

THE USE OF VIRTUAL HUMANS IN A SIMULATED OPERATING ROOM TO ASSESS LAPAROSCOPIC TROUBLESHOOTING SKILLS

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INTRODUCTION

- Virtual humans (VHs) are life-sized, interactive avatars that can be used to teach and assess nontechnical skills in a simulated OR setting.
- The purposes of our study were to demonstrate the fidelity of VH teammates in a simulated laparoscopic troubleshooting scenario and to demonstrate that residents participating in a VH scenario have similar performance (non-inferiority) compared to residents participating in a human confederate scenario

Figure 1: Resident participating in VH simulation

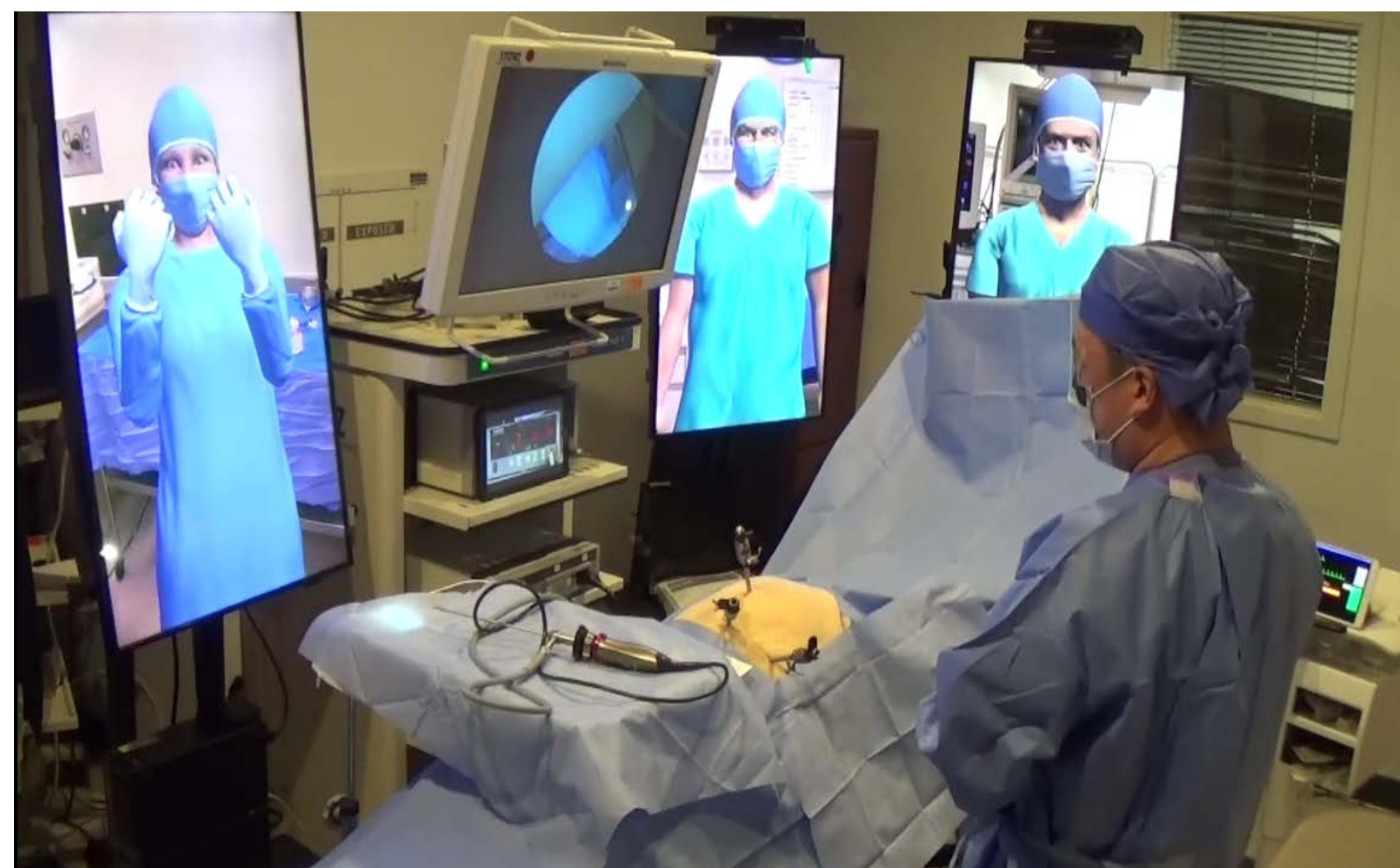


Table 1: Performance of troubleshooting steps by study group

Troubleshooting Challenge	Confederate (n=14)	Scripted VH (n=14)	Hybrid VH (n=12)	p-value*
<i>Hypotension/Bradycardia</i>	# Yes (%)	# Yes (%)	# Yes (%)	
Desufflate abdomen	12 (85.7)	11 (78.6)	11 (91.7)	0.86
Fluid bolus	14 (100.0)	11 (78.6)	11 (91.7)	0.19
Administer atropine	6 (42.9)	6 (42.9)	7 (58.3)	0.78
Administer epinephrine	4 (28.6)	7 (50.0)	8 (66.7)	0.16
<i>Case Continuation</i>				
Flow <= 2 L/min	4 (28.6)	3 (21.4)	8 (66.7)	0.06
Pneumo <= 10 mmHg	4 (28.6)	4 (28.6)	5 (41.7)	0.76
<i>Hypercarbia</i>				
Desufflate abdomen	10 (71.4)	11 (78.6)	9 (75.0)	0.91
Increase minute ventilation	12 (85.7)	8 (57.1)	7 (58.3)	0.19
Administer paralytic	1 (7.1)	1 (7.1)	1 (8.3)	0.99
Check breath sounds	5 (35.7)	5 (35.7)	1 (8.3)	0.20
*Fisher's exact test, $\alpha = 0.05$ NS = Not significant				

Table 3: Fidelity and Immersiveness of the Simulation

Question	Mean Group Score \pm SD			p-value*
	Confederate (n=14)	Scripted VH (n=14)	Hybrid VH (n=12)	
<i>To what degree did each of the following enhance the immersiveness of the simulation?</i>				
Circulating nurse	4.21 \pm 0.70	4.00 \pm 0.68	3.92 \pm 0.79	0.55
Anesthesiologist	4.50 \pm 0.52	4.43 \pm 0.65	4.25 \pm 0.62	0.56
Surgical technologist	4.21 \pm 0.70	3.71 \pm 1.07	4.08 \pm 0.79	0.30
OR set up	4.43 \pm 0.51	4.64 \pm 0.50	4.42 \pm 0.67	0.50
OR instrumentation (instruments, equipment, etc)	4.21 \pm 0.58	4.14 \pm 0.77	3.83 \pm 0.83	0.39
Gowning and gloving	4.00 \pm 0.96	4.07 \pm 0.73	4.17 \pm 0.83	0.88
Placement of abdominal simulator on OR table	4.36 \pm 0.63	4.50 \pm 0.52	4.42 \pm 0.67	0.82
Simulated abdomen	4.36 \pm 0.63	4.43 \pm 0.51	4.17 \pm 0.72	0.60
<i>Please rate the following statements:</i>				
I felt as though I was in a real operating room	4.07 \pm 0.48	4.29 \pm 0.61	4.08 \pm 0.67	0.57
The presence of the teammate characters enhanced the scenario and made it seem more realistic	4.50 \pm 0.65	4.50 \pm 0.65	4.50 \pm 0.52	1.00
*One-way ANOVA, $\alpha = 0.05$				

Table 2: Mean performance score by study group

Troubleshooting Challenge	Mean Group Score \pm SD			p-value*
	Confederate (n=14)	Scripted VH (n=14)	Hybrid VH (n=12)	
Hypotension/Bradycardia (Maximum score = 4)	Hypotension/Bradycardia	2.57 \pm 0.94	2.50 \pm 1.09	3.08 \pm 0.79
Case Continuation (Maximum score = 2)	Case Continuation	0.57 \pm 0.85	0.50 \pm 0.65	1.08 \pm 0.67
Hypercarbia (Maximum score = 4)	Hypercarbia	2.00 \pm 0.88	1.79 \pm 0.80	1.50 \pm 0.67
Total Score (Maximum score = 10)	Total Score	5.14 \pm 1.96	4.79 \pm 1.53	5.67 \pm 1.07
*One-way ANOVA, $\alpha = 0.05$, NS = Not significant				

RESULTS

- Overall performance in the module was mediocre.
- There were no significant differences in resident performance across the three study groups (Table 2).
- There were no differences in how participants rated the immersiveness of the scenario across the groups.

CONCLUSION

- Performance by residents and fidelity of the simulation were similar across the study groups.
- Our study highlights gaps in knowledge in the aspect of laparoscopic surgery and VHs in a simulated OR could potentially address this need.

REFERENCES

- ACS/APDS Surgical Skills Curriculum for Residents. Module 5: "Laparoscopic Crisis." Joint Commission on Accreditation of Health Care Organizations Sentinel Event Data Root Causes by Event Type 2004–2Q 2014—Root_Causes_by_Event_Type_2004-2Q_2014.pdf. http://www.jointcommission.org/assets/1/18/Root_Causes_by_Event_Type_2004-2Q_2014.pdf.
- Flin R, Mitchell L. Safer surgery: analyzing behavior in the operating theatre. Aldershot (United Kingdom): Ashgate; 2009.
- Nagpal K, Vats A, Lamb B, Ashrafian H, Sevdalis N, Vincent C, Moorthy K. Information transfer and communication in surgery: a systematic review. Ann Surg. 252(2):225-39, 2010.
- Deladisma AM, Johnsen K, Raji A, Rossen B, Kotranza A, Kalapurakal M, Szlam S, Bittner JG 4th, Swinson D, Lok B, Lind DS. Medical student satisfaction using a virtual patient system to learn history-taking communication skills. Stud Health Technol Inform. 132:101-5, 2008.
- Robb A, Cordar A, Lampotang S, White C, Wendling A, Lok B. Teaming Up with Virtual Humans: How Other People Change Our Perceptions of and Behavior with Virtual Teammates. IEEE Trans Vis Comput Graph. 21(4):511-9, 2015.
- Goering W, JWMenard, Deladisma A, Dimachk M, WoodJ, Lok B, Lampotang S, Wendling A, Cordar A, Lind DS. "The Use of Virtual Humans for Team Training in the Operating Room." Academic Surgical Congress, 2018.

METHODS

- Study subjects participated in a virtual scenario with three OR teammates (anesthesiologist, circulating nurse and surgical technologist based on the "Laparoscopic Troubleshooting Module" in the ACS/APDS Surgery Resident Skills Curriculum (Figure 1).
- Forty general surgery (n=16) and obstetrics and gynecology residents (n=24) were randomized into three study groups: human confederate teammate (n=14), scripted VH teammates (n=14), and hybrid VH teammates (n=12).
- VHs provided either prerecorded, scripted responses or real-time, "hybrid" responses from a study proctor using voice-changing software.
- Resident performance in the troubleshooting challenges (hypotension/bradycardia, case continuation, and hypercarbia) was scored by a second proctor.
- Fidelity of the scenario was assessed using questions related to immersiveness of the characters, setting, and content rated on a 5-point Likert scale.
- Dichotomous performance scores were compared by group using Fisher's exact test and mean performance scores and mean validity scores by study group were compared using one-way ANOVA.