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Title: Between Physical and Virtual: The Landscape of Immersive Medical Simulation

Immersive simulation platforms are playing an increasingly important role in healthcare education and clinical training by enabling learners to engage with procedures, environments, and patient scenarios in ways that extend beyond traditional instruction. These systems span a continuum from physically grounded simulation using mannequins and task trainers, to mixed reality systems, to fully virtual immersive environments. As these modalities evolve, the boundaries between physical and digital training experiences are becoming increasingly fluid, creating new opportunities for hybrid instructional design.

This talk provides a structured exploration of immersive healthcare simulation across defined verticals of real-time immersive training. These verticals include visualization, procedural skills training, clinical planning, and collaborative simulation environments. Each vertical represents a distinct dimension of how immersive technologies can be applied in healthcare contexts, with different levels of fidelity, interactivity, and system integration.

A key focus of the discussion is the set of bottlenecks and opportunities that emerge across these verticals. In visualization, the central challenge lies in balancing realism with cognitive clarity as well as balancing realism with computational capabilities. In skills training, emphasis is placed on procedural sequencing, where training platforms thrive when supporting multiple modes (like training vs. evaluation), enabling learners not only to practice steps but also to be assessed in consistent and meaningful ways. In planning-oriented simulation, emerging opportunities lie in automation and intelligent system support for patient-specific data, where immersive environments can scaffold decision-making and scenario preparation. In collaborative simulation, distributed and networked systems introduce both opportunities and constraints related to communication, form factor, and shared spatial awareness across users and devices.

The talk also examines the evolving relationship between physical and virtual training environments. Rather than viewing these as competing approaches, the discussion highlights a best-of-both paradigm, where certain tasks are more effectively supported through physical props and tactile engagement, while others benefit from the flexibility, repeatability, and scalability of virtual simulation. Designing effective training and evaluation systems therefore requires careful decomposition of clinical tasks to determine where physicality is essential and where virtualization adds value.

Through real-world examples and demonstrations, the session will highlight emerging design patterns, common simulation verticals, and practical considerations that influence how immersive learning environments (ILEs) are structured and delivered. Attendees will gain insight into how immersive systems can be designed not only for instruction, but also for assessment, feedback, and iterative skill development across multiple levels of fidelity.