

SCREENING PATIENTS FOR MR PROCEDURES AND INDIVIDUALS FOR THE MR ENVIRONMENT

Frank G. Shellock, Ph.D.

Institute for Magnetic Resonance Safety, Education, and Research
Los Angeles, CA

The establishment of thorough and effective screening procedures for patients and other individuals is one of the most critical components of a program that guards the safety of all those preparing to undergo MR procedures or to enter the MR environment. An important aspect of protecting patients and individuals from MR system-related accidents and injuries involves an understanding of the risks associated with the various implants, devices, accessories, and other objects that may cause problems in this setting. This requires constant attention and diligence to obtain information and documentation about these objects in order to provide the safest MR setting possible. In addition, because most MR-related incidents have been due to deficiencies in screening methods and/or a lack of properly controlling access to the MR environment (especially with regard to preventing personal items and other potentially problematic objects into the MR system room), it is crucial to set up procedures and guidelines to prevent such incidents from occurring.

Magnetic Resonance (MR) Procedure Screening for Patients

Certain aspects of screening patients for MR procedures may take place during the scheduling process. This should be conducted by a healthcare worker that is specially trained in MR safety (i.e., this person should be trained to understand the potential hazards and issues associated with the MR environment and MR procedures and be familiar with all of the information contained on the screening forms for patients and individuals). During this time, it may be ascertained if the patient has any implant that may be contraindicated for the MR procedure (e.g., a ferromagnetic aneurysm clip, pacemaker, etc.) or if there is any condition that needs careful consideration (e.g., the patient is pregnant, has a disability, etc.). Preliminary screening helps to prevent scheduling patients that may be inappropriate candidates for MR examinations.

After preliminary screening, every patient must undergo comprehensive screening in preparation for a magnetic resonance (MR) procedure (i.e., MR imaging, MR angiography, functional MRI, MR spectroscopy). Comprehensive patient screening involves the use of a printed form to document the screening procedure, a review of the information on the screening form, and a verbal interview to verify the information on the form and to allow discussion of any question or concern that the patient may have. An MR-safety trained healthcare worker must conduct this aspect of patient screening.

A screening form for patients developed by Sawyer-Glover and Shellock (2000) was recently revised in consideration of new information in the peer-reviewed literature. This

two-page form entitled, **Magnetic Resonance (MR) Procedure Screening Form for Patients**, was also created in conjunction with the Medical, Scientific, and Technology Advisory Board and the Corporate Advisory Board of the Institute for Magnetic Resonance Safety, Education, and Research (IMRSER). A “downloadable” version of this form may be obtained from the MR safety web sites, www.IMRSER.org and www.MRIsafety.com.

Page one of this screening form requests general patient-related information (name, age, sex, height, weight, etc.) as well as information regarding the reason for the MR procedure and/or symptoms that may be present. Pertinent information about the patient is required not only to ensure that the medical records are up-to-date, but also in the event that the MR facility needs to contact the referring physician for additional information regarding the examination or to verify the patient’s medical condition.

The form requests information regarding a prior surgery or operation to help determine if there may be an implant or device present that could create a problem for the patient. Information is also requested pertaining to prior diagnostic imaging studies that may be helpful to review for assessment of the patient’s condition.

Next, important questions are posed in an effort to determine if there are possible problems or issues that should be discussed with the patient prior to permitting entry to the MR environment. For example, information is requested regarding any problem with a previous MR examination, an injury to the eye involving a metallic object, or any injury from a metallic object or foreign body. Questions are posed to obtain information about current or recently taken medications as well as the presence of drug allergies. There are also questions asked to assess past and present medical conditions that may affect the MR procedure or the use of an MRI contrast agent in the patient.

At the bottom of page one, there is a section for female patients that poses questions that may impact MR procedures. For example, questions regarding the date of the last menstrual period, pregnancy or late menstrual period are included. A definite or possible pregnancy must be identified prior to permitting the patient into the MR environment so that the risks vs. the benefits of the MR procedure can be considered and discussed with the patient. MR procedures should only be performed in pregnant patients to address important clinical questions. MR facilities should have a clearly defined procedure to follow in the event that the patient has a confirmed or possible pregnancy.

Questions pertaining to the date of the last menstrual period, use of oral contraceptives or hormonal therapy, and fertility medication are necessary for female patients undergoing MR procedures that are performed to evaluate breast disease or for OB/GYN applications, as these may alter the tissue appearance on MR imaging. An inquiry about breastfeeding is included in case the administration of MRI contrast media

is being considered for nursing mothers.

The second page of the form has a statement at the top that indicates: “**WARNING:** Certain implants, devices, or objects may be hazardous to you and/or may interfere with the MR procedure (i.e., MRI, MR angiography, functional MRI, MR spectroscopy). Do not enter the MR system room or MR environment if you have any question or concern regarding an implant, device, or object. Consult the MRI Technologist or Radiologist **BEFORE** entering the MR system room. The MR system magnet is **ALWAYS** on.”

Next, there is a section that lists various implants, devices, and objects to identify anything that could be hazardous to the patient undergoing the MR procedure or that may produce an artifact that could interfere with the interpretation of the MR procedure. In general, these items are arranged on the checklist in order of the relative safety hazard (e.g., aneurysm clip, cardiac pacemaker, implantable cardioverter defibrillator, electronic implant, etc.), followed by items that may simply produce imaging artifacts that could be problematic for the interpretation of the MR procedure. Additionally, questions are posed to determine if the patient has a breathing problem, movement disorder, or claustrophobia because these are known to present difficulties for MR procedures.

Figures of the human body are included on the second page of the screening form for the patient as a means of showing the location of any object inside of or on the body. This information is particularly useful so that the patient may indicate the approximate position of any object that may be hazardous or that could interfere with the interpretation of the MR procedure as a result of producing an artifact.

Page 2 of the screening form also has an **Important Instructions** section that states: “Before entering the MR environment or MR system room, you must remove all metallic objects including hearing aids, dentures, partial plates, keys, beeper, cell phone, eyeglasses, hair pins, barrettes, jewelry, body piercing jewelry, watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, tools, clothing with metal fasteners, & clothing with metallic threads. Please consult the MRI Technologist or Radiologist if you have any question or concern **BEFORE** you enter the MR system room.”

Finally, there is a statement on the **Magnetic Resonance (MR) Procedure Screening Form for Patients** that indicates hearing protection is “advised or required” to prevent possible problems or hazards related to acoustic noise. In general, this should not be an option for a patient undergoing an MR procedure on a high-field-strength MR system. By comparison, it may not be necessary for the use of hearing protection by patients undergoing MR procedures on low-field-strength MR systems.

It should be noted that undergoing previous MR procedures without incidents does not guarantee a safe subsequent MR examination. Various factors (e.g., the static magnetic

field strength of the MR system, the orientation of the patient, the orientation of a metallic implant or object, etc.) can substantially change the scenario. Thus, a written screening form must be completed each time a patient prepares to undergo an MR procedure. This is not an inconsequential matter because a surgical intervention or accident involving a metallic foreign body may have occurred that could impact the safety an MR procedure or of entering the MR environment.

With the use of any type of written questionnaire, limitations exist related to incomplete or incorrect answers provided by the patient. For example, there may be difficulties associated with patients that are impaired with respect to their vision, language fluency, or level of literacy. Therefore, an appropriate accompanying family member or other individual (e.g., referring physician) should be involved in the screening process to verify any information that may impact patient safety. Versions of this form should also be available in other languages, as needed (i.e., specific to the demographics of the MR facility).

In the event that the patient is comatose or unable to communicate, the written screening form should be completed by the most qualified individual (e.g., physician, family member, etc.) that has knowledge about the patient's medical history and present condition. If the screening information is inadequate, it is advisable to look for surgical scars on the patient and/or to obtain plain films of the skull and/or chest to search for implants that are known to be particularly hazardous in the MR environment (e.g., aneurysm clips, cardiac pacemakers, etc.).

Following completion of the **Magnetic Resonance (MR) Procedure Screening Form for Patients**, an MR-safety trained healthcare worker should review the form's content. Next, a verbal interview should be conducted by the MR-safety trained healthcare worker to verify the information on the form and to allow discussion of any question or concern that the patient may have before undergoing the MR procedure. This allows a mechanism for clarification or confirmation of the answers to the questions posed to the patient so that there is no miscommunication regarding important MR safety issues. In addition, because the patient may not be fully aware of the medical terminology used for a particular implant or device, it is imperative that this particular information on the form be discussed during the verbal interview.

After the comprehensive screening procedure is completed, any patient that is transferred by a stretcher, gurney, or wheelchair to the MR system room should be checked thoroughly and systematically for metal objects under the sheets or blankets such as ferromagnetic oxygen tanks, monitors, or other objects that could pose a hazard.

Magnetic Resonance (MR) Environment Screening for Individuals

Before any "non-patient" individual (e.g., MRI technologist, MR support person, patients,

family member, visitor, allied health professional, physician, maintenance worker, custodial worker, fire fighter, security officer, etc.) is allowed into the MR environment, he or she must be screened by a MR-safety trained healthcare worker. Proper screening for individuals involves the use of a printed form to document the screening procedure, a review of the information on the form, and a verbal interview to verify the information on the form and to allow discussion of any question or concern that the individual may have before permitting entry to the MR environment.

In general, magnetic resonance (MR) screening forms were developed with patients in mind and, therefore, pose many questions that are inappropriate or confusing to other individuals that may need to enter the MR environment. Therefore, a screening form was recently created specifically for individuals that need to enter the MR environment and/or MR system room. This form, entitled, **Magnetic Resonance (MR) Environment Screening Form for Individuals** was developed in conjunction with the Medical, Scientific, and Technology Advisory Board and the Corporate Advisory Board of the Institute for Magnetic Resonance Safety, Education, and Research (IMRSER). A “downloadable” version of this form may be obtained from the MR safety web sites, www.IMRSER.org and www.MRIsafety.com.

At the top of this form, the following statement is displayed: “The MR system has a very strong magnetic field that may be hazardous to individuals entering the MR environment or MR system room if they have certain metallic, electronic, magnetic, or mechanical implants, devices, or objects. Therefore, all individuals are required to fill out this form BEFORE entering the MR environment or MR system room. Be advised, the MR system magnet is ALWAYS on.”

The **Magnetic Resonance (MR) Environment Screening Form for Individuals** requests general information (name, age, address, etc.) and poses important questions to determine if there are possible problems or issues that should be discussed with the individual prior to permitting entry to the MR environment. A warning statement is also provided on the form, as follows: “**WARNING:** Certain implants, devices, or objects may be hazardous to you in the MR environment or MR system room. Do not enter the MR environment or MR system room if you have any question or concern regarding an implant, device, or object.” In addition, there is a section that lists various implants, devices, and objects to identify the presence of anything that could be hazardous to an individual in the MR environment (e.g., an aneurysm clip, cardiac pacemaker, implantable cardioverter defibrillator (ICD), electronic or magnetically activated device, metallic foreign body, etc).

Finally, there is an **Important Instructions** section on the form that states: Remove all metallic objects before entering the MR environment or MR system room including hearing aids, beeper, cell phone, keys, eyeglasses, hair pins, barrettes, jewelry (including body piercing jewelry), watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, steel-

toed boots/shoes, and tools. Loose metallic objects are especially prohibited in the MR system room and MR environment. Please consult the MRI Technologist or Radiologist if you have any question or concern BEFORE you enter the MR system room.”

The proper use of this written form along with thorough verbal screening of the individual by an MR-safety trained healthcare worker should prevent accidents and injuries in the MR environment.

[Portions of this text were adapted with permission from Sawyer-Glover A, Shellock FG. Pre-Magnetic Resonance Procedure Screening, In: Magnetic Resonance Procedures: Health Effects and Safety, FG Shellock, Editor, CRC Press, LLC, Boca Raton, FL, 2001. The screening forms, **Magnetic Resonance (MR) Procedure Screening Form For Patients** and **Magnetic Resonance (MR) Environment Screening Form for Individuals** were developed in conjunction with the Medical, Scientific, and Technology Advisory Board and the Corporate Advisory Board of the Institute for Magnetic Resonance Safety, Education, and Research (IMRSER), 2002 © F. G. Shellock, 2002]

Pertinent References

<http://www.MRIsafety.com>

<http://www.IMRSER.org>

Kanal E, Borgstede JP, Barkovich AJ, Bell C, et al. American College of Radiology White Paper on MR Safety. American Journal of Roentgenology 2002;178:1335-1347.

Sawyer-Glover A, Shellock FG. Pre-Magnetic Resonance Procedure Screening, In: Magnetic Resonance Procedures: Health Effects and Safety, FG Shellock, Editor, CRC Press, LLC, Boca Raton, FL, 2001.

Sawyer-Glover A, Shellock FG. Pre-MRI procedure screening: recommendations and safety considerations for biomedical implants and devices. J Magn Reson Imaging 2000;12: 92-106.

Shellock FG. Reference Manual for Magnetic Resonance Safety: 2002 Edition. Amirsys, Salt Lake City, Utah, 2002.

Shellock FG. New recommendations for screening patients for suspected orbital foreign bodies. Signals, No. 36, Issue 4, 2001, pp. 8-9,

Shellock FG. Biomedical implants and devices: assessment of magnetic field interactions with a 3.0-Tesla MR system. J Magn Reson Imaging (in press).

Shellock FG. MR safety update 2002: Implants and devices. J Magn Reson Imaging (in press)

Shellock FG, Crues JV. Commentary. MR safety and the American College of Radiology White Paper. American Journal of Roentgenology 2002;178:1349-1352.

Shellock FG, Kanal E. Policies, guidelines, and recommendations for MR imaging safety and patient management. J Magn Reson Imaging 1991;1:97-101.

Shellock FG, Kanal E. SMRI Report. Policies, guidelines and recommendations for MR imaging safety and patient management. Questionnaire for screening patients before MR procedures. J Magn Reson Imaging 1994;4:749-751, 1994.

Shellock FG, Kanal E. Policies, guidelines, and recommendations for MR imaging safety and patient management. J Magn Reson Imaging 1991;1: 97-101.

Shellock FG, Kanal E. Magnetic Resonance: Bioeffects, Safety, and Patient Management. Second Edition, Lippincott-Raven Press, New York, 1996.

MAGNETIC RESONANCE (MR) PROCEDURE SCREENING FORM FOR PATIENTS

Date ____/____/____ Patient Number _____

Name _____ Age _____ Height _____ Weight _____
Last name First name Middle Initial

Date of Birth ____/____/____ Male Female Body Part to be Examined _____
month day year

Address _____ Telephone (home) (____) ____-____

City _____ Telephone (work) (____) ____-____

State _____ Zip Code _____

Reason for MRI and/or Symptoms _____

Referring Physician _____ Telephone (____) ____-____

1. Have you had prior surgery or an operation (e.g., arthroscopy, endoscopy, etc.) of any kind? No Yes

If yes, please indicate the date and type of surgery:

Date ____/____/____ Type of surgery _____

Date ____/____/____ Type of surgery _____

2. Have you had a prior diagnostic imaging study or examination (MRI, CT, Ultrasound, X-ray, etc.)? No Yes

If yes, please list: Body part Date Facility

MRI _____/____/____ _____

CT/CAT Scan _____/____/____ _____

X-Ray _____/____/____ _____

Ultrasound _____/____/____ _____

Nuclear Medicine _____/____/____ _____

Other _____/____/____ _____

3. Have you experienced any problem related to a previous MRI examination or MR procedure? No Yes

If yes, please describe: _____

4. Have you had an injury to the eye involving a metallic object or fragment (e.g., metallic slivers, shavings, foreign body, etc.)? No Yes

If yes, please describe: _____

5. Have you ever been injured by a metallic object or foreign body (e.g., BB, bullet, shrapnel, etc.)? No Yes

If yes, please describe: _____

6. Are you currently taking or have you recently taken any medication or drug? No Yes

If yes, please list: _____

7. Are you allergic to any medication? No Yes

If yes, please list: _____

8. Do you have a history of asthma, allergic reaction, respiratory disease, or reaction to a contrast medium or dye used for an MRI, CT, or X-ray examination? No Yes

9. Do you have anemia or any disease(s) that affects your blood, a history of renal (kidney) disease, or seizures? No Yes

If yes, please describe: _____

For female patients:

10. Date of last menstrual period: ____/____/____ Post menopausal? No Yes

11. Are you pregnant or experiencing a late menstrual period? No Yes

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

13. Are you taking any type of fertility medication or having fertility treatments? No Yes

If yes, please describe: _____

14. Are you currently breastfeeding? No Yes

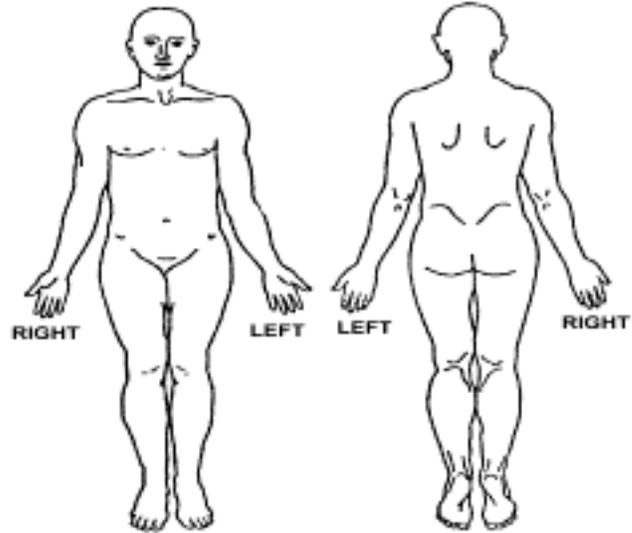


WARNING: Certain implants, devices, or objects may be hazardous to you and/or may interfere with the MR procedure (i.e., MRI, MR angiography, functional MRI, MR spectroscopy). **Do not enter** the MR system room or MR environment if you have any question or concern regarding an implant, device, or object. Consult the MRI Technologist or Radiologist **BEFORE** entering the MR system room. **The MR system magnet is ALWAYS on.**

Please indicate if you have any of the following:

- Yes No Aneurysm clip(s)
- Yes No Cardiac pacemaker
- Yes No Implanted cardioverter defibrillator (ICD)
- Yes No Electronic implant or device
- Yes No Magnetically-activated implant or device
- Yes No Neurostimulation system
- Yes No Spinal cord stimulator
- Yes No Internal electrodes or wires
- Yes No Bone growth/bone fusion stimulator
- Yes No Cochlear, otologic, or other ear implant
- Yes No Insulin or other infusion pump
- Yes No Implanted drug infusion device
- Yes No Any type of prosthesis (eye, penile, etc.)
- Yes No Heart valve prosthesis
- Yes No Eyelid spring or wire
- Yes No Artificial or prosthetic limb
- Yes No Metallic stent, filter, or coil
- Yes No Shunt (spinal or intraventricular)
- Yes No Vascular access port and/or catheter
- Yes No Radiation seeds or implants
- Yes No Swan-Ganz or thermodilution catheter
- Yes No Medication patch (Nicotine, Nitroglycerine)
- Yes No Any metallic fragment or foreign body
- Yes No Wire mesh implant
- Yes No Tissue expander (e.g., breast)
- Yes No Surgical staples, clips, or metallic sutures
- Yes No Joint replacement (hip, knee, etc.)
- Yes No Bone/joint pin, screw, nail, wire, plate, etc.
- Yes No IUD, diaphragm, or pessary
- Yes No Dentures or partial plates
- Yes No Tattoo or permanent makeup
- Yes No Body piercing jewelry
- Yes No Hearing aid
(Remove before entering MR system room)
- Yes No Other implant _____
- Yes No Breathing problem or motion disorder
- Yes No Claustrophobia

Please mark on the figure(s) below the location of any implant or metal inside of or on your body.



! IMPORTANT INSTRUCTIONS

Before entering the MR environment or MR system room, you must remove all metallic objects including hearing aids, dentures, partial plates, keys, beeper, cell phone, eyeglasses, hair pins, barrettes, jewelry, body piercing jewelry, watch, safety pins, paperclips, money clip, credit cards, bank cards, magnetic strip cards, coins, pens, pocket knife, nail clipper, tools, clothing with metal fasteners, & clothing with metallic threads.

Please consult the MRI Technologist or Radiologist if you have any question or concern BEFORE you enter the MR system room.

NOTE: You may be advised or required to wear earplugs or other hearing protection during the MR procedure to prevent possible problems or hazards related to acoustic noise.

I attest that the above information is correct to the best of my knowledge. I read and understand the contents of this form and had the opportunity to ask questions regarding the information on this form and regarding the MR procedure that I am about to undergo.

Signature of Person Completing Form: _____ Date ____/____/____
Signature

Form Completed By: Patient Relative Nurse _____
Print name Relationship to patient

Form Information Reviewed By: _____
Print name Signature

MRI Technologist Nurse Radiologist Other _____

