

## ACS 2026 Surgeons and Engineers: A Dialogue on Surgical Simulation

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### Research In-Progress

#### Robotic Surgery Simulation for Warm Up, Skill Maintenance, and Skill Enhancement in Practicing Surgeons

Andrew Yee, PhD; Niranjan Sathivel, MD; Nuvi Njinimbam; Jeffrey Voien; Karlis Draulis; and Gretchen Purcell Jackson, MD, PhD, FACS

*Intuitive Surgical, Atlanta, GA; Intuitive Surgical, Sunnyvale, CA; Intuitive Surgical / Vanderbilt University Medical Center, Nashville, TN*

**Introduction:** Simulation has traditionally been applied to early surgical training. However, robotic surgical skills can deteriorate with prolonged intervals between cases, and practicing surgeons are continually challenged to adopt new technologies throughout their careers. To address these needs, we developed simulation-based programs to support warm up, skill maintenance, and skill enhancement for practicing surgeons.

**Methods:** Using the SimNow 2 (Intuitive Surgical, Sunnyvale, CA) learning framework, we designed three complementary programs: (1) Warm-up Program - brief, targeted exercises performed prior to the first case of the day to activate hand, arm, and foot motor function; prior evidence suggests that warm-up improves both technical and psychomotor performance; (2) Skill Maintenance Program - a 30-minute set of intermediate and advanced exercises (i.e., four arm control, retraction, needle and suturing, and energy), recommended every other week for surgeons with longer operative gaps to sustain proficiency; research has shown that only 30 minutes of simulation every other week can maintain resident robotic skills; and (3) Skill Enhancement Program - designed for experienced surgeons, this program emphasizes identifying areas for improvement, enhancing efficiency, and refining specific intermediate and advanced robotic surgery skills. The framework provides targeted skill exercise recommendations when deficiencies are identified. Programs were launched in July 2025. Evaluation includes surgeon surveys, qualitative interviews, and analysis of objective performance indicators (OPIs) and efficiency and productivity metrics from system and simulation data.

**Preliminary Results:** Several surgeons of varying experience levels and institutional backgrounds have begun to adopt these programs.

**Next Steps:** Analyses of early user experience and changes to OPIs, efficiency, and productivity measures are ongoing, with results anticipated by March 2026. Simulation may provide a structured pathway for practicing surgeons to maintain and enhance robotic surgical skills, offering a model for lifelong learning and sustained operative performance.