From Knowing MRI to Doing MRI: Why Our Graduates Are Underprepared for Clinical Practice

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2026 JULY 19–22 VANCOUVER, BC
JOINT AAPM | COMP MEETING

ABSTRACT

Traditional MRI education for medical physicists emphasizes physics theory, lectures, and artifact recognition, yet often fails to produce graduates who can function independently in clinical practice. We define core MRI competencies for graduating physicists and show how Entrustable Professional Activities (EPAs) can bridge the gap between physics knowledge and clinical competence. Clinically relevant tasks that trainees must perform unsupervised—optimizing sequences to reduce motion and artifacts, managing specific absorption rate (SAR) and safety, debugging artifacts, and communicating technical limitations to radiologists, extended to advanced applications such as MR angiography, diffusion, perfusion, and functional MRI—were structured into candidate EPAs, mapped to integrated competencies, and linked to a graduated scale of supervision and workplace-based assessment. The resulting framework clarifies what a graduate can do rather than only what they know, enabling objective assessment, independent problem-solving across modalities, and effective communication with clinical teams. Shifting from knowledge-focused training to competency-based clinical readiness prepares graduates to practice safely and independently, ultimately enhancing patient care and collaboration with radiologists.

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INTRODUCTION

Traditional MRI education emphasizes physics knowledge, lectures, and artifact recognition, but often does not produce graduates who can function independently in clinical practice. We aim to define core MRI competencies for graduating medical physicists and demonstrate how Entrustable Professional Activities (EPAs) can bridge the gap between physics knowledge and clinical competence, ensuring that theoretical understanding translates into safe, effective clinical performance.

METHODS AND MATERIALS

We identified clinically relevant tasks that medical physics trainees (graduates and residents) must perform independently, including: optimizing sequences to reduce motion and artifacts, explaining SAR tradeoffs and safety considerations to clinicians, debugging artifacts in clinical MRI, and communicating technical limitations to radiologists. The scope was extended to specialized applications such as time-of-flight (TOF) effects in MRA, diffusion imaging, perfusion MRI, and functional MRI (fMRI), with attention to sequence-specific tradeoffs, signal-to-noise optimization, and artifact mitigation. These competencies were structured into measurable outcomes to guide curriculum design and trainee assessment in graduate and residency programs, explicitly linking physics knowledge to clinical tasks.

RESULTS

A competency-based framework clarifies what a graduating physicist should be able to *do*, rather than just what they know. Mapping clinical expectations to measurable tasks across conventional and advanced MRI applications enables educators to: 1) Target instruction to skills that directly translate physics knowledge into clinical competence; 2) Assess trainees using objective, observable outcomes; 3) Enable independent problem-solving across a range of MRI modalities; 4) Communicate technical limitations effectively to clinical teams.

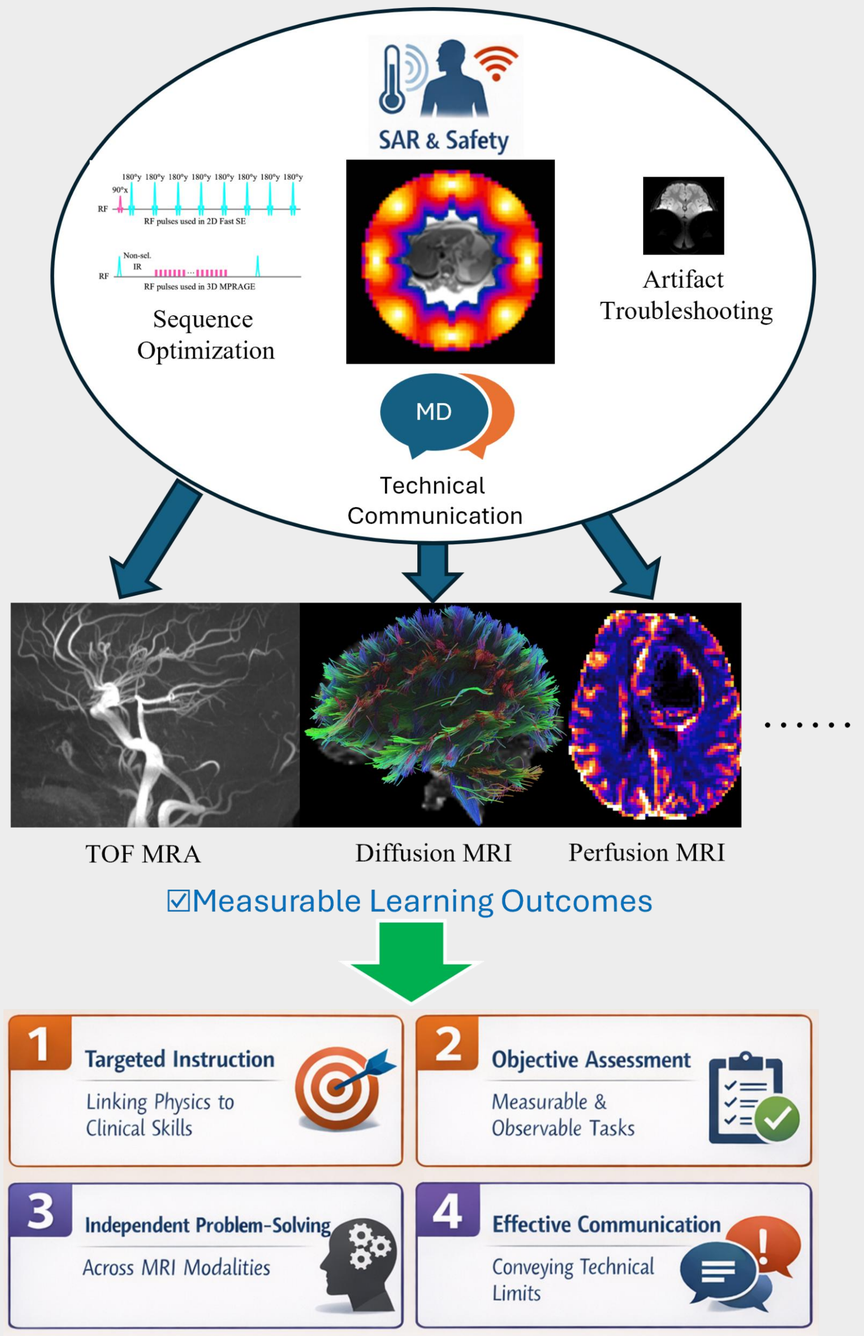

Figure: An example of competency-based framework for clinical MRI training. The figure illustrates the Methods (top) and Results (bottom) of defining and structuring essential clinical MRI competencies for medical physics trainees. In the Methods section, four core tasks—Sequence Optimization, SAR & Safety, Artifact Troubleshooting, and Technical Communication—are shown as foundational competencies, linked to, but not limited to specialized MRI applications such as TOF MRA, Diffusion Imaging, and Perfusion MRI. The framework emphasizes measurable learning outcomes for curriculum design and trainee assessment. The Results section highlights four educational outcomes enabled by this competency mapping: Targeted Instruction (linking physics knowledge to clinical skills), Objective Assessment (measurable and observable tasks), Independent Problem-Solving across MRI modalities, and Effective Communication of technical limitations to clinical teams. This structure clarifies the translation of physics knowledge into practical clinical competence.

CONCLUSIONS

Traditional MRI education answers the question of what a graduate knows; clinical practice asks what a graduate can do. Framing core MRI competencies as Entrustable Professional Activities—each an observable clinical responsibility that a trainee can be entrusted to perform with decreasing supervision as competence grows—bridges that gap. By anchoring both conventional and advanced modalities in EPAs, programs can graduate physicists who are clinically capable, independent, and confident, ultimately improving patient care and strengthening collaborative practice with radiologists and clinicians

DISCUSSION

Shifting MRI education from knowledge-focused training to competency-based clinical readiness bridges the gap between physics knowledge and clinical competence, preparing graduates to function safely and independently across the full spectrum of MRI applications. Applying EPAs to conventional and advanced modalities equips programs to produce trainees who are clinically capable, and confident, ultimately enhancing patient care and supporting collaborative practice with radiologists and clinicians.

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