

ACS 2026 Surgeons and Engineers: A Dialogue on Surgical Simulation

P-C-02

Challenges in Surgical Education

Beyond One-Size-Fits-All Tailoring Simulation Models to Surgical Learning Objectives

Kayla Gray; Mikaela G. Mahrer; Angela Mankin; Han Grezenko; Rylee McGuire, DO; James A. Mankin, MD; and Hahn Soe-Lin, MD, FACS

CommonSpirit, Phoenix, AZ; CommonSpirit, Scottsdale, AZ; Creighton University, Phoenix, AZ

Background: Surgical education programs face critical decisions about simulation modality selection as medical knowledge expands exponentially while training timeframes remain static. With medical knowledge doubling every 73 days compared to every 50 years in 1950, residents must achieve competency across diverse procedures using limited educational resources. The ACGME mandates simulation access for surgical programs, yet institutions lack systematic frameworks for matching specific simulation modalities to learning objectives. Current selection processes prioritize resource availability over educational effectiveness, creating suboptimal training experiences that may not adequately prepare residents for clinical practice demands.

Current Challenges: Existing research fails to provide adequate guidance for right-fitting simulation models to specific procedural training needs. Programs choose between cadaveric, mannequin, virtual reality, and animal models without evidence-based criteria for optimal modality-procedure pairings. Assessment tools measure technical outcomes uniformly across modalities, missing critical learning process differences that determine long-term skill acquisition and clinical transfer. Two-thirds of comparative studies are underpowered, validity concerns persist regarding clinical applicability, and methodological limitations prevent definitive conclusions about which simulation approaches best serve specific learning objectives within different procedural domains.

Need of Innovation: Surgical education requires systematic frameworks for precision-matching simulation modalities to procedural complexity, learning objectives, and competency requirements. This demands rigorous comparative research identifying optimal modality-procedure combinations, learning theory applications that guide simulation selection based on feedback requirements and cognitive load considerations, and integrated assessment approaches that capture both immediate skill acquisition and clinical transfer potential. Evidence-driven simulation matching represents the essential pathway for maximizing training efficiency within constrained timeframes, ensuring that each educational intervention optimally serves specific learning goals while preparing competent practitioners for contemporary surgical practice demands.