Evaluating a Augmented Reality Simulator: A pilot study for Remote Training and Certification in Laparoscopic Surgery

Authors: Zaina Aloul, Mohammed El-Bahnasawi, Samuel Colman, Nayaab Abdulkader, Pramod Luthra, Jeremy Brown, David Rawaf

Objectives of the Technology:

The (LapAR™) is an Augmented Reality-based surgical simulator and training suite designed to provide a realistic surgical training experience. The primary objective is to offer natural haptic feedback through synthetic soft tissue models, creating an immersive environment. Integrated screen-based digital overlays allow for objective performance capture. The take-home version used in this study enables remote learning, increasing accessibility for a broader reach.

Description of the Technology & Method of its use or application:

The LapAR™ simulator facilitates simulated full surgical procedures and basic skills tasks by connecting to users' PCs. Performance data is captured into an online portfolio, which users can download. The simulator includes lifelike haptic feedback, integrates of realistic digital anatomy with soft tissue models, and simulates full procedures across various specialties. It empowers users to trigger and manage intraoperative complications, providing objective feedback on critical surgical performance metrics.

Preliminary Results:

A prospective cohort study evaluated the effects of the take home (LapAR™) on junior surgical trainees' skill acquisition and overall experience. It involved 15 trainees benchmarked 2 consultants across five training sites. Trainees performed ten appendicectomies, interspersed with relevant LapPass tasks. Objective measurements of completion time and distance revealed improvement in these key outcome metrics during repeated laparoscopic appendicectomies. Enhanced smoothness, acceleration, and ambidexterity were observed among surgical trainees. Qualitative analysis emphasized the relevance of this technology in early surgical training, valuing it for list prep, skill acquisition, and knowledge enhancement.

The study aimed to validate the (LapAR™) for remote laparoscopic surgery training and certification. Construct validity was demonstrated through improved objective skill scores, while content validity was supported by positive feedback on the educational content from qualitative interviews. The chosen procedure, appendicectomy, ensured face validity, as it represents a common and relevant surgical emergency with well-defined laparoscopic techniques. Face validity is also partially supported by agreement on the realism of the appendix model in the qualitative analysis. Key metrics, such as reduced procedure time, indicated the LapAR™ device's effectiveness in enhancing surgical skills and potentially reducing complication rates, aligning with Kirkpatrick Level 4, 'Benefit'. Overall, the study provides a comprehensive assessment of trial validity, establishing the LapAR™ device as a valuable tool for remote training and certification in laparoscopic surgery.

Figure 1: the completion time of all participants as an average. A linear regression analysis was conducted on all 15 trainees in all attempts made. A statistical significance is noted.

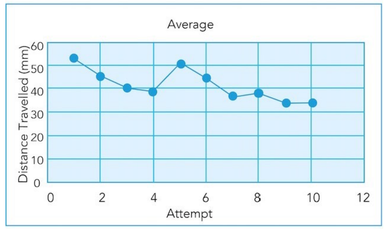

Figure 2: the distance travelled by all participants as an average. A linear regression analysis was conducted on all 15 trainees in all attempts made. A statistical significance is noted ($P<0.05$).

Future Directions:

In conclusion, (LapAR™) proves to be a promising tool for remote laparoscopic surgery training. Future considerations should explore broader applications of this technology across various surgical specialties, expanding its versatility. Ongoing research could address customizing the training curriculum based on individual trainee needs, optimizing the device's effectiveness. Refinements could address enhance the realism of the models and address technical challenges faced by some of the trainees. Given its innovative nature, there is a need for research on the long-term retention of the skills acquired and its translatability into real-life surgical procedures.

As the study establishes the LapAR™ as a valuable instrument for remote surgical training, ongoing developments will likely play a crucial role in advancing its integration into mainstream surgical education.

Figure 1. A Kirkpatrick Evaluation Pyramid highlighting outcomes 1 and 2 satisfied throughout the study.

Acknowledgements:

We are interns/executives within Inovus Medical, which has provided support but not funding for this study. We have sought to avoid over-mentioning products or pushing sales. Our intention is to increase awarenesss of alternative augmented reality training options to drive surgical training away from the patient's bedside.

We extend gratitude and thanks to SAGES for allowing us to present our findings.

Inovus Medical is an eligible company and is an accredited provider for CPD/CME points for surgical training.