Redefining MRI:
From Image to Insight

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MR Safety: From Zone to Device - A Practical Guide for Clinical Practice

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As MRI utilization expands and patient populations grow increasingly complex, a systematic approach to MR safety is essential for every radiologist and MR technologist. This lecture provides a practice-oriented overview of MR safety across four core domains.

MR Environment and Zone Management
The ACR defines four safety zones (Zone I–IV) to restrict access based on magnetic field exposure, primarily to prevent projectile events and implant-related injuries. Between 2008 and 2017, the FDA recorded 1,568 MRI-related adverse events, with thermal injuries (59%) and projectile events (9%) among the most common. A domestic patient fatality from an oxygen tank projectile in 2021 underscores the critical importance of rigorous zone control.
MR Screening. A two-level screening protocol — at scheduling (Level I) and upon arrival (Level II) — is recommended for all non-emergency patients, with particular attention to cardiac devices, cochlear implants, and metallic foreign bodies.

Implant Safety
Devices are classified as MR Safe, MR Conditional, or MR Unsafe per ASTM standards. For active implanted devices, including cochlear implants and cardiac implantable electronic devices (CIEDs), model-specific verification and pre/post-scan device interrogation are mandatory. Insulin pumps and continuous glucose monitors must be removed before scanning.

Special Populations and Gadolinium Safety
Gadolinium use should be avoided in pregnancy unless benefit clearly outweighs risk. In patients with severe renal impairment, nephrogenic systemic fibrosis risk is now effectively mitigated through exclusive use of macrocyclic agents in Korea since 2018. Awareness of Symptoms Associated with Gadolinium Exposure (SAGE), proposed by the ACR in 2022, is also recommended.

A structured, protocol-driven approach to MR safety ensures that MRI remains both diagnostically powerful and consistently safe across all clinical settings.

Keywords: *MR safety, ACR safety zones, MR screening, Cardiac implantable electronic devices, Gadolinium contrast agents*