) is intended to be mounted on equipment identified as MRI Conditional or the older MRI Compatible rating to prevent a user from bringing the equipment inside the 30 gauss field where it may be attracted to the magnet and pulled toward the bore or even become a projectile, potentially injuring staff, a patient, or damaging the magnet. If there is any question about the equipment, use the equipment manufacturer's documents to determine if it is appropriate to use any model **GaussAlert** with the device.

  GaussAlert Model 501-100 (100 gauss or 1.0 mT) is intended to prevent monitored equipment from inadvertently being moved into the exclusion zone by alarming when the equipment is inside the 100 gauss line. If the monitored equipment's manufacturer recommended field strength limit is exceeded, image degradation as well as projectile effect, or torque effect may occur, resulting in the injury of a patient or staff, damage to the magnet, or the monitored equipment.

  The **GaussAlert APPLICATION NOTES** is available at: http://www.koppdevelopment.com

Kopp Website Resources

- **Economic Justification for FerrAlert**
  To analyze the potential financial implications of the acquisition of the FerrAlert ferromagnetic detection system in terms of capital outlay compared with the expected accrual of potential operational savings through the device's use.

  The Economic Justification worksheet or a spreadsheet to insert your site's information is available at: www.koppdevelopment.com

- **Who recommends Ferromagnetic Detectors?**

  Summary listing of agencies recommending Ferromagnetic Detectors. Document is available at: www.koppdevelopment.com

- **Customer references, Veterans Administration Inspector General's Review, Editorials**, and several **MRI Safety** papers are available at: www.koppdevelopment.com

- **Technical Drawings and Wiring Diagrams for Architects, Designers and Builders**

  To better assist you in the architectural and design phase of your MRI facility, we will be happy to guide you to download our products' Technical Drawings and Wiring Diagrams. Sitting Ferromagnetic Detectors at MRI facilities will help you to comply with Joint Commission (JCAHO) and Facility Guidelines Institute (FGI) standards. A link to request this information is available at:

  www.koppdevelopment.com

Kopp Website Resources

- **2010 Edition of the Guidelines for Design and Construction of Health Care Facilities in U.S. published by the Facility Guidelines Institute (FGI)**

  Suites for MRI equipment shall be planned to conform to the four-zone screening and access control protocols identified in the American College of Radiology's "Guidance Document for Safe MRI Practices. A number of states have adopted the FGI 2010 Edition as their code for construction of Health Care Facilities.

The Section for MRI suites extracted from the Guidelines is:

2.2-3.4.4.2 DESIGN CONFIGURATION OF THE MRI SUITE:

1. *Suites for MRI equipment shall be planned to conform to the four-zone screening and access control protocols identified in the American College of Radiology's "Guidance Document for Safe MRI Practices."*

2. *The layout shall include provisions for the following functions:*

- ***a.*** *Patient interviews and clinical screening*
- ***b.*** *Physical screening and changing areas (as indicated)*
- ***c.*** *Siting of ferromagnetic detection systems*
- ***d.*** *Access control*
- ***e.*** *Accommodation of site-specific clinical and operational requirements*

3. *An anteroom visible from the control room shall be located outside the MRI scanner room so that patients, health care personnel, and other employees must pass through it before entering the scanning area and control room. This room shall be outside the restricted areas of the MRI's magnetic field.*

4. *Any area in which the magnetic field strength is equal to or greater than 5 gauss (0.5 millitesla) shall be physically restricted by the use of key locks or pass-key locking systems.*

The FGI website is available at: fgiguidelines.org

Additional Information on Kopp Website

- Willis HRH STRATEGIC OUTCOMES PRACTICE Technical Advisory Bulletin is available at: **www.koppdevelopment.com/articels**

- The New MRI Design Guide from Department of Veterans Affairs Recommends Use of Ferromagnetic Detectors. Document is available at: **www.koppdevelopment.com/pdfs/VA_MRI_Design_Guide-08**

- A number of MRI Safety related papers are available at: www.koppdevelopment.com

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References

- American College of Radiology www.acr.org
- ECRI Institute www.ecri.org
- Institute of Magnetic Resonance Safety, Education, and Research www.MRIsafety.com
- PA Patient Safety Authority www.patientsafetyauthority.org
- Reliability Center, Inc. www.reliability.com
- The Joint Commission www.jointcommission.org

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