TABLE E-1
Validation for Surgical Simulators by Type of Educational Use

Simulation Environment	Educational Mode of Use	Validated?		
		Yes	No	Not Tested
Endo	Task Training	28	3	2
	Decision Making	7	0	1
	Total	35	3	3
Lap	Task Training	38	1	3
	Decision Making	12	1	0
	Total	50	2	3

Notes:

1. Since several studies described more than one type of educational use, the numbers add up to more than the total number of papers. In addition, the educational mode of use was frequently evaluated by more than one method (objective/modular vs. subjective/global).
2. The types of validation include content, criterion, and construct, as detailed in Table I. If listed in the "No" column, then the simulation was specifically found to not be validated.
3. Abbreviations: Endo = endoscopy, Lap = laparoscopy.

TABLE E-2
Validation of Surgical Simulators by Type of Validation and Type of Measurement

Subject	Measurements	Level of Validation	Validation	
			No	Yes
Endo	Objective/Modular	Content	0	0
		Criterion	0	7
		Construct	2	10
	Subjective/Global	Content	1	3
		Criterion	0	6
		Construct	0	2
	Totals	Content	1	3
		Criterion	0	13
		Construct	2	12
Lap	Objective/Modular	Content	0	3
		Criterion	1	10
		Construct	0	15
	Subjective/Global	Content	0	2
		Criterion	0	1
		Construct	1	7
	Totals	Content	0	5
		Criterion	1	11
		Construct	1	22

Notes:

1. Detailed breakdown of the types of validation performed for simulation-based education in the studies. The types of validation are defined in Table I. If listed in the "No" column, then the simulation was specifically found to not be validated. The objective/modular measures are limited to checklist type assessment of specific maneuvers independent of the overall performance, while subjective/global measures examine the overall procedure performance.
2. Since several studies reported on more than one type of validation, the numbers add up to more than the total number of papers.
3. Abbreviations: Endo = endoscopy, Lap = laparoscopy.

TABLE E-3
Relationships of Performance in Simulation to Other Educational Parameters

		Correlations Between:		
		Learning and Testing	**Objective and Subjective**	**Performance in Simulated and Clinical Environments**
Endo	**Yes**	11	2	5
	No	0	0	1
Lap	**Yes**	8	2	5
	No	6	0	1

Notes:

1. Analysis of the correlation between performance in a simulation environment to other measures of performance. "Learning and Testing" refers to the correlation of performance during the training phase of the education to the final summative assessment. "Objective and Subjective" details the relationship between the objective/modular measures and subjective/global measures that were obtained on the same study subjects. "Performance in Simulated and Clinical Environments" refers to the performance on the simulator after training compared to the subsequent clinical performance.
2. If a "Yes" is listed in the column, the study observed a significant relationship between the parameters indicated. A "No" means that no such correlation was found. Studies that did not explicitly test for these relationships are not included in this analysis.
3. Abbreviations: Endo = endoscopy, Lap = laparoscopy.

TABLE E-4
Clinical Transfer of Simulation-Based Learning

Clinical Competence		Clinical Effect					
		Accuracy Improved	Competence Faster/Better	Speed Improved	Errors Decreased	Same as Traditional	Worse
Task Training	Endo	2	1			1	1
	Lap	3	1			2	0
Global Assessment	Endo		5			0	1
	Lap			2		2	0
Error Reduction	Endo				1	0	1
	Lap				2	0	0

Notes:

1. The evaluation of how well simulation-based education was expressed in clinical performance for endoscopy (Endo) or laparoscopy (Lap). The clinical evaluation was based on either specific task performance (e.g., suture tying), overall performance (Global Assessment), or avoidance of performance errors (Error reduction).
2. The categories of the clinical effects are aggregated from the various studies. “Accuracy Improved” refers to greater economy of motion or fewer misses of targets by the simulation-educated subjects than by the traditionally trained controls. “Competence Faster/Better” means that a predetermined level of performance (deemed to be “competence”) was achieved quicker, or at a higher level, by the simulation subjects compared to controls. “Speed Improved” means that the task or procedure was completed more rapidly than control subjects. “Errors Decreased” means that maneuvers that were potentially dangerous to the tissues or “patient” were less frequent in simulation subjects. “Same as Traditional” found no differences between the simulation and control groups. “Worse” means that the simulation-educated group performed worse than the control group.