Editorial on "ACR Guidance Document on MR Safe Practices: Updates and Critical Information 2019

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/jmri.26990

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With its latest MRI safety publication (1), the American College of Radiology reaffirms and reinforces key points from its 2013 publication (2) and introduces new details. The greatest strength of this update lies in the "Refinements to Previously Published ACR Guidance on MR Safe Practice." The new areas provide general introductions and point the way to needed future work.

The most severe threat posed by MRI is the potential for morbidity or mortality due to projectiles created by the magnetic field interaction with ferromagnetic objects. Since the tragic death of a pediatric patient in an MRI scanner in 2001, MRI practitioners have worked diligently to prevent, but have not eliminated, such accidents. Despite awareness of the threat, the practical problem of keeping ferromagnetic objects away from magnets has remained unsolved.

The new ACR publication describes an important refinement for Zone IV access. The "full-stop and final check" has been shown to be an effective tool for reducing projectile incidents in busy, complex clinical MRI departments. In large centers, it is not uncommon to have physicians, nurses, anesthesia personnel, and nurses all working in the magnet room, and it is difficult for a single MRI technologist to manage the patient as well as control Zone IV entry. "Visiting" staff members, despite potential MR safety training and experience, are high risks for bringing ferromagnetic objects into Zone IV.

There are two key benefits to implementing the "full-stop and final check:" A substantial reduction in actual and "near miss" projectile events involving ferromagnetic objects, and the establishment and continual reinforcement of the MRI technologist's role as "captain and commander" of the MRI room. This gives the most highly-trained and experienced team member, with direct knowledge of the environment and hazards, the essential control and opportunity to exercise vigilance over safety. Many centers (including ours) have implemented the "full-stop and final check" over the past few years and, with its formal inclusion in the ACR guidelines, this should be the most widely and immediately beneficial impact of the new guidelines.

Whereas projectile hazards pose the most severe threat to patients and staff, thermal injuries to patients pose the most likely and frequent hazard (3). Fully protecting patients from burns has proven elusive. The new document strengthens three key points: preventing skin-to-skin contact points, preventing contact between the patient and the magnet cover surface, and changing all patients into known MR Safe gowns or scrubs supplied by the facility. The former two recommendations formalize good practices that have been developed and used for years; it is a welcome addition to see them formally described in the ACR guidance. Hopefully this will lead to better and more widespread implementation of these practices.

The latter recommendation, changing all patients out of street clothing for all MRI exams, is a struggle for many MRI departments. The risks of scanning patients in their own clothing were known in 2013, and in 2019, the ACR – wisely – strengthened its previous recommendation. There are many practical difficulties in ensuring that all patients are changed into MR Safe gowns or scrubs for all MRI exams, without exceptions. Outpatients often find this requirement inconvenient and, given the increasing focus on (and reimbursement implications of) patient satisfaction ratings, departments will doubtless find themselves under pressure to relax this requirement to gain an edge in patient satisfaction. Facilities are also likely to prioritize practices that will encourage patients to return for future exams and to give positive word-of-mouth referrals to friends and family. Where changing requirements are not universally implemented within health systems, patients complain about changing procedures and cite the precedent that they were not required to do so at sister facilities. The language about gown use in the 2013 ACR guidance was not specific enough to support a medical director in making their case for safety to an administration focused on marketing, competition, and HCAPHS scores. The 2019 update provides such support in the form of a clear, direct, and welcome recommendation.

Mapping the limits in medical device manufacturers' MR Conditional labeling to the realistic physical conditions that exist during an MRI study remains a major difficulty. Limits for SAR and magnetic spatial field gradient (SFG) are often misinterpreted, typically in ways that result in patients being unnecessarily denied access to MRI. The new ACR document provides helpful examples of realistic assessments of implants for SFG conditions. Here, the ACR missed an opportunity to require that manufacturers report more details of the MR safety testing of devices, such as actual deflection angles in addition to maximum SFG allowances. Consistency in SFG documentation by MRI manufacturers is lacking, as demonstrated in the ACR document. The new details will help refine simplistic assessments and improve patient access, but the ACR should use its influence to guide industry toward more transparency and standardization of safety data.

While the update mentions and details literature regarding special circumstances and requirements for PET/MRI, MR-guided radiotherapy, intraoperative, interventional, and clinical 7T MRI, it does not detail current best practices for these settings. For intraoperative MRI in particular, there are two points that will likely require future clarification. The ACR reiterates Level 1 and 2 training requirements, but fails to mention that intraoperative MRI converts the entire operating room into a Zone IV environment, requiring that all OR personnel be trained as MR personnel. Also, the acoustic noise from the MRI scanner can be

problematic in adjacent OR suites, and RF shield doors frequently lack sufficient acoustic insulation. This has practical implications for utilization as a "normal" magnet while surgery is performed in the neighboring OR, and ACR guidance as to acceptable noise levels would provide practical help with this emerging tool.

The ACR guidelines are an essential tool for all MRI users and overall we are enthusiastic for such regular and practical updates which codify and propagate proven safety practices to a wider audience. The ACR is to be commended for its ongoing commitment to this work. Support for evaluating MR Conditional devices remains a strong need for future updates.

1. Greenberg TD, Hoff MN, Gilk TB, et al.: ACR guidance document on MR safe practices: Updates and critical information 2019. *J Magn Reson Imaging* 2019:jmri.26880.

2. Kanal E, Barkovich AJ, Bell C, et al.: ACR guidance document on MR safe practices: 2013. *J Magn Reson Imaging* 2013; 37:501–30.

3. Delfino JG, Krainak DM, Flesher SA, Miller DL: MRI-related FDA adverse event reports: A 10-yr review. *Med Phys* 2019:mp.13768.

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