Supplementary Online Content

Sparks JL, Crouch DL, Sobba K, et al. Association of a surgical task during training with team skill acquisition among surgical residents: the missing piece in multidisciplinary team training. *JAMA Surg*. Published online May 24, 2017. doi:10.1001/jamasurg.2017.1085

This supplementary material has been provided by the authors to give readers additional information about their work.

eFigure. SAST Mannequin Design

Synthetic anatomical models of liver, gall bladder, and spleen were made of silicone foam using casts of cadaveric organs (Fig. S.1A, B). Organ models were plumbed to facilitate simulated bleeding due to trauma (Fig. S.1A). Plumbing to organs was installed in the abdominal cavity of an existing mannequin, and simulated blood was pumped from a reservoir using a remote-controlled pump. Other abdominal structures (abdominal wall, omentum, stomach, bowel) were represented using commercially available models or hand-made silicone structures (Fig.S. 1 C, D). Tethering ligaments were included for major organs, as well as representations of retroperitoneal structures. Airway and lungs were simulated with flexible plastic tubing attached to an inflatable bag to allow for intubation. The cost to build two SAST mannequins was approximately $7,500, plus $2000 in consumable materials. For study scenarios using cadaveric simulated patients, simulated blood was pumped through the vasculature via a remote-controlled pump similar to the SAST mannequin pump. For study scenarios using Laerdal SimMan, the mannequin was unaltered.

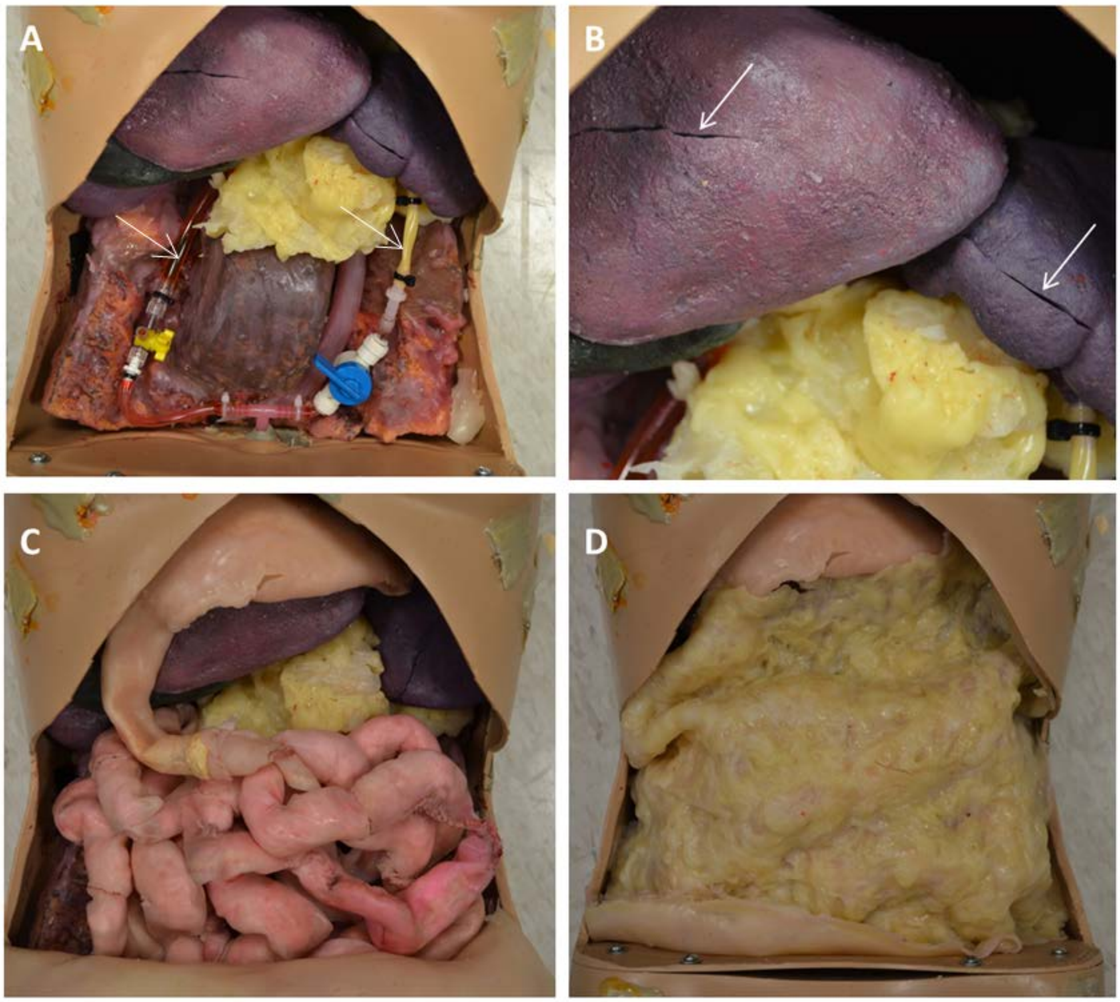

Figure S.1. SAST mannequin design showing simulated abdominal contents in situ, including simulated vessels (A) that enabled bleeding from liver and spleen lacerations (B). Simulated stomach, bowel, and omentum are also shown (C, D).

eTable 1. Participant Feedback Questionnaire

Evaluating Statement	Responses (1=no, 3=somewhat, 5=yes)				
I found it easy to treat the model as a simulated human.	1	2	3	4	5
The abdominal wall simulated the human abdomen well.	1	2	3	4	5
The abdominal organs simulated human organs well.	1	2	3	4	5
The bleeding encountered was realistic.	1	2	3	4	5
The monitors functioned well as part of the simulation.	1	2	3	4	5
The scenario was realistic.	1	2	3	4	5
I felt that the simulation prompted realistic responses from me.	1	2	3	4	5
The video cameras did not interfere with the simulation experiences.	1	2	3	4	5

Evaluating Statement	Responses (1=no, 3=somewhat, 5=yes)				
Simulator enhanced learning more than reading would.	1	2	3	4	5
I did things I could never have a chance to practice otherwise.	1	2	3	4	5
I expect that the knowledge gained from the scenario will be helpful to me in practice.	1	2	3	4	5
The simulation is suited for initial training in my specialty.	1	2	3	4	5
The simulation is suited for advanced training in my specialty.	1	2	3	4	5
The simulation is suited for refresher training in my specialty.	1	2	3	4	5
The simulation is suited for a recertification program.	1	2	3	4	5
Debriefing session was constructive.	1	2	3	4	5

eTable 2. Kirkpatick's Hierarchy of Evaluation

Kirkpatrick's Hierarchy of Evaluation[a] (as adapted for medical simulation[2])		
Level 1 - Reaction	Measurement of satisfaction	Were the participants pleased with the program? How would they rate their experience? What suggestions can be made to improve the experience?
Level 2 - Learning	Measurement of learning	What skills, knowledge, insights or attitudes have changed from the program?
Level 3 - Behavior	Measurement of behavior change	Did the participants change their behavior based on what was presented in the program?
Level 4 - Results	Measurement of results	Did the change in behavior positively affect the organization or influence an objective outcome?

[a]Residents' teamwork competency was assessed using multiple measurement instruments that correspond with different levels of Kirkpatrick's hierarchy of evaluation[1,2]. Kirkpatrick's model was developed as a methodology for judging the effectiveness of training programs. According to this hierarchy, the complexity of the behavioral change increases as evaluation strategies ascend to each higher level. However, the length of time needed for the evaluation, the lack of reliable objective measures, and the number of potential confounding factors all increase with the complexity of the change[3]. Thus, we chose to use multiple measurement instruments in order to offset the limitations associated with outcome measures from only one hierarchical level. We chose measurement instruments that span levels 1 through 3 in the hierarchy. Specifically, the Participant Feedback Questionnaire falls in Level 1 because it assesses participants' reaction and degree of satisfaction with the experience. The Surgeon Self-Efficacy Questionnaire falls in Level 2 because it assesses changes in participants' attitudes. Finally, the NOTECHS Nontechnical Skill Assessment, the Trauma Management Skill Assessment, and the CRM Checklist fall in Level 3 because they measure participant behavior change as scored by faculty evaluators.

eReferences

1. Kirkpatrick DL. Evaluation of training. In: Craig R, Mittel I, eds. Training and Development Handbook. New York: McGraw Hill; 1967.

2. Doyle DJ. Simulation in Medical Education: Focus on Anesthesiology. *Med Educ Online*. 2009;7. doi:10.3402/meo.v7i.4544.

3. Hutchinson L. Evaluating and researching the effectiveness of educational interventions. *Brit Med J.* 1999;318:1267.