Safety protocols for interventional magnetic resonance imaging (iMRI) departments are based on the safety protocols of diagnostic MRI departments but need to be enhanced to account for surgical or procedural imperatives. The American College of Radiology (ACR) published a white paper on MR safety(1) in 2002 which was revised in 2004(2), that contains excellent recommendations for an MRI department. Recommendations most relevant to interventional MR will be summarized. In addition, specific recommendations for interventional MR departments that have been implemented in intraoperative MRI Departments(3) will be presented.

Safety in the interventional MR suite is even more of a challenge than in a diagnostic suite because of the additional equipment typically employed and the anesthetized patient. Increased hazards and a less responsive patient require increased training and vigilance by hospital staff, so education combined with strict adherence to policies and procedures are the primary means to maintain safety. MR safety training with annual re-certification is required for all hospital staff who would work in the department or respond to a code in the department. Sites have required physicians to pass a written test demonstrating knowledge of system features and safety procedures as a condition for credentials to operate in the suite.

However, policies and procedures may not be sufficient to prevent human error. Careful architecture and thoughtful engineering can provide effective safety enhancements. Restricted access to Zone 3 and 4 with personalized passcodes, in-suite instrument processing and color-coded instrument pans, proximity alarms based on magnetic field strength and locked tethers to restrain non-compatible equipment can all help prevent dangerous situations. ASTM testing standards help vendors evaluate and document the safety and compatibility of new devices. Testing methods agreed to by the Radiology, Surgery, Biomedical Engineering and Risk Management departments can augment the range of devices available in the suite and expand the range of patients benefiting from the technology.

Architecture and design considerations are complex for both single modality and multi-modality suites. Single modality suites, where the entire interventional or surgical procedure is done in the presence of the magnet, put greater restraints on the equipment in those suites, since they must be MR safe and compatible, but the policies and procedures tend to be more straightforward because the hostile environment is always present. Multi-modality suites, where the patient or the radiology systems move, can be operated in the same way or they can offer the physician the opportunity to do part of the procedure with non-compatible equipment, which must then be relocated or removed when the patient moves into the MR zone 4 or when the magnet moves to the patient. This increased flexibility broadens the range of equipment that can be used but requires more complex procedures to insure safety when the patient is exposed to the magnetic field. This does not have to be a limiting factor. One site has streamlined their surgery/imaging transitions procedures significantly, reducing their safety checklist from 4 pages to 2 and consistently reconfiguring their suite from surgery to imaging in 10-12 minutes(4).

The number of multi-modality suites is increasing because they tend to offer improved utilization of the both the MR asset and prime square footage within the institution. As the number of systems increases the range of clinical applications is also increasing. As the range of clinical applications increases and the economics of the systems improves, the suites are being installed in hospitals of all sizes, not just major academic research sites. All these sites will need to implement and rigidly adhere to the policies and procedures mentioned above, and develop new policies and procedures to accommodate the needs of new specialties utilizing the systems. Interventional MR has achieved an excellent safety record to date, which should be maintained by the additional institutions installing these systems.

The multiple choice questions are:
Which of the following are ASTM standards designed to assist vendors and hospitals in evaluating the MR safety and compatibility of medical devices?
   A) Measurement of Gradient Induced Voltages on Medical Devices in the Magnetic Resonance Environment
   B) Measurement of Magnetically Induced Torque on Medical Devices in the Magnetic Resonance Environment
   C) Measurement of RF Induced Heating by Active Electronic Medical Devices in the Magnetic Resonance Environment
   D) Measurement of Force and Torque for Large Medical Devices in the Magnetic Resonance Environment
Correct answer is “B”

Which of the following are methods that can be employed to promote a safe environment in an interventional MR suite:
   A) Staff certification with annual re-certification.
   B) Access restrictions with personal codes that identify the individual accessing the restricted Zone.
   C) Color coded instrument sets that are packaged and/or processed within the suite.
   D) All of the above.
Correct answer is “D”.