ACS 2026 Surgeons and Engineers: A Dialogue on Surgical Simulation

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Promoting Technology and Collaboration

Engineers in the Operating Room Collaborative Innovation in Surgical Technology Through Engineering-Driven Clinical Exposure

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Background: Biomedical engineering education often emphasizes design without adequate clinical exposure, limiting impact. To address this, a rotational program paired engineering students with surgical teams, immersing them in the operating room to observe workflows and identify unmet needs. Cross-specialty discussions fostered novel perspectives on surgical technology development.

Technology Overview: The engineering students identified impaired perspectives in medical student education during surgery observation, specifically, the attending surgeon's intraoperative viewpoint. This collaboration led to the development of an endoscope-like prototype that enabled remote observation, recorded analysis, and enhanced teaching opportunities. The technology is in early development with potential to adapt across surgical subspecialties.

Potential Application in Surgical Simulation and Education: The unveiling of physician perspective in livestream format provides insights never before conveyed to medical students observing from afar while surgeons work. Students can be educated on deep cavities otherwise unobservable from their position, or the camera can highlight anatomical structures usually only felt by touch. The technology not only addresses observational limitations but also serves as a tool for surgical simulation, allowing learners to study complex anatomy, refine techniques, and review procedures iteratively from recent cases.

Potential Opportunities to Collaborate: This model highlights a scalable pathway for fostering surgeon-engineer partnerships, advancing surgical education, and driving the next generation of surgical technologies. The close-quarters environment and discussion with engineers and surgeon end-users allow faster development and iteration of medical devices, with surgeons having strong design implications from the ground up, where the direction of surgical technology can be driven by the perspective of experienced surgeons to inexperienced but knowledgeable engineering students. By bridging clinical and engineering perspectives, this initiative underscores the value of cross-disciplinary collaboration, demonstrating how surgeons and engineers can co-create accelerated solutions tailored to clinical realities.

Figure 1: Panel A depicts Prototype 1, a two-meter portable endoscope. Panel B depicts a 3D printed camera hand mount designed to allow finger dexterity for prototype 1. Panel C depicts Prototype 2, a flexible surgical boom mountable wireless HD video system. Panel D depicts a motor controlled pan-tilt object tracking video system through artificial intelligence.