MRI Patient Positioning Risk in Zone IV: A Systems-Level Gap in Safe Patient Handling, MR Safety, and Clinical Documentation

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Abstract

Background: Magnetic Resonance Imaging (MRI) safety programs emphasize screening, implant safety, and ferromagnetic risk. However, patient positioning within Zone IV represents a frequent and physically demanding task that is not consistently captured within Safe Patient Handling and Mobility (SPHM) frameworks. This gap is particularly pronounced among patients with obesity, who often require additional positioning support and accommodation. This project examines MRI patient positioning as an under-recognized occupational and accessibility risk, with emphasis on obesity, and to identify systemic gaps in documentation, safety integration, and regulatory compliance.

Methods: A conceptual workflow analysis supported by SPHM literature, occupational health research, and federal regulatory frameworks, including Section 504 of the Rehabilitation Act is used. The concepts of the "continuity gap" and "absence of evidence" are applied to evaluate documentation asymmetry across the MRI care pathway.

Results: A consistent gap exists between pre-MRI documentation of mobility limitations and the absence of structured intra-MRI documentation regarding positioning assistance. Current SPHM programs and MR safety frameworks fail to capture this exposure due to equipment constraints, workflow classification, and documentation limitations. SPHM evidence indicates that manual patient handling remains a leading cause of musculoskeletal disorders (MSDs) among healthcare workers, and that reliance on training alone is insufficient without engineering controls (Centers for Disease Control and Prevention [CDC], 2024; Kugler et al., 2024).

Conclusions: MRI positioning represents a measurable occupational safety issue and a civil rights obligation that can be addressed through standardized documentation, integration into SPHM programs, and adoption of MR-conditional engineering controls. Closing this gap has implications for staff safety, imaging quality, and regulatory compliance.

Keywords

MRI safety, safe patient handling, musculoskeletal injury, radiology workflow, occupational health, documentation, Zone IV

Introduction

Magnetic resonance imaging (MRI) safety has historically centered on screening protocols, implant safety (MR Safe, MR Conditional, or MR Unsafe status), and ferromagnetic hazards. These priorities remain essential, yet they do not fully capture the operational realities experienced by frontline technologists. One such gap exists in patient positioning within the MRI scanner room (Zone IV), where manual handling is frequently required under constrained ergonomic conditions.

This gap is magnified by the increasing prevalence of obesity. A substantial proportion of hospitalized patients present with elevated body mass index (BMI), contributing to reduced mobility, altered biomechanics, and increased need for positioning assistance. These factors significantly increase the physical demands placed on technologists while complicating imaging workflows.

SPHM programs emphasize minimizing manual handling through assistive technologies and have been widely adopted to reduce injury risk. Guidance from the National Institute for Occupational Safety and Health (NIOSH) emphasizes that manual patient handling is a primary risk factor for work-related musculoskeletal disorders (WMSDs) and remains prevalent across healthcare settings (CDC, 2024). However, MRI environments restrict access to conventional patient handling equipment, forcing reliance on manual techniques, particularly in patients with obesity, creating both occupational risk and potential inequities in care. This manuscript reframes MRI patient positioning in Zone IV as an under-recognized occupational safety, patient accommodation, and documentation challenge, particularly among patients with obesity; and to identify gaps in the integration of MR safety, SPHM, and regulatory compliance frameworks.

Methods

This project used a conceptual systems-analysis approach to examine MRI patient positioning within Zone IV as an intersection of MR safety, SPHM, occupational health, and accessibility frameworks. Relevant literature on SPHM, musculoskeletal injury prevention, bariatric patient handling, MRI safety, and federal disability regulations was reviewed to identify gaps in workflow integration and risk recognition. The concepts of the continuity gap and absence of evidence were applied to evaluate disparities between pre-imaging documentation of patient mobility limitations and the lack of structured documentation for positioning assistance during MRI examinations.

Findings

MRI positioning risk is best understood as a systems alignment problem rather than a failure of any single domain. See Table 1: Conceptual Framework - The Three-Domain Alignment Problem. MR safety frameworks are designed to control access, enforce screening, and mitigate ferromagnetic hazards (Pedrosa et al., 2025). Radiology workflow focuses on achieving diagnostic image quality through positioning and immobilization. SPHM programs, in contrast, rely on measurable handling events and documented interventions to monitor injury risk (Teeple et al., 2017).

Patients with obesity expose the limitations of this fragmentation. Although mobility and body habitus can be documented pre-scan, these factors are rarely translated into structured positioning strategies within Zone IV, resulting in a disconnect between identified need and delivered support. Although each domain performs effectively within its own scope, they do not fully interconnect in the MRI environment. As a result, patient positioning, particularly in Zone IV, remains insufficiently captured within any single safety system.

The Continuity Gap

A defining feature of the continuity gap is the asymmetry between pre-MRI and intra-MRI documentation. Prior to imaging, patient records often document mobility limitations such as wheelchair use, obesity, or sedation. See Figure 1: SPHM Risk MRI Zone IV. Once the patient enters Zone IV, however, there is typically no structured documentation describing how these limitations were managed during positioning is absent.

This gap reflects structural limitations. Technologists often compensate through manual stabilization using non–load-bearing support. These efforts remain undocumented, obscuring both staff exposure and whether adequate patient accommodation was provided.

In patients with obesity, this gap becomes particularly significant. The absence of documentation may indicate not only unmeasured physical strain but also a failure to demonstrate compliance with accessibility requirements. This continuity gap reflects a systemic absence rather than a documentation error.

Figure 1. Awkward Use of Pillows and Cushions for Support

Absence of Evidence

The concept of absence of evidence reframes missing documentation not as a neutral omission, but as a meaningful and interpretable signal within clinical systems. In complex healthcare workflows, particularly those involving manual patient handling, what is not recorded can be as informative as what is documented.

The absence of structured data on patient positioning suggests that critical elements of physical workload, staff effort, and risk exposure are occurring outside the boundaries of formal measurement and accountability. In this way, documentation gaps function as indicators of systemic blind spots, where operational realities are absorbed into routine practice without visibility or auditability.

Within the MRI environment, this phenomenon is especially pronounced in Zone IV, where positioning is performed under unique constraints and often without the support of standardized assistive technologies. Because positioning is typically classified as routine workflow rather than a discrete handling event, it is rarely captured in SPHM reporting systems or clinical documentation fields. As a result, the physical demands placed on technologists, including sustained stabilization, awkward postures, and repeated repositioning, remain largely unquantified. Over time, this lack of visibility contributes to the normalization of high-strain activities, reinforcing a cycle in which risk is both expected and unmeasured.

Table 1: Conceptual Framework: The Three-Domain Alignment Problem

Domain	Primary Focus	Limitation in MRI Context
MR Safety	Access control, screening, ferromagnetic risk	Does not address ergonomic/ positioning risk
Radiology Workflow	Positioning, image acquisition	Treats positioning as routine workflow
SPHM & Risk Management	Injury prevention, measurable handling events	Cannot capture MRI positioning without devices

In patients with obesity, the implications of this absence are amplified. Elevated body mass, altered biomechanics, and reduced mobility increase the likelihood that positioning will require significant manual effort and adaptation. When these efforts are not documented, the organization loses the ability to assess the true scope of biomechanical exposure, evaluate staffing adequacy, or justify the need for engineering controls. Equally important, the absence of documentation obscures whether appropriate accommodations were provided to meet patient needs.

From a regulatory perspective, this gap has direct implications for compliance with Section 504 of the Rehabilitation Act. Healthcare organizations are required to provide reasonable accommodations to ensure equitable access to services for individuals with disabilities, including patients whose obesity substantially limits major life activities (U.S. Department of Health and Human Services [HHS], 2024). However, compliance is not established solely through policy or intent; it must be demonstrable. Without documentation of positioning assistance, equipment use, or workflow modifications, organizations cannot substantiate that accommodations were implemented in practice. In this context, the absence of evidence becomes evidence of potential noncompliance.

This dual significance, simultaneously reflecting unmeasured occupational exposure and unverified patient accommodation, positions documentation gaps as a critical target for system improvement. Addressing this issue requires the development of structured documentation frameworks that capture positioning complexity, manual assistance, and accommodation strategies at the point of care. By transforming absence into data, healthcare organizations can make previously invisible risks visible, measurable, and ultimately manageable. This becomes particularly significant when treating patients with obesity. The absence of documentation may indicate not only unmeasured physical strain but also a failure to demonstrate compliance with accessibility requirements.

Occupational Risk

Manual patient handling remains one of the leading contributors to musculoskeletal disorders (MSDs) among healthcare workers, with overexertion injuries closely associated with lifting, repositioning, and sustained patient support (Centers for Disease Control and Prevention [CDC], 2024). The National Institute for Occupational Safety and Health (NIOSH) has established that manual lifting of patients frequently exceeds recommended safe limits, particularly when loads surpass 35 pounds (15.9 kg) under ideal conditions (Waters et al., 2007). In real-world clinical environments where patient cooperation, positioning, and environmental constraints vary, these limits are routinely exceeded.

Biomechanical demands associated with patients with obesity increase nonlinearly rather than proportionally. Increased body mass altered center of gravity, and limited patient participation requires higher exertion forces and greater stabilization effort. Biomechanical studies have demonstrated that patient handling tasks can generate spinal compression forces approaching or exceeding 3,400 N, a commonly cited threshold associated with increased risk of low back injury (Waters et al., 2007; Garg & Kapellusch, 2012). These forces are further amplified when handling patients with higher body mass or when tasks involve extended reach, trunk rotation, or constrained positioning.

MRI positioning represents a uniquely high-risk scenario within this context. Unlike general patient care environments, MRI workflows impose spatial and technological constraints that limit the use of conventional assistive devices. Technologists frequently perform positioning tasks within confined bore geometry, requiring forward flexion, asymmetric loading, and sustained isometric muscle contraction. See Figure 1: Awkward use of Pillows and Cushions for Positioning.

These conditions shift the exposure profile from discrete lifting events to prolonged static loading, which has been shown to accelerate muscle fatigue and increase injury risk even at lower force thresholds (Holmes et al., 2010). See Table 2: Occupational Risk in MRI Positioning.

Quantitative evidence supports the relationship between obesity and increased occupational exposure. Increased frequency of bariatric patient handling has been associated with higher odds of back pain, with one study demonstrating that increased bariatric handling frequency significantly elevated the likelihood of chronic back pain among healthcare

Table 2: Occupational Risk in MRI Positioning

Risk Factor	Impact
Obesity/body habitus	Increased load, difficult stabilization
Limited mobility	Increased reliance on staff
Sedation/Pain	Loss of patient self-support
Confined geometry	Reduced positioning tolerance Awkward posture, reach
Repetition	Cumulative strain

workers (Barim et al., 2023). Additionally, insufficient access to bariatric equipment has been associated with higher rates of overexertion injuries, with many injuries occurring when powered assistive devices were not used (Barim et al., 2023).

From a workload perspective, these exposures are cumulative. Radiologic technologists may perform positioning tasks repeatedly throughout a shift, with each event involving submaximal but sustained loading. When combined with static stabilization during scan acquisition, cumulative spinal loading may reach levels associated with fatigue failure in musculoskeletal tissues over time. This cumulative exposure model helps explain why injury risk persists even in the absence of a single high-force event (Wiggermann et al., 2020).

Institutional bariatric handling policies emphasize that patient management requires alignment of equipment capacity, staffing levels, and environmental design. These policies often define thresholds (e.g., patient weight > 300 lb. or BMI ≥ 30) requiring specialized equipment and additional personnel (McClean et al., 2021). However, in MRI environments, these thresholds are frequently identified without the corresponding availability of MR-safe equipment, creating a mismatch between required handling capacity and actual system capability.

Importantly, quantitative evidence demonstrates that engineering controls substantially reduce biomechanical load. The use of powered lifts, ceiling-mounted systems, and friction-reducing devices has been shown to reduce spinal loading and significantly decrease injury rates (Garg & Kapellusch, 2012; Collins et al., 2004). In contrast, reliance on training alone has not demonstrated meaningful reductions in MSD incidence (Kugler et al., 2024). In MRI settings where such engineering controls are limited or absent, the expected reduction in force exposure is not realized, leaving technologists exposed to repeated high-risk loading conditions.

Within this framework, patients with obesity represent a predictable, high-frequency exposure category characterized by higher peak forces, longer duration of force application, greater cumulative load per shift, and reduced feasibility of engineering controls. This combination places MRI technologists at elevated risk of musculoskeletal injury. As mentioned earlier, the absence of structured measurement or documentation of these exposures further obscures their magnitude, limiting the ability of organizations to quantify risk, allocate resources, or implement targeted interventions.

A quantitative framing of MRI positioning risk therefore supports a shift from task-based assumptions to exposure-based assessment, where force, frequency, duration, and cumulative load are explicitly considered. Without this shift, the handling of patients with obesity will remain a high-risk, under-measured component of healthcare work.

Indirect Indicators in Workflow and Imaging Outcomes

Although positioning risk is rarely documented directly, it can be inferred from workflow and imaging patterns. Extended preparation times, delays in scan initiation, and repeated repositioning events suggest challenges in achieving stable positioning.

Similarly, motion artifacts, repeat imaging sequences, and incomplete studies may reflect difficulties in maintaining patient stability during scanning. These patterns are consistent with findings in MRI safety literature, where underreporting workflow-related issues have been documented.

When these indicators cluster within specific patient populations, they should be interpreted as evidence of a recurring handling burden rather than isolated inefficiencies.

Regulatory and SPHM Convergence

Regulatory frameworks increasingly emphasize the reduction of manual patient handling and the implementation of safer alternatives. OSHA identifies patient handling as a recognized occupational hazard requiring mitigation, while NIOSH guidance prioritizes engineering controls over manual techniques (CDC, 2024).

Section 504 of the Rehabilitation Act requires healthcare organizations to provide equal access to services for individuals with disabilities. Recent federal guidance clarifies that obesity qualifies as a disability when it limits major life activities, requiring reasonable accommodation. SPHM frameworks emphasize reducing manual handling through engineering controls, while Section 504 establishes a legal obligation to provide reasonable accommodation (American Industrial Hygiene Association et al., 2024; HHS OCR, 2024).

In MRI, accommodation extends beyond access to the scanner. It includes appropriate positioning support, staffing, and equipment. Failure to provide these may result in delayed diagnostics, unsafe workarounds, or incomplete studies, which are patterns documented in bariatric care literature.

The lack of structured documentation in Zone IV creates a defensibility gap. Without evidence of accommodation, organizations cannot demonstrate compliance, particularly as 2026 implementation deadlines approach.

SPHM policy statements similarly highlight the need for reasonable accommodation, patient safety and worker safety (Human Factors and Ergonomics Society [HFES], 2023). Clinical practice guidelines, including those from perioperative and nursing organizations, reinforce the need for consistent SPHM practices across all care environments (Association of periOperative Registered Nurses [AORN], 2024).

These converging pressures underscore the importance of addressing gaps in MRI, where traditional SPHM strategies have not been fully implemented. See Table 3: Why Existing Systems Fail to Capture the Risk

Discussion

MRI positioning is frequently classified as routine clinical workflow rather than a patient-handling event. This classification obscures the physical demands placed on technologists, particularly when managing patients with complex positioning needs.

At the same time, MR safety frameworks prioritize hazard screening and access control rather than ergonomic risk (Pedrosa et al., 2025). Without MR-safe assistive devices or structured documentation requirements, positioning activities are not systematically recorded. As a result, exposure remains both frequent and cumulative but largely invisible within organizational safety systems.

The persistence of MRI positioning risk reflects fragmentation across safety systems that are otherwise effective. SPHM programs have demonstrated that reducing injury risk requires not only training but also consistent use of assistive technologies and measurable workflows (Teeple et al., 2017). MR safety programs, while highly effective in controlling environmental hazards, have not historically addressed ergonomic risk within Zone IV.

Bridging this gap requires reframing positioning as both a clinical and occupational safety event. Standardized documentation, combined with the adoption of MR-conditional assistive technologies, would allow organizations to quantify exposure and integrate MRI workflows into SPHM oversight.

Conclusion

Patient positioning in MRI Zone IV represents a high-frequency, high-strain activity that is magnified in patients with obesity and remains under-recognized within current safety frameworks. Further, evidence from SPHM research confirms that manual patient handling is a primary driver of musculoskeletal injury and that effective prevention requires engineering controls in addition to training (Kugler et al., 2024).

At the same time, Section 504 establishes a clear requirement to provide reasonable accommodation. Addressing the continuity gap allows organizations to meet both occupational safety and civil rights obligations, which transforms an invisible risk into a measurable and manageable process.

This shift has the potential to improve workforce safety, enhance imaging quality, and strengthen regulatory compliance. See Table 4: Recommendations for Practice

Table 3: Why Existing Systems Fail to Capture the Risk

These gaps result in an exposure that is operationally significant but administratively invisible
Limitations of SPHM Programs • MR-safe equipment cannot be used in Zone IV • Positioning is not classified as a "lift" event • Technologists are often excluded from SPHM tracking
Limitations of MR Safety Frameworks • Focus on access and screening rather than biomechanics • Lack of structured documentation fields for positioning
Documentation Gaps • No standardized method to record manual stabilization • Lack of auditability and trend analysis

Table 4: Recommendations for Practice

- Implement structured documentation for positioning assistance
- Integrate MRI workflows into SPHM programs
- Define escalation criteria for high-risk patients
- Monitor workflow indicators (delays, repeats) as safety signals
- Evaluate MR-conditional engineering controls
- Include technologists in occupational risk surveillance

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MRI Zone IV — Section 504 Accessibility & MR Safety Confirmation

Complete before the patient leaves Zone IV. Scan into the chart with the ACR MRI Safety Screening Questionnaire.   Facility / Dept: ____________________   v3.0

Patient name	MRN	Date of birth
Date of exam	**Scanner / Room (Zone IV)**	**Exam / body part**
Ordering physician	☐ Two patient identifiers verified (TJC NPSG 01.01.01) Tech initials: ______	

1. Section 504 Accessibility Assessment (45 CFR Part 84)

Arrival mobility: ☐ Ambulatory–independent ☐ Ambulatory–with assist ☐ Wheelchair ☐ Stretcher / gurney ☐ Other: ______

Mobility-related conditions: ☐ Kyphosis / spinal curvature ☐ Obesity (BMI ≥30) ☐ Limited ROM ☐ Spinal hardware / implant ☐ Bariatric ☐ None   Weight: ______   BMI: ______

Communication accommodation: ☐ N/A ☐ Provided: ____________________ (interpreter, ASL, large print, assistive listening)

Cognitive / sedation: ☐ Alert & oriented ☐ Cognitive impairment: ______ ☐ Sedation (separate record) ☐ Claustrophobia — managed by: ______

☐ Patient informed of positioning accommodations and assistive devices available.

2. Safe Patient Handling in Zone IV (OSHA SPHM / NIOSH 35-lb — no solo manual lift over 35 lb)

Patient on table (time): __________   Patient off table (time): __________

☐ MR-conditional positioning device used per manufacturer IFU — elevation angle (if applicable): ______° ☐ wedge / leg support also used

☐ Other SPHM aid: ☐ transfer board ☐ mechanical lift ☐ sliding aid ☐ gait belt + ≥2 staff

☐ No assistive device used — alternative method (staff, body mechanics, patient habitus, clinical reason): ________________________________

☐ No manual lifting or off-label / non-approved supports were used in Zone IV (compliant)

☐ Manual lift or off-label support used — describe for risk review: ________________________________

3. Patient Instruction & Scan Tolerance (ACR Manual on MR Safety)

☐ Hearing protection provided and verified in place: ☐ foam earplugs ☐ MR-safe headphones ☐ both

☐ Squeeze-ball / call system and emergency stop explained ☐ teach-back confirmed

☐ Scan completed without issue. ☐ Issue — describe (discomfort, pause, repositioning, incomplete exam): ____________________

4. CPT 76017–76019 MR Safety Services — implant / foreign body only (complete only if performed)

Day-of-exam · physician/QHP supervision required · each code needs a separate written report; this form supplements it.

☐ None of the below performed today

☐ 76017 — MR safety medical physics examination customization / planning

☐ 76018 — MR safety implant electronics preparation (programming / verification)

☐ 76019 — MR safety implant positioning / immobilization: physical protection (e.g., inflatable positioning aid or equivalent) to secure the implanted device from translational / vibrational forces, functional changes, or RF burns

Implant / device type	Anatomic location	MR status (Safe / Cond. / Unknown)

Risk addressed: ☐ translational / torque ☐ RF heating ☐ vibration / acoustic ☐ functional change ☐ unknown status

Physical protection applied: ☐ immobilization / motion control ☐ alignment with B0 ☐ contour support at implant ☐ stable positioning through exam

Supervising physician / QHP: ___________________ Signature: ___________________ Date/time: __________

5. Attestation

By signing, I confirm:

☐ Two patient identifiers verified (TJC NPSG 01.01.01).

☐ Safe patient handling performed per OSHA SPHM / NIOSH 35-lb, or the alternative method is documented in Section 2.

☐ Section 504 accessibility assessment completed and accommodations offered (45 CFR Part 84).

☐ Hearing protection and patient instruction completed (ACR Manual on MR Safety).

☐ Any CPT 76017–76019 services checked above are supported by this record and the separate written report.

MRI Technologist: ____________________ Signature: ____________________ Date: __________

Supervising Radiologist / Physician (if applicable): ____________________ Signature: ____________________ Date: __________

☐ Shift check (not per patient): Zone IV emergency response & quench readiness verified at shift start — log ref: ______ Verified by: ______

References: OSHA SPHM · NIOSH 35-lb · HHS Section 504 (45 CFR Part 84) · TJC NPSG 01.01.01 · ACR Manual on MR Safety · CPT 76017 / 76018 / 76019